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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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1863.

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

CONTENTS OF VOL. XII.

[THIRD SERIES.]

NUMBER LXVII.

NUMBER LXX.

NUMBER LXXI.

PLATES IN VOL. XII.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

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

No. 67. JULY 1863.

I.—*On some Phenomena of the Development of the Organic Cell.* By Prof. H. KARSTEN*.

[Plate I.]

THE physics of the development and of the life of the cell, as the basis of all anatomy and physiology, constitute the first problem to be solved in both those sciences. Since Schwann declared that both animal and vegetable tissues consist of cells originally of a like nature, the similarity also in function of such cells both in animals and plants has been rendered more and more evident.

A clear perception of the whole of the physico-chemical phenomena which by their union constitute life will only be attained by an accurate knowledge of the origin and growth of the cell.

The formative elements of the cells which unite to constitute organic tissues have been largely investigated since the time when Robert Brown indicated the presence of a nucleus in numerous cells, and since I demonstrated that the cell-wall, previously regarded as a single sac, consists in reality of several endogenous superimposed laminæ (Karsten, De Cella vitali, 1843).

* Translated by Dr. Arlidge from a separate impression from Poggendorff's 'Annalen' (vol. cxviii., Berlin, 1863), for the communication of which we are indebted to the author.

The primary object at present is to determine the physical and chemical changes of the histological elements of cells during their development and multiplication, and, by the elucidation of these processes, to establish the laws which govern the origin and growth of an organ or of an organism, and which collectively make up the phenomena of life.

The most recent treatise on human histology, that by Kölliker (1862), refers to the purpose of the different histological elements of the cell, in respect both to its existence and its functions, thus:—1. The external wall of the cell serves only as a defence to its fluid contents (p. 39), except so far as it takes part in those intrinsic vital processes which are shown to occur by changes in its chemical constitution (p. 36); 2. the fluid cytoblastema pre-eminently constitutes the living portion of the cell (p. 39); and, 3. the cell-nucleus plays the most important part in cell-formation (p. 26).

This last proposition is advanced on the understanding that "the doctrine of free-cell formation in a cytoblastema has been set aside" (p. 28)—that cell-construction always coincides with cell-multiplication, being a result of the fission of a parent cell by means of the formation of folds in and the constriction or segmentation of its internal lamina (the primordial layer), although Kölliker fails not to remark that this process has, it is true, not yet been satisfactorily made out.

These fundamental doctrines of the histology of the animal body, which harmonize with the prevailing, but groundless, opinions upon the formation and function of the vegetable cell, have, however, not been confirmed in the vegetable organism with the clearness necessary for conviction. The history of development has rather proved that, in those cases (Karsten, *op. cit.* and Histologische Untersuchungen *, 1862) which have been cited as furnishing certain evidence of the multiplication of cells by segmentation, daughter cells, which originate freely in the fluid contents of the parent cell, cause the increase, and by their enlargement the division of the cell-interior by means of septa is brought about.

Moreover the wall of the cell is not simple, but composed of several cells placed one within the other, which are frequently regenerated from within outwards by the unfolding of the nuclear cell, and each of which cells passes through a course of development peculiar to itself.

The involution of the coats of the cell, in the few tissues where it has as yet been actually observed, does not give rise to

* A translation of these valuable investigations will appear in a future Number of the 'Annals.'

new cells, but is only a phenomenon passively accompanying cell-multiplication.

The so-called nucleus is a nuclear cell possessing the faculty of development, though frequently suppressed in the course of development, and near to or within which two or more new cells (cell-nuclei) may arise in order to carry on the multiplication of the individual cell in question. Mirbel taught, and Mohl coincided with his views, that the fission of the cell proceeded by the growth of centripetal septa, or of involutions of its wall, breaking up its contents into sections, the external surface of which became subsequently hardened into a firm lamina or special cell-wall; and side by side with, but partially opposed to, this theory of cell-formation based on imperfect observations Schleiden afterwards enunciated his peculiar views on the function of the "resting" nuclear cell—the cell-nucleus first observed by Robert Brown, which, in cells developing slowly, may be frequently met with.

These opinions of Schleiden regarding the signification of the nuclear cell became a great impediment to advancing the knowledge of cell-development. His followers entered so fully into the notion that the nuclear sac is the constant formative centre of the cell, exercising a catalytic effect upon its fluid contents, whereby it brings about the precipitation from the surrounding fluid of a pellicular deposit around itself, that even those who regard the whole organism as built up by repeated multiplication of the first ovum-cell, resulting, as Mirbel supposed, from centripetal involutions of the integument, consider this cell-nucleus as the starting-point in this mode of cell-multiplication.

This involution is assumed to proceed, in these nuclear cells, in the same way as in the parent cell-membrane itself, by constriction followed by division—each of the segments of the cell-nucleus deriving, by means of a folding and constriction of the inner lamina of its mother cell, a capacious envelope constituting the wall of a new cell.

This process of multiplication of the nuclear cell (cell-nucleus), however, no more takes place than that of the mother cell by constriction.

The so-called constrictions or segmentations of the cell-nucleus belong, in fact, to the same category as the so-termed germinating cells. These forms are produced by the excessive development of daughter cells in a feebly vegetating parent cell which is in course of destruction; whilst the partial septa or folds interposed between the endogenous cells are not so much centripetal growths as the result of a passive condition of the cell-wall at those parts. (The simultaneous growth of these septa with the endogenous cells is not indeed a matter of direct observation; on the other hand, their subsequent absorption has been observed in various instances.)

That a cell-nucleus is, as a rule, present in actively growing cells, and that in withered cells or in those in a resting-state it disappears, corroborates the statement derived from direct observation, that this nuclear cell possesses the property of development in itself.

Indeed the constant absence of nuclear cells in the normally detached cells of the epidermis of animals, and of the epithelium, in the cells of the tissue in the tail of the tadpole, in the woody cells of plants, &c., intimates the incapacity of such cells for further regeneration and individual development.

As only the resting-form of the nuclear cell in tissue-cells has hitherto been recognized as the cell-nucleus, in many cases the nucleus has been denied to exist where actually present and, indeed, in process of evolution, as, for instance, in tissues in continuous course of regeneration, *e. g.* in muscular tissue, the endogenous cells of which have at one time been considered nuclei, at another cells.

And it follows that, in cells which do not undergo regeneration as lasting tissue-cells, nor self-multiplication, the nucleus is always absent. Such cells are met with in those vesicles that are produced in connexion with secretions, and are to be found usually in large numbers in the fluid contents of genuine cell-tissue.

These generations of vesicles enclosed within a tissue-cell, and often engaged in constant formation and transformation, are the active instruments in the elaboration of organic material, transforming the inorganic matters dissolved in the cell-juices into combinations of a progressively higher grade. By means of the assimilative properties possessed by these simple cells, those substances are produced which either subserve the nutrition of the still assimilating membrane of the parent cell, or, where the cycle of its development is closed, are employed by the nucleus in the regeneration of the life-energy of the cell.

Moreover, when the individual development of the cell has ended, and, together with the nuclear cell suppressed in its revolution and destined to its regeneration, two or more new daughter cells are formed and developed at the expense of the parent cell, these secretory materials are employed for this purpose; and even after the formation of all such secondary generations is brought to a close, they are transferred by exosmose to other and remote parts of the organism to serve kindred purposes.

Some of these secretion-cells have walls so much thickened (*e. g.* starch), or such opake and solid contents (*e. g.* chlorophyll), that, for a long time, they have been looked upon, as some even now are, as solid unorganized particles; whilst others have such thin walls that they have either been overlooked, or else regarded as cavities in the less transparent and denser cell-contents.

Such gaps in our knowledge of the structure of the cell render the right apprehension of its functions impossible, as is shown, for example, among other problems, by that of the phenomenon of the circulation of the sap, which has been so much canvassed, and regarding which a distinguished physiologist has recently expressed himself in a manner which can only be explained by a misapprehension of the anatomical nature of the cell.

In my 'Histological Researches' (p. 61) I have detailed my views respecting the general cause of the circulation of the juices within cells; and I will now describe the structure of the hairs of *Urtica*, which explains the apparently wonderful circulation within their large cell-cavities. In Pl. I. figs. 1 & 2, is represented a large hair of *Urtica urens*, with its curved and rounded extremity. The large hair-cell, under a low magnifying power, appears filled with a colourless though somewhat turbid liquid, and has an inferior rounded extremity surrounded by an epidermic layer of cells. On the wall (as in fig. 1) or in the median line (in fig. 2) of the portion of the hair-cell which projects freely from the cup-like base is seen a large nuclear cell filled with a whitish mucilaginous substance and a nuclear vesicle. At times, particularly in fully grown stages, this organ is concealed by the cellular envelope at their base.

By rather stronger magnifying powers, it becomes evident that this nucleus is the central point of currents of a turbid finely granular fluid, which spreads itself more or less completely over the inner surface of the thick wall of the hair. By a little attention, it is further seen that the streams which pass across the interior of the cell are not all thread-like, as appears at first sight, or at least are not constantly so, but in part coalesce into a thin layer of fluid, which here and there, especially in the lower portion of the hair, gets collected in the form of a thicker column, usually more rapid in its course. The fibre-like stream is also as little constant in character as the wider but thinner current: at times it flows rapidly, at others slowly; at one time the tenacious-looking granular fluid collects in one place, at another it breaks away from the locality in which it has been confined, to extend to other parts, and thereby suffers some change in its direction. A rapid current is established especially after the hair has been placed in water under the microscope for a short time, as from two to three minutes, —a circumstance, no doubt, due to the diffusion of the water.

The circulation then proceeds for several hours, becoming weaker and weaker, until it at length entirely ceases, the fibres of the cloudy fluid growing more obscure, from an apparent coalescence within the interior of the cell.

The central nuclear cell, moreover, usually sank, during these phenomena, lower down in the cell; and the same organ, when attached to the wall, often showed also a slight change of place.

The largest portion of the upper extremity of the cell is usually divided, by only one obliquely directed stratum of circulating fluid, into two long sections; but its lower portion is broken up into several rounded clear spaces by shorter layers. In the interspaces formed by the contiguous borders of three such clear spaces, as also in the canals running along the wall of the cell, bounded by the adjoining sides of other two, circulate more rapidly the usually thicker, filiform and more visible threads.

Hence it is evident that the internal cavity of the thick-walled large hair-cell is subdivided into several hollow spaces, filled with a transparent homogeneous fluid, and that these spaces are capable of undergoing some change of form very gradually, and are separated from one another and from the external wall, more or less completely, by means of a system of mucous currents.

There also exist within the interior of the hair-cell, betwixt the spaces filled with homogeneous watery fluid, other spots unoccupied by the turbid matter in circulation; or such are seen to originate under the eye of the observer by a disintegration of the circulating substance. At such spots the larger clear spaces are therefore separated by very thin dissepiments. All these conditions bear testimony to the fact that the hair-cells of *Urtica urens*, and, in fact, many parenchymatose plant-cells, are occupied, at a certain stage of their development, by a tissue composed partly of non-nuclear cells (secretion-cells) which are separated from one another not by a firm but by a fluid intercellular substance. When such a hair-cell is moistened with water, imbibition takes place through the external wall, and the intercellular matter gets diffused, the more remote portions becoming intermingled with the more central. The process may be watched for hours, and the streams seen to set out, until at length the delicate diosmotic and, doubtless, assimilating membrane of the endogenous cell-wall becomes destroyed by the excessive imbibition of the water.

From this object, therefore, the physiologist might satisfy his problem of explaining the vital phenomena of the organism from its structure and from the physical and chemical changes taking place in it, without being compelled to have recourse to an inherent contractility not referable to these factors. The rotation of the cell-juices appears to be a mere phenomenon of diffusion, —endosmosis co-operating on the one hand, and the property of assimilation possessed by the enclosing cell-wall on the other, in a continuous act of intermixing the materials concerned.

Brücke's interesting experiments prove that, as the lightning shivers the strong oak, so an excessive electrical current shatters the delicate cells within the hairs of *Urtica*, and puts an end to the interesting phenomenon of the circulation of their fluid contents.

If the lower segment of the hair be deprived of its outer coat and opened, one or more of the delicate-walled cells which occupy this portion swell up and protrude, whilst the rest sink down from the apex into the space thus left vacant, and occupy it.

The extruded cells have frequently (Pl. I. fig. 3) cellular contents, not observable in those contained in the naked apical portion; they therefore belong to the category of true tissue-cells.

The circumstance that the integument of actual tissue-cells (particularly in the lower animal organisms) is frequently as delicate as the thin walls of the cells found within the hairs of the nettle, and that also in other tissue-cells (especially in the simplest plants) it is so thick, gelatinous, and transparent that it is difficult to trace their boundary, has more than once lately given rise to the idea that there may be naked cells (without walls), which are only mucous globules.

In my 'Histological Researches,' before referred to, I have enumerated several instances in which apparently deficient cell-membranes, notwithstanding their great tenuity, could be recognized with certainty.

In this respect the Confervæ possess a special interest; they offer peculiarly suitable conditions for making investigations respecting the structure and development of the cell, as they may be examined under the microscope whilst growth proceeds—an advantage unattainable in more complex plants or in animals.

In fact, in many species of these plants, their component (tissue-) cells, in the earlier phases of development, are so very thin and transparent that they are rendered appreciable only by a more attentive observation of the changes in form and position of the other and more solid cell-contents. The observer may likewise arrive at a more ready acquaintance with the origin and growth of cells by the comparative investigation of their development under different conditions of nutrition—experiments and observations which are indispensable also to the systematist; for a change of the conditions of nutrition alters not only the phenomena of the growth of cells, but also frequently the very form of the Alga itself, even when this has been accounted a specific character.

The cultivation of *Spirogyra* has proved to me that this plant, when liberally supplied with organic nitrogenous matter, generates new cells profusely, but that, if this nourishment be withheld, growth is limited to the cell-wall. This observation consequently shows that a deficiency of such organic nutritive supply promotes the centripetal involution of the cell-wall of *Spirogyra,* which in normal conditions of nutrition does not happen.

On the contrary, by a large supply of organic nitrogenous material, the growth of the cell-wall, relatively to the formation and evolution of new cells, remains in arrear. The cultivation of such species of *Spirogyra* as *S. Hornschuchii* shows this. The partition-walls (septa) of this plant, under normal conditions of development, immediately after their origin produce circular folds of a determinate size; and the tissue-cells (joint-cells) only proceed to produce new cells, after the septiform circular folds have acquired their normal dimensions. (Pl. I. fig. 4 *a.*) But this same species, when richly supplied with nourishment in the manner stated, presented in the same individual three, and sometimes four, or even five partition-walls, *without such circular folds,* and thus indicated that the thickening and further evolution of the cell-wall had been supplanted by an augmented development of cells.

The accelerated formation and development of new joint-cells was accompanied by a considerable increase in the deposit of chlorophyll. The successive spiral coils of this substance, which are normally separated from one another by intervals of about twice their width, approximated so closely frequently about the middle and at the extremities of the cell as to touch, and sometimes to overlap, each other at their edges, or, indeed, in their entire width; the spiral band being, relatively to the extension of the cell, disproportionately elongated (figs. 7 & 8).

In those instances where the layer of chlorophyll does not acquire such an excess above its usual length, its increase will nevertheless be indicated by a horizontal coil being substituted in place of the normal oblique one, in the centre of the cell, over the very delicate nucleus (fig. 4). This coil, at the commencement of the development of new joint-cells, loses the concave, furrowed character of its external surface, becomes pressed against the wall of the cell and fixed in its central position, as it appears, and as the further course of cell-development proves, by the production of the daughter cells, which grow up from the two opposite extremities of the cell, and extend themselves towards its middle line. These have, however, as yet such thin and delicate walls, that they are not themselves visible, but become evident only by the changes they produce in the disposition of the layer of chlorophyll, and by the action of diosmotic fluids. Moreover, the chlorophyll-deposit gravitates towards the centre of the cell, in the vicinity of the nuclear cell and the approximating ends of the two endogenous cells (figs. 9 & 10). According as the enlargement of the nuclear cell, the absorption of the chlorophyll, or the increase in size of the daughter cells prevails at this stage, the subsequent phenomena vary.

Within the nuclear cell two new cells originate, not by any constriction and segmentation of its membrane, but by new growth within its fluid contents, the nuclear vesicles of which become at the same time absorbed. These facts cannot be more readily verified than in the larger species of *Spirogyra*. (See Histological Researches, figs. 83–85.)

The nuclear cell of *S. Hornschuchii* and of allied species is so delicate and transparent that it cannot usually be clearly demonstrated without the addition of iodine (Pl. I. fig. 5). And as the two daughter cells (fig. 6) contained in it are also only rendered perceptible by this treatment, this species is therefore not suitable for the study of this histological element of the joint-cell.

The growth of the two daughter cells contained in the nuclear cell into new joint-cells, as observed in other *Spirogyræ*, does not appear to take place in *S. Hornschuchii*; for in this example it is only the daughter cells of the secondary cell which constitute new joint-cells, whilst the daughter cells of the tertiary cell (the cell-nucleus) enclosed between septum-building young joint-cells, proceed to grow into the little circular folds on the partition-wall.

The hypothesis I first promulgated in Wiegmann's 'Archiv' for 1843, on the origin of the cup-shaped circular folds of the septa, derives confirmation from the occurrence of such developmental phases as are seen in fig. 11, which, though, indeed, of rare occurrence, are sometimes encountered, particularly in cultivated plants.

In this example the middle portion of the septum projects in the form of a hemisphere from each aspect, instead of two circular folds. Between this extreme modification and the usual form every intermediate grade may be met with.

The precipitation of the chlorophyll on the nuclear cell is scarcely observable under the ordinary conditions of nutrition and development, and is probably connected with a general increase in the amount of chlorophyll deposited.

It not unfrequently occurs that three daughter cells are simultaneously developed in a single joint-cell of *Spirogyra*. In the joint-cells of *S. nitida* it is most decidedly seen that the new partition-walls are not produced by a fold of the membrane of the parent cell; for the several chlorophyll-laminæ or bands which are present, and completely coherent or continuous at first, overlie the septum which originates from the mutual apposition of the endogenous cells (fig. 13).

In fig. 15, a cell of *S. orthospira* is represented, in which the two daughter cells, *a, a* (covered by slender chlorophyll-vesicles, within the secondary cell *b*, which has been cautiously detached by diosmosis from the primary cell, by the addition of a weak solution of chloride of calcium), are in process of forming a new septum between themselves, and having the nuclear cell interposed. The formation of folds from the secondary cell (primordial sac) is evidently here not the cause of the septum in existence, though it be still incomplete with reference to the parent cell.

Fig. 16 exhibits the following stage of development of a joint-cell of the same individual, in which neither the two daughter cells nor the secondary cells could be detached by the same reagent from the wall of the mother cell, although the secondary cells of the daughter cells have become separated from the coats of their primary cells. These latter formed the still extremely delicate septum which divides the cavity of the mother cell into two portions. The secretory materials (chlorophyll, starch, &c.) are in this stage already enclosed within the secondary cells of the daughter cells, whilst in the previous phase, represented in fig. 15, they are still found within the secondary cells of the parent cell.

The process of absorption of the chlorophyll-vesicles contained within the mother cell, and their reproduction in the daughter cells, may be detected in this genus of plants, although not in its details; but in *Œdogonium* I have witnessed this process after the origin of new joint-cells.

These at first exceedingly delicate partition-walls, developed in a normal manner, can scarcely be confounded with the centripetal circular folds which the cell-membrane of badly nourished Confervæ, particularly *Cladophoræ* and *Spirogyræ*, not unfrequently produce; for these latter are much thicker, and their central edge always rounded, as is shown in figs. 12 & 14. In these examples, the membrane of the secondary cell which was detached from the thickened wall of the primary, as a result of diosmosis, at the constricted part at *x*, and which, during the operation of the reagent, was disturbed from its position, was free from chlorophyll. This nitrogenous secretory matter could not, from the deficiency of suitable nutritive material, develope itself proportionately with the growing cell-membrane, and, probably also from this same defect in the supply of nitrogenous substance from without, was absorbed by the more actively assimilating membrane of the fold.

In *S. nitida* I have observed such circular folds for fourteen days together, without being able to detect a further enlargement of them; and I can give so much the less credence to the hypothesis that septa and cells originate from these folds, as I have noticed similar circular folds in *Cladophora glomerata* lasting for a period of three months without any change in their central aperture taking place.

Further, I have not only observed, in *Cladophora*, the new joint-cells, in certain exceptional cases, take on such a development as to present two free endogenous cells dividing in the cavity of the mother cell (as in cork-cells, in *Spirogyra*, and *Œdogonium*: see my 'Histological Researches,' figs. 21–29), but I have also seen, in the plant in question, that the thick membranous folds intervening between the two daughter cells grow gradually thinner and become finally absorbed. In *Spirogyra*, moreover, I have also witnessed the absorption of the membrane of the secondary mother cell, which has subsided, along with the chlorophyll-vesicles connected with it, towards the conjoined ends of two slowly growing joint-cells, and has there become included in the septum produced, and assumed the form of an elevation or fold. (Histological Researches, p. 63.)

From the analogy of these occurrences, it may be assumed that even the folds represented in figs. 12 and 14 would become absorbed by the neighbouring cells, if these last were restored to a vigorous and normal state of nutrition, which might in all probability be effected, where atrophy had not too far advanced, by the cautious supply of organic nutritive matter.

Fig. 19 exhibits a specimen of *Cladophora glomerata,* in which one of the two daughter cells, during the absorption of the secreted matters by the fold, has penetrated this last in the course of its growth, come into contact with its sister cell, and thus established a new septum.

In the same plant (fig. 18) a thick fold has formed a boundary between the two new daughter cells, and so created an obstacle to their coming into apposition. In the centre of the fold a large corpuscle, like a starch-globule, remains unabsorbed by the daughter cells which did not touch it. It would seem that, in this example, the very thick circular fold of the mother cell has prevented the formation of a septum by the daughter cells.

A careful examination of *Cladophora* is sufficient to convince any one who might regard an appeal to analogy, even in allied plants, as inadmissible, that though an endogenous cell-growth is often difficult to discover in this plant, yet such is the fact; whilst the majority of naturalists, without it, acknowledging the general application of the law of analogy, will not suppose that, in the simplest processes of organization, nature follows totally different courses.

The primitive form which matter capable of organization assumes is that of the vesicle—the cell, inseparably composed of membrane (wall) and contents. Each of these two constituents of the elementary organ, constantly exerting the most intimate influences upon each other, is capable of advancing further in its development by the aid of the physico-chemical forces to which it is indebted for its existence.

The membrane of the cell grows, but not by passive extension as a consequence of endosmose of its fluid contents. It is rather itself engaged in a constant, although, in fact, almost imperceptible, change of the quantity and nature of the matter composing it, assuming peculiar forms, very probably dependent upon the nature of this material, as I have in some measure shown in the preceding pages and in several other contributions.

The fluid contents of the cell have also their own peculiar powers of development. Whilst the cell-wall shows this by its enlargement, and usually laminated thickening, the fluid contents manifest it by the production in them of secretion-cells, of transient duration.

Indeed, as the assimilative faculty of the cell-wall gives rise to the formation of progressively higher combinations, the soluble products of which become finally dissolved in the general nutritive fluid, so, by the agency of the same faculty, secretion-cells make their appearance in the fluid contents of tissue-cells at certain periods of their development. These transient secretion-cells serve for the maintenance of the cells of a secondary, tertiary, and succeeding generation, which originate in the cell-juices, are developed at the cost of the absorbed secreted matters, and serve for the reparation of the primary cell and the maintenance of the cell-individual. This formative process within the cell is not restricted, under certain conditions of nutrition, to the regeneration of the individual cell, but from the cell-contents rich in formative material several new cells, of the nature of the reproducing mother cell, are simultaneously produced, having for their object the multiplication of the tissue-cells.

Owing to this complicated structure of the tissue-cells which enter into the composition of developed organisms, it is erroneous to speak of unicellular plants and animals. With as little reason can we imagine cells without membranes; such bodies, in my opinion, should be designated drops or granules.

II.—*On the Developmental History of the* Stomapoda. By Dr. Fritz Müller, of Desterro*.

[Plate II.]

Under the name of *Zoëa* we have long known young states of the Crabs and Hermit-Crabs, distinguished especially by the want of the ten feet to which the adult animals are indebted for their name of Decapoda. I have recently described the *Zoëa*-forms of the *Porcellanæ* as those approaching most closely to those of the Crabs. But in certain Prawns and Stomapoda, as I have since ascertained, similar conditions occur. Of the metamorphosis of the former, which commences sometimes (as in the Cirripedia and Rhizocephala) with Monoculoid forms and passes through very peculiar Zoëoid and *Mysis*-like states, and sometimes with *Zoëa*-forms which in structure and mode of movement resemble those of the Hermit-Crabs, whilst in others we can hardly say that there is any metamorphosis, I hope shortly to be able to give a tolerably complete account. In the case of the latter I have at present no prospect of fresh observations, and therefore communicate what I have recorded upon the only larva yet discovered.

The little animal (Pl. II. fig. 1), which is 3·25 mill. in length, has the general form and likewise all the glassy transparency of an *Alima*. The segments exist in almost the same number as in mature Stomapods, only the sixth and seventh abdominal segments being not yet distinct from each other; as in the *Zoëæ* of the Crabs and *Porcellanæ*, the appendages of the six hinder thoracic segments† and the lateral laminæ of the caudal fin ‡ are still entirely deficient.

* Translated from Wiegmann's Archiv, 1862, by W. S. Dallas, F.L.S.

† I have never been able to reconcile myself to the exceedingly forced notion which limits the thorax of the Crustacea, like that of Insects, to three segments. It is contradicted, as appears to me, by the developmental history of those Crustacea which are subject to a metamorphosis, whilst the ordinary and readily perceptible division between the thorax and abdomen is confirmed thereby. It is only a reference to the Insecta that could have led from this and to that new artificial line of demarcation. But if any Crustacea can be compared with certainty (as regards the divisions of the body) with Insects, these are certain *Zoëa*-forms (*e. g.* of *Pagurus*) with three pairs of buccal organs, three pairs of legs, and an abdomen destitute of appendages. These three pairs of feet certainly become the foot-jaws of the Crab in accordance with the notion referred to; but the five pairs of true feet of the Crab are produced, not from the abdomen of the *Zoëa* whilst a new "postabdomen" sprouts forth behind, but they are formed *in front* of the abdomen, and often simultaneously with and in the same form as the third pair of foot-jaws. They are to be regarded as an addition to the thorax which is entirely wanting in Insects; and here, again, the process is repeated, that after the appearance of new posterior legs the anterior ones give up their original function, and become feelers or manducatory organs.

‡ The distinction of the last two abdominal segments, which usually

The *carapace*, which leaves the three hindmost thoracic segments uncovered, is flat, and scarcely, if at all, bent down laterally. Its posterior part has nearly the form of the so-called Sea-Mouse, or of a quadrangle with its corners drawn out into points directed backward and forward, with its fore and hind margins of equal width (about two-thirds of the length), and its sides gently arched. The posterior margin is notched in the middle as far as it lies upon the body. The anterior angles lie over the origin of the posterior antennæ; between them the carapace is produced forward, becoming rapidly narrower and running out into a point, which projects beyond the body about one-sixth of its length. The length of the anterior portion of the body, covered by the carapace, is to that of the posterior uncovered portion about as 3 : 5.

The foremost division of the body (fig. 2), bearing the eyes and antennæ, which is almost entirely filled by a large nervous mass, has a quadrangular form; it is 0·28 mill. in length, and the same in breadth behind; the width in front is only half as much; on the middle of its lower surface stands a short spine directed forward. From its anterior angles spring the *eyes*, the extreme convexities of which, when turned quite laterally, are 0·5 mill. apart; one-third of this distance is due to the frontal margin and the slender basal joints of the peduncles. The terminal joint of the eye-stalk forms an oblique cone, the anterior margin of which is about two-thirds the length of the posterior margin; the latter is about equal to the diameter of the basal surface, over which the true eye arches itself.

Below the frontal margin, in the middle of a semicircular process, is seen a small black *single eye*, which perhaps indicates that even here the development commences with monoculoid forms.

Rather nearer to the eyes than to the posterior antennæ, the *anterior antennæ* spring from the margin of the body; they have a three-jointed stem, a two-jointed upper branch, and a jointless inner lower branch, and attain one-fifth of the length of the body. Of the three joints of the stem, the intermediate one is half the length of each of the other two; the first joint is cylindrical, the third thickened at the end. The upper branch is slender, as long as the stem, and bears a long bristle at the end of the first and two at the end of the short second joint. The inferior branch is of a pointed conical form, shorter, but far thicker, than the upper, with a long terminal bristle; about the middle of its upper surface it bears six thin cylindrical filaments

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differ so remarkably from the preceding ones, under the special name of the tail, may also be justified from the developmental history of the animal under notice.

or "bacilli," with rounded apices and very delicate outlines (Pl. II. fig. 3). The three upper of these are about 0·2 mill. in length; the three lower ones attain only one-third of this length.

With regard to these *"bacilli" on the inner antennæ of the Crustacea,* I may be permitted to make a slight digression. These structures, to which attention has lately been called amongst the lower Crustacea by more than one writer*, appear to be very generally diffused throughout the class. I have found them in different Copepods, in the larva of *Balani* and Rhizocephala, in young *Bopyri,* in *Tanaïs* and other Isopods, in *Caprella,* in many *Gammarini,* in *Hyperia, Cuma,* and *Bodotria,* and in all stalk-eyed Crustacea which I examined for them. I missed them only in some parasites (*Bopyrus, Cymothoa*) and Crustacea inhabiting the land (*Ligia, Orchestia*). Of two species of the last-named genus found here, they are wanting in the one, whilst the other possesses them†. In their number and arrangement, size, and form, they are subject to great variety. I have found a single bacillus in many Isopoda (Pl. II. fig. 15), and in the middle of the antenna in a Copepod (fig. 18); a fan of about ten bacilli occurs in the young of *Bopyrus* (fig. 13). In Isopoda, *Caprellæ,* and Amphipoda, one or two usually stand at the apex and on the lower surface of the joints of the flagellum, sometimes on all the joints, sometimes with the exception of the basal one (figs. 14, 17). In *Squilla,* in which the outer branch of the inner antenna is again divided, I found them to the number

* Schödler saw them, in 1846, in *Acanthocercus*; Leydig, in 1851, in *Branchipus,* and subsequently in *Polyphemus* and other Daphnidæ; Max Schultze, in 1852, in larvæ of *Balanus.* "The peculiar pod-shaped, stalked appendages" (fig. 12) which I met with, in 1846, on the third and following joints of the flagellum of the inner antennæ of the *Sphæroma* of the Baltic may belong here, notwithstanding the difference of their form.

† Note by Max Schultze:—The structures under discussion are described more in detail than in the passages known to Fritz Müller, by De la Valette in his inaugural dissertation 'De Gammaro puteano,' 1857, by Leydig, 'Naturgeschichte der Daphniden,' 1860, pp. 42–46, and most accurately by the same author in the 'Archiv für Anat. und Physiol.,' 1860, 'Ueber Geruchs- und Gehörorgane der Krebse und Insekten,' p. 281. Leydig, like Fritz Müller, comes to the conclusion that the structures are, in all probability, organs of smell. It does not appear, however, from Leydig's statements, what is to be regarded as essentially characteristic of the appendages which are to be interpreted as organs of smell; but, independent of their position on the antennæ (in the Crabs on the inner pair), their abundance of nerves and a certain delicacy of the external membrane, the obtuse apices and the appearance of an orifice in these, may be regarded provisionally as characteristic. According to this, the bristle-like feelers first described by me in larvæ of *Balanus,* as issuing near the eye (Zeitschr. für Wiss. Zool. iv. p. 191), and overlooked by later observers, but again met with and classed as organs of smell by Fritz Müller, would rather be tactile organs.

of three at the extremity of the last fourteen joints of the shorter, 42-jointed branch. In the Decapoda they appear usually to occupy the commencement of the flagellum, leaving the extremity free. This is the case in *Mysis*, in one species of which (fig. 10) they are condensed upon a peculiar process. So also in Crabs, *Porcellanæ*, and *Paguri* (fig. 8), in which they occur in the greatest number and of the largest size (up to 1 mill. in length), and, forming one or more transverse rows, beset the thick short joints of the branch, which rapidly diminishes from its thickened base. When the anterior antennæ serve as feet, the bacilli are wanting, as in the larvæ of Prawns *; or they spring from the body itself, as in the larvæ of *Balani* and Rhizocephala.

The bacilli are generally simply cylindrical; I found them dilated into a bulbous form at the base, and here furnished with a tougher membrane, in *Squilla* (fig. 11), in a small Prawn (*Hippolyte*? fig. 9), and in *Ocypoda*. The extremity is usually rounded off in a hemispherical form, and sometimes exhibits a small strongly refractive spot. In the Prawn just mentioned (fig. 9 *a*) a short delicate point was appended to the rounded extremity. Sometimes they are narrowed towards the extremity: I found them thus in *Pagurus*; here, as in the Crabs and *Porcellanæ*, they are divided by delicate annular furrows into shorter or longer segments, and conically pointed. In the larger bacilli the contents sometimes appear delicately striated longitudinally, or very fine granules arranged in longitudinal rows are seen in them.

What is the function of these bacilligerous flagella? If we are unwilling to assume a sense entirely deficient in us inhabitants of the land (in favour of which, however, the rudimentary condition of the inner antennæ in terrestrial Crustacea, such as *Onisci*, *Orchestia*, and *Ocypoda* †, might be adduced), we can scarcely avoid considering them as organs of smell. In the Crabs, in which their bacilli are most highly developed, they are unadapted for feeling solid bodies, on account of their position, their inconsiderable length, and even on account of their bearing these delicate and readily injured appendages. From perceiving movements in the water, for which they would appear to be but ill adapted even on account of their shortness, they are prevented by a rapid current passing by and over them from the mouth. In a current of this kind, running from the mouth, we should certainly not seek for organs of taste. Thus, of our five senses,

* The antennæ of the Prawns are metamorphosed swimming-feet; the swimming-feet of the *Daphniæ* are, however, hardly "transformed antennæ."

† In *Gelasimus*, also, I find the bacilli unusually delicate and short.

only smell remains. This cannot be deficient in animals which may be attracted by a strong-smelling bait. If we now consider how the inner antennæ of Crabs, *Porcellanæ*, and *Paguri* are in almost uninterrupted motion, as it were feeling through the water, which passes over them in a constant stream, by short, rapid strokes with their tufts of bacilli, we must consider them just as well adapted for the perception of odours as the parts in the basal joints of the inner and outer antennæ hitherto indicated as organs of smell appear ill fitted for that office, the latter wanting the most indispensable requisite of an organ of smell, namely, the ready and free access of water.

To return to our larva.

The *posterior antennæ* likewise spring from the margin of the body at the posterior angles of the above-mentioned quadrangular part bearing the eyes and antennæ; they are scarcely shorter than the anterior, and consist of a two-jointed stem and a laminar apical joint, somewhat dilated and beset with bristles towards its rounded extremity, equal in length to the stem, and directed backwards in repose. The jointed flagellum of the mature Stomapod does not appear.

The *mouth* is situated in the middle between the four lateral angles of the carapace; before it is a large helmet-shaped *labrum*; at its sides the *mandibles* (fig. 4), apparently destitute of palpi, each armed with three pointed teeth, which increase in length backwards, and are again finely denticulated on their anterior margin. Then follow two pairs of weakly developed *maxillæ*; the anterior (fig. 5) has two branches, each armed with three spine-like bristles and a minute palpus; the posterior (fig. 6) is a completely unjointed longish stump, with a few bristles at the end.

The feet of the following pair are thin, slender, and five-jointed, and reach to the sides of the mouth anteriorly, nearly to the origin of the posterior antennæ; their last two short joints are usually turned inwards and backwards.

Close behind these spring the large *prehensile feet*. The little animal likes to carry them widely extended as it hangs perpendicularly in the water (fig. 1). The basal joint then reaches outwards to the margin of the carapace; the second and third form a stalk slightly thickened towards the extremity, and 1 mill. in length, which, being directed obliquely upwards, reaches to the level of the eyes; the fourth joint is short and not distinctly separated, and unites the stalk with the horizontal palm, 1 mill. in length, which is slightly clavate and bears on its straight inner margin one long spine and a series of very short ones. Lastly, the claw is slightly curved, not denticulated, and about two-thirds the length of the palm. At the base of the raptorial feet there is a small, roundish, laminar or vesicular appendage.

The raptorial feet are followed by six segments destitute of appendages: of these the three anterior, which are covered by the carapace, but not amalgamated with it, increase in length backwards in the proportion of about 2 : 3 : 4; taken together, they are half the length of the three posterior ones, which are equal to each other. The six rings together are 0·75 mill. in length; their breadth is 0·2 mill.

The following five segments, which together make up fully one-fourth of the length of the body, are about one-half broader, somewhat constricted at the articulations, and each armed at its posterior angles with a short spine. The four anterior of these five segments bear natatory feet (fig. 7), which are all constructed in the same manner:—a large basal joint, 0·3 mill. in length, and somewhat dilated at the extremity, bears two terminal laminæ of about half that length, and beset with bristles; of these the inner one has a small finger-like process towards the end of its inner margin. The branchiæ are still entirely wanting.

The tail, consisting of a single piece, forms a large quadrangular lamina of about one-fifth the length of the body, and scarcely less in breadth; its lateral margins are gently arched, and its hinder margin slightly emarginate; sixteen minute denticles stand in this emargination, a somewhat longer one at each posterior angle, and six on each lateral margin.

The only Stomapod with which I am acquainted here is a *Squilla*, differing little, if at all, from *S. Mantis*. The larva described will probably belong to this. Young *Squillæ* of the same species, of about 10 mill. in length, are already exactly similar to the mature animal, except in the smaller number of joints in the antennæ, of teeth on the raptorial feet, of branchial filaments, and the like. They had still the glassy transparency of our larva, and possessed like it a median eye.

EXPLANATION OF PLATE II.

Fig. 1. *Zoëa* form* of a Stomapod from the Sea of Santa Catharina; magnified 15 diameters.

Figs. 2–7. Different parts of the same; magn. 90 diam.
- 2. Anterior part of the body, from below.
- 3. Anterior antenna, from the side.
- 4. Mandible.
- 5. Anterior maxilla.

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* I would extend the name of *Zoëa* to all larvæ of Crustacea possessing two pairs of antennæ, three pairs of buccal organs, and two or three pairs of legs on the thorax, but still destitute of the five or six last pairs of thoracic feet.

Fig. 6. Posterior maxilla.
7. The last two segments of the thorax and the first of the abdomen, with one of its natatory feet.

Figs. 8–18. Bacilli from the inner antennæ of various Crustacea, magn. 90 diam. (except figs. 10, 12, and 16): *s*, stalk; *a*, outer, and *i*, inner branch of the antenna; *v*, blood-vessel.
8. From a small *Pagurus*; 8 *a*, apex of one of the bacilli.
9. From a small Prawn (*Hippolyte*?); 9 *a*, apex more highly magnified.
10. From *Mysis*; magn. 45 diam.
11. From *Squilla.*
12. From the *Sphæroma* of the Baltic; magn. unknown.
13. From a young *Bopyrus.*
14, 15. From two different species of *Tanais.*
16. From *Caprella*; magn. 180 diam.; *g*, ganglion (?).
17. From *Gammarus.*
18. From a Copepod.

III.—Lucernaria *the Cœnotype of Acalephæ.* By Prof. Henry James Clark, of Harvard University, Cambridge*.

The present communication is a mere sketch of a most thorough and exhausting anatomy of *Lucernaria*, which I have illustrated by numerous plates, and which I propose to publish in an extended memoir, in connexion with some considerations upon the general morphology and systematic relations of Acalephæ. I have been engaged during the whole of the past year upon the organical and histological anatomy of this animal, in order to determine what are its relations to Radiata in general, and to Acalephæ in particular. I have had abundant materials for study, inasmuch as this species of *Lucernaria* is a very common inhabitant of our shores, wherever the eel-grass (*Zostera marina*) grows. Almost invariably *Lucernaria* is to be found upon the *Zostera*, and very rarely upon any other plant. It may be obtained from the last of August, when it is most frequently met with in a young state, until the last of June, at which time the young ones of the autumn season have developed to full-grown animals. In an adult state it measures nearly an inch across the disk, exclusive of the tentacles, and about the same in height. It varies in colour from green, which is the most common tint, to deep olive; from light yellow to reddish brown, or from light violet to the deepest purple. In form it is octagonal, and most frequently it so comports itself that the four sides opposite the bifarious genitalia are shorter than those alternating with them; but frequently the same individual reverses the order of things, and the latter become either as short as or even shorter than the first. From this we infer that the specific differences, based

* From Silliman's American Journal for May 1863.

upon the approximation of the bunches of tentacles, two and two, are entirely erroneous, as this obtains in all octagonal Lucernarians in a greater or less degree. As these animals are very sensitive and irritable, they contract upon the least disturbance; and as the muscular system is most highly developed in the region which lies about the four partitions of the disk, it is most natural that, when the creature contracts, it should draw the two halves of the genitalia and the bunches of tentacles together more closely here than at the alternate quarters; hence arises the frequently observed quadrate outline of the disk. Again, in regard to another feature oftentimes employed to discriminate between different species, or even groups, I would say that the absence of auricles alone, without other differences in the animal, does not indicate a specific difference from those individuals possessing them, but rather an accidental atrophy of these organs,—and that this fact is to be classed in the same category as the occasional development of one of the tentacles into a semiauricular body. I have always noticed that individuals in such a condition have an unnatural appearance—that they are not so lively as the others, and appear to be diseased*. I believe this species to be identical with *L. auricula*† of the English coast. The most characteristic figure that I know of, although unsatisfactory, is in Gosse's little book, 'The Aquarium'‡.

In order to contrast the structure of *Lucernaria* with that of

* I have found such specimens most frequent at that time of the year which is the breeding-season of our common shore-crab, *Cancer* (*Platycarcinus*) *irroratus*, when it comes up out of deeper water, and is most abundant and active. At first, only now and then, I found a Lucernarian with one or two auricles bitten off; but later it was common to find specimens with all the auricles nipped, and nothing but a small portion of their base, or a mere scar, left to indicate their former presence. The moment a Lucernarian is touched by a Crab, it jerks its tufts of tentacles inward, but the reverted auricles are left exposed, and all the more prominent by the act than usual, and a conspicuous morsel for the predaceous creature. As the season advances towards summer, the bunches of tentacles also disappear one after another, until it becomes quite common also to find individuals with two, three, or four bunches bitten off; and at the same time specimens become more and more rare (at the last of June, for instance), and finally (by the early part of July) it is impossible, by the most diligent search, to find a single specimen. As this happens at the time when the Lucernarians are laying their eggs, it is clear that the destruction of the adult does not necessarily annihilate the race. During the next two months, no Lucernarians are to be found; but in the last of August I have collected young ones, much less than $\frac{1}{16}$ of an inch in diameter.

† *Haliclystus auricula*, H. J. C., Journal Boston Soc. Nat. Hist., March 1863, p. 559.

‡ The original figure by Rathke (Müll. Zool. Danica, iv. 1806, pl. clii.), although sufficiently correct for identification, can neither be called characteristic nor graceful as far as attitude is concerned.

the Steganophthalmatan Medusæ, and, moreover, in order that I may not complicate matters, I will compare it, organ for organ and part for part, with one of our most common Medusæ, *Aurelia flavidula*, Agassiz. The aboral side, which corresponds to the so-called dorsal region of other Acalephæ, projects at the apex into a moderately long columnar body, usually called the peduncle of *Lucernaria*. With the exception of the four equidistant channels and the four muscular cords which alternate with them, the peduncle is a solid gelatiniform mass, covered by the outer wall. This gelatiniform substance also constitutes the bulk of the disk, filling the entire space between the outer wall and the inner or lining wall of the digestive cavity, and directly continuous with that in the peduncle. In *Aurelia*, *Cyanea*, and other Acalephs, this substance appears like an amorphous gelatiniform or semicartilaginous mass, with a few irregular cells scattered here and there*; but in *Lucernaria* it has a highly organic structure. Extremely elongate, columnar,

* In June 1862, I made a careful study of the structure of the gelatiniform substance of *Aurelia flavidula*, Ag. There are two kinds of fibro-cellular bodies which pervade the gelatiniform layer. One kind are irregular, dark, conspicuous cells, similar in appearance and size to those of the outer wall of the aboral side, with from one to four or five jagged caudate prolongations projecting in every direction. These are most numerous next the aboral side of the disk, and departing from that region they become less frequent as we appoach the oral side, at which place they are very much scattered. The other kind of bodies are very faint, nucleated, nodose fibres, and form a vast anastomosing network, which, like the darker, caudate cells, pervades the whole of the gelatiniform mass of the body, from the aboral to the oral side. It resembles elastic tissue very closely. Next the aboral side these fibres trend mostly parallelwise with the outer wall, or at very oblique angles to it; but, passing inwardly, they gradually assume a direction transverse to this, and then, anastomosing less frequently, they become in appearance like slender parallel columns, based upon the double wall in which the chymiferous channels run. Between the latter and the outer wall of the oral side the fibrous bodies are excessively faint and less frequent, but still continue the trend which they have on the aboral side of the double wall. The peculiarities of these two kinds of bodies are fully described by Max Schultze (Ueber den Bau der Gallertscheibe der Medusen, Müll. Archiv, 1856, p. 311, pl. 11, 12) from observations which he made upon *Medusa* (*Aurelia*) *aurita*, *Rhizostoma Cuvieri*, and *R. Aldrovandi*; but in all of them, he says, the fibres run in every direction: "sie laufen gestreckt in allen Richtungen, theilen sich häufig und verbinden sich unter einander unter allen möglichen Winkeln." Now, in *Medusa* (*Aurelia*) *aurita*, which is very near, if not identical with, our *Aurelia flavidula*, Ag., it is very probable that these fibres are arranged as in ours; and yet I cannot see how Schultze could have overlooked this arrangement. My observations were made upon perfectly fresh specimens, and without the help of any reagents. In our Lucernarian, and, in fact, in all the *Lucernariæ* (see Journal Boston Nat. Hist. Soc., March 1863), the fibrous bodies do not anastomose, but trend in direct lines, from the outer to the inner wall.

cell-like bodies extend in close proximity from the outer to the inner wall, so that, in a section of the thickness of the disk, it appears to be transversely striated. In the peduncle, as a transverse section reveals, these columnar cells are arranged about the axis, in peculiar regular groups: some columns pass from one channel to the next on either side, some diagonally across the axis from one channel to an opposite one, and others extend obliquely from the channel to the muscular cords which alternate with them. This arrangement reminds one of the methodical disposition of the great cells in the body of *Pleurobrachia**, as I have described them in Prof. Agassiz's third volume of his 'Contributions to the Natural History of the United States.' In the oral or lower side of the disk of *Aurelia*, the gelatiniform substance has the same structure as in the aboral side, while in *Lucernaria*, although it has all the regularity in the disposition of its components that obtains in the aboral side, yet it possesses a totally different nature, as I will describe hereafter in connexion with the muscular system.

* At the time the investigation of the gelatiniform mass of *Pleurobrachia rhododactyla*, Ag., was made, I had not in my possession lenses of the proper definition and working-distance to make out the histological elements with the accuracy that such excessively transparent bodies demand, and therefore, using inferior lenses, I fell into an error which I am only too glad to correct. Since that time I have obtained one of Tolles's half-inch objectives, with an exceedingly sharp definition and an extraordinary working-distance; so that I have been enabled to work with perfect freedom upon the living animal, and without injuring its tissues in the least. What formerly I mistook to be the outlines of the walls of enormous cells are in reality *elastic fibres*. The mistaking the fibres for the profile of cell-walls does not affect the arrangement in the least as I formerly described it, and which I have since verified with my new objectives. The elastic fibres assume various forms, according to the degree of expansion or contraction of the animal; sometimes they are perfectly straight, and at others they are contracted either in a loose spiral, or retracted into a close coil. This is most easily observed in young specimens. In the young of another Ctenophoran, viz. *Bolina alata*, Ag., about $\frac{1}{32}$ of an inch in diameter, at which size its proportions, shape, the considerable depth of the tentacular sockets, and the length of its tentacles render it remarkably like a *Pleurobrachia*, the elastic fibres are very few, but quite conspicuous, and have a peculiar mode of branching. Single fibres extend radiatingly from the corners of the stomach; when about halfway to the surface of the body, each fibre forks two or three times, and then one prong goes to each of the two nearest longitudinal chymiferous tubes, and the third one extends to the base of the deep tentacular socket. This is the general arrangement at this age, although occasionally one of the prongs of the fork is absent or only partially developed. Sometimes each prong forks again, at a narrow or wide angle. From the tentacular sockets fibres extend also to the surface midway between the mouth of the former and the adjacent longitudinal chymiferous tube. So few are all the fibres, however, that with a casual glance they might be mistaken for light unimportant streaks here and there, instead of such methodically arranged bodies.

From the middle of the base of each of the four flat sides of the quadrate proboscis, a light streak, which has the deceptive appearance of a radiating canal, passes in a direct line nearly to the border of the disk: this is the line along which the oral and aboral floors of the disk unite, and form a solid partition, by which the digestive cavity is divided into four broad chambers, which communicate with one another at the inner or proximal ends, about the base of the proboscis, and also at the outer or distal ends, through the narrow passage between the terminus of the partition and the edge of the disk. In the peduncle there are four equidistant broad tubes, which merge into one cavity at its base, and correspond in position to the four chambers of the digestive cavity. The grouped tentacles which occupy the eight corners of the disk are hollow, as likewise are the auricles, and communicate openly and directly with the digestive cavity. This is all that constitutes the chymiferous circulatory system of *Lucernaria*. In *Aurelia* we have radiating canals at the points corresponding to the partitions of *Lucernaria*, as well as in the intermediate sections.

In *Aurelia* the genitalia are four single circular organs, one of each being placed opposite the flat side of the proboscis; whereas in *Lucernaria* each genital is a double organ, the halves of which have a peculiar shape, and are situated respectively one on each side of the partition, and extend along the inner face of the oral floor of the disk from the base of the proboscis to the extreme limits of the corners of the disk, where they almost touch the bases of the tentacles. Across the proximal end of each partition, triple or quadruple rows of slender digitiform bodies extend each way for a considerable distance along the border of each half of a genital, thus forming the common appendages of the two, and clearly indicating their *unity**. Each half of a genital has a peculiar form, which may be represented by an inequilateral triangle whose longest side extends nearly in a straight line from the inner end of the partition to the tentacles, and the two other sides, slightly curving outwardly and meeting at a very broad angle, form the rest of the outline. In the adult, the longest side of the triangle is to its height as two to one. This feature, alone, has a degree of speciality which raises these organs in rank above all others of their kind among Acalephæ; but when we examine their components, we find an

* In the family Cleistocarpidæ, as I have recently characterized it (Journal Boston Nat. Hist. Soc., March 1863), the genital halves are directly united to each other, so as to form a continuous organ across the proximal end of the partition: thus there can be no doubt that there are but four genitals in *Lucernariæ*, and not eight, as described by various authors.

unlooked-for structure, hitherto unknown among Acalephæ. What appear to the naked eye to be eggs of enormous size are really little pouches, which contain either numerous eggs or matrices of spermatic particles, according as the individual is male or female. Each pouch, or *genital saccule,* as it may be called, projects freely into the digestive cavity, and is attached by a very short and rather narrow neck to the inner wall of the oral floor of the disk. This constitutes another step in the specialization of these organs, but does not complete the process. At the base of each genital saccule, and on that side which faces toward the proboscis, there is a small aperture, which leads to the interior, where there is a considerable cavity. This cavity is formed by the lateral inversion of the single wall of the saccule upon itself, and the constriction of the wall about the entrance to the chamber. The eggs or spermatic material* are enclosed in saccular folds of the wall of this chamber, into which they fall when mature, and pass thence outwardly through the lateral outlet at the base of the saccule. One may see at a glance that this is a type of the reproductive organs not to be found among the other Acalephæ.

In *Aurelia* the generative products, whether eggs or spermatozoa, lie immediately beneath the *outer wall,* and imbedded in the muscular layer which extends throughout the length and breadth of the oral face of the disk as I have described it in the fourth volume of Professor Agassiz's 'Contributions.' Between the muscular layer and the inner wall which forms the immediate parietes of the digestive cavity, a thick layer of gelatiniform substance intervenes; and its presence naturally suggests the inquiry, How are the eggs or sperm to escape into the digestive cavity, as they are known to do? The spermatic particles I have observed frequently escaping directly through the outer wall into the ocean; and I have seen them, with the broadest end out, projecting like bundles of hairs from the cavity of the matrix through the apertures in the outer wall. When the reproductive material is fully ripe, the inner wall, with the gelatiniform layer, and the muscular layer as far as it includes the material

* The spermatic particles have an elongate-cordate body, from the broad end of which an excessively long tail-like filament trails in broad curves as it swims; at the pointed end are attached two exceedingly delicate filaments, which are in constant motion, bending and coiling, or stretching in every direction, as if they were the tactile organs of an *Euglena* or some other similar Infusorian. The pseudoproboscides defy detection with ordinary objectives; in fact, to determine their presence with certainty requires very careful manipulation of such objectives as have the most accurate defining-power, and which are to be obtained only from our best makers. The spermatic particles of our common *Echinus* (*E. granulatus*) also possess a double pseudoproboscis.

in question, splits off from the outer wall along two lines corresponding to the two borders of the generative organ, and hangs loosely, in ribbons, in the digestive cavity. From the newly formed raw face of these ribbons the eggs or spermatic particles escape into the main chamber of the disk. This I take to be the universal rule, and such the type of genitalia among all Steganophthalmata—a structure totally unlike that of *Lucernaria*, in which the *inner wall* alone is concerned in the highly complicated reproductive organs.

Passing now to the consideration of the *muscular system*, I will call your attention to the four white slender columns which alternate with the four dark tubes imbedded in the gelatiniform substance of the peduncle. Sars was the first to indicate the true nature of these columns, and he rightly called them muscular cords. They extend from the base of the peduncle to the base of the proboscis, coursing along just beneath the outer wall, but still within the gelatiniform substance, until they reach the upper third of the peduncle, and then, gradually approximating the axial line, they meet the inner wall of the disk just below the base of the proboscis, and thence pass along, still beneath this wall, for a short distance, and finally *each one enters the oral side of the disk* at the inner or axial end of the partition. At this point, each muscular column expands and forms a fan-shaped layer just beneath the outer wall, and extends laterally so as to occupy the whole space between the two halves of a genital. At the distal end, this layer diverges right and left of the partition into a broad muscular band, which borders the disk and is eventually distributed in ridges or cords beneath the outer wall of the tentacles and the auricles. At the inner end of the partition, the muscular layer also passes into the base of the proboscis, and forms a stratum immediately beneath the outer wall. At four equidistant points, alternating with the partitions and genitals, and opposite the four corners of the proboscis, there is a weaker muscular layer, which occupies the same relative position in regard to the outer walls as does the stronger system of muscles first mentioned. On the one hand it passes into the marginal muscular band; and on the other it enters the corners of the proboscis, and forms a layer in common with the one extending from the partitions. By these alternating stronger and weaker divisions of the muscular layer, the disk is relieved of the sameness which prevails in the muscular system of the Steganophthalmata, and we have indubitable proofs of a higher degree of specialization than in the latter order, where the unvarying repetition of similar divisions all around the disk unmistakably indicates inferiority. Moreover, in addition to this, we have a peculiar specialization of the gelatiniform layer, which is embraced by the outer and inner walls of this floor, or, rather, between the muscular layer and the inner wall: instead of repeating, as occurs in *Aurelia*, the peculiarities of the gelatiniform layer of the aboral floor, it has a totally different appearance and consistency, and an almost unlimited degree of expansion and contraction. In the tentacles it occupies a very deep space between the outer wall, or, rather, the muscular layer, and the inner wall. In this latter respect, *Lucernaria* is again peculiar, since, in addition to the muscular layer, which alone is present in the young, it developes this gelatiniform layer—the *musculo-gelatiniform layer*, as I propose to call it—the like of which does not exist in the tentacles either of Steganophthalmata or Gymnophthalmata. In the auricles we have also a specialization peculiar to *Lucernaria*; for, in addition to the pigment eye-spot which is imbedded in the base of the oral face of these bodies, the auricles, which in the young cannot be distinguished from the tentacles, gradually thicken the outer wall as age advances, and peculiar granuliferous adhesive vesicles are developed between the cells. In the adult their tentacular nature is almost or altogether obliterated, and the swollen outer wall, together with the enormous thickness of the musculo-gelatiniform layer, forms an oval mass, thickly studded with adhesive organs, by which they cling in a most tenacious manner to any body which they may touch. These organs and the base of the peduncle are the only means of adherence which *Lucernaria* possesses; although it is true that the tentacles are used, as in *Aurelia*, for prehension, they are comparatively very weak, and can only serve to retain the prey, and never effect the purpose for which the auricles are constructed*. In consideration

* The nettling organs, or lasso-cells, which crowd the globular tips of the tentacles, are of two kinds, and both are imbedded in the intercellular substance which fills the spaces between the columnar cells of the outer wall. One kind consists of an oval thick-walled vesicle, about $\frac{1}{2000}$ of an inch long, or a little less, one end of which is introverted, and projects, in the form of a stout hollow shaft, along the axis of the cell about four-fifths of its length, and then, rather suddenly thinning into a slender thread which also is hollow, it bends upon itself, returns nearly to the aperture of the cell, and, pressing closely against the inner face of the cell-wall, it forms a close coil which terminates at the end opposite the mouth of the introversion. When the coil of thread is ejected, which is accomplished by sliding through the hollow axial shaft, which in its turn retroverts also, just as the finger of a glove is turned inside out, the whole aspect of the apparatus is changed. The oval cell is considerably diminished in size, and from its aperture the enormously enlarged hollow shaft projects in a straight line; the half of the shaft next the cell is cylindrical, and half as broad as the latter, with a slight expansion where it joins the mouth of the cell; the distal half abruptly expands into an oval form, half as broad again as the cylindrical portion, and rapidly tapers into a smooth, trihedral, twisted thread. The

of the very obvious office of an auricle, I would propose the name *anchor* for it.

Were the above-mentioned features in the organism of *Lucernaria* alone to be taken into account, there could be no hesitation in saying that this genus should be considered as the highest of the class of Acalephæ, because of its highly complicated and specialized gelatiniform mass, the high grade and the peculiar and distinctive grouping of its muscular system, the definite and bilateral form of the genital organs, as well as their saccular subdivision, the twofold nature and disposition of the prehensile organs, the tentacles and anchors,—and, moreover, that it belongs to an order separate from the other orders of Acalephæ, because of the typical elements of its genital saccules, which are altogether different from either the Steganophthalmic or Gymnophthalmic type of genitals—and also on account of the anchors, which have no parallel in all the class of Acalephæ. But there are parts of the Lucernarian organism which are of a lower grade than those of similar nature among the other Acalephæ. I refer, in the first place, to the Hydra-like form of *Lucernaria,* and its

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oval part of the shaft is endowed with three equidistant spiral rows of setæ, which number about a dozen in each row. The setæ are comparatively large, and in length equal two-thirds the broadest diameter of that part of the shaft from which they project. Each row makes but one turn about the shaft, and terminates as if in continuation of the angles of the trihedral thread. There is not the least trace of setæ or projections of any kind upon the trihedral thread, but it continues, with a very gradual taper, perfectly smooth, to the blunt termination. The angles of the thread appear, at first glance, as if they might be spiral rows of setæ; but a most careful and prolonged examination with one of Spencer's $\frac{1}{4}$-inch objectives convinces me that they are truly the angles of a twisted trihedral filament. The extent of the thread is from twenty to twenty-four times the length of the cell. The other kind of nettling cell is much more simple in structure, but yet more remarkable. The introverted shaft is very slender—in fact, no larger than the rest of the thread; it does not project into the axis of the cylindrico-oval cell, but presses close to the side of the latter, and extends four-fifths of the way to its opposite end, and then, bending abruptly upon itself, the thread passes with a long curved sweep nearly to the aperture of the cell, from whence it again returns, with another long sweep, which is repeated eight to ten times, until the inner face of the cell-wall is lined by a close coil which winds lengthwise, instead of transversely as it does in the other kind first described. When extended, the thread is from twelve to fourteen times the length of the cell; it offers not the least sign of appendages of any kind, but is simply a smooth round filament, of uniform thickness throughout, except at the end, where it tapers slightly and terminates in a blunt tip. The cell itself, when retroverted, is sensibly diminished in size, and narrows rapidly into the prolonged filamentary portion. It would seem to be perfectly incontestable that, as the cell diminishes in size with the expulsion of the thread, it forms the propelling power, and by the contraction of its wall forces its contents outward.

comparatively stiff and hydroidal tentacles, evidently indicating a typical affinity to the fixed hydroid generation of the *Sarsiæ, Bougainvilliæ, Steenstrupiæ*, &c. The simple, almost unilocular chymiferous system is hardly more medusoidal, as regards the multiplicity of its subdivisions, than in some of the Tubularians, such as *Tubularia* and *Corymorpha*, which are described in Professor Agassiz's fourth volume of his 'Contributions.' In connexion with the hydroid form of *Lucernaria*, I would also mention the total absence of a veil. This might, at first thought, appear to furnish an argument in favour of the high relations of this genus; but I think it is to be deemed one of the signs of its inferior connexions. However, let us look at the progress of velar development. In the *ephydra* state of all Steganophthalmata, the veil is at one time greatly preponderant, when compared with the size of the whole individual; but with growth it gradually becomes less conspicuous, and finally, in some adult genera of this order, it remains as a mere trace of a veil, or, as in *Cyanea* and some Rhizostomidæ, it is altogether obscured. Now, it is noteworthy that among the lowest of this order, such as *Pelagia*, we have a strong resemblance to the ephydra state, and the ephydroid tongue-like veil is quite prominent; and in *Chrysaora* it is hardly less so: ascending the scale, we find it more inconspicuous in *Aurelia*, and still more so in *Cassiopeia*, and, finally, altogether absent in *Cyanea* *, the highest, in my opinion, of all the Steganophthalmata. Now, one might suppose *Lucernaria*, in respect to the veil, to be in the same category with *Cyanea*, which has resorbed its veil; this, however, is not the case; for, as I know from the study of the younger stages of *Lucernaria* that it never passes through the veiled phase, it falls short in its development as regards this particular feature of Acalephan morphology. We must take into consideration, also, the eyes, which are found to be as low in point of structure as the merest pigment eye-spot of the Gymnophthalmata.

* The ephydra-like appearance of *Cyanea* is illusory: the lobes about the eyes comprise not only the original ocular lappets, but also a part of the tentacular margin; in fact, one-half of each margin on each side of an eye is continuous with the ocular lappet adjacent. The tentacular margin being incurved toward the centre of the disk, the veil must be still further inward, and very probably the margin of the muscular bands corresponds to it, the two merging into each other. The wide lacunar character of the radiating canals is not a feature of inferiority, as might appear, but represents a continuation of the tendency (as may be seen in the progressive stages of growth of *Aurelia*) to channel out the whole breadth of the disk, until it finally becomes a simple cavity. In *Rhizostoma, Stomolphus*, and *Polyclonia* the channeling is less carried out than in *Cyanea*; in fact, the former is but a little beyond *Aurelia* in this respect.

Thus, in balancing the value of the organic characters of this animal, we are inevitably led to the conclusion, on the one hand, that *Lucernaria* does not stand *as a totality* above all other Acalephæ, nor, on the other hand, does it, by any means, belong below them, and that much less does it affiliate exclusively with the Gymnophthalmata. The only relation that it possibly can be considered under is that of a *correlation to both types of Acalephæ* —viz. to the Gymnophthalmata, including the *Siphonophora*, and to the Steganophthalmata—yet not as a graduated connecting link which would seem to show that the two orders pass into each other, but as an *ordinal type*, equivalent in value to either of the others, by reason of the peculiar and distinctive morphology of certain of its organs. On this account *Lucernaria* is to be considered and may be designated as the *cœnotype* (*κοινὸς*, common) of the Acalephæ. In this respect it holds such relations to the other two orders of Acalephæ as do the Crinoids to the other orders of Echinodermata, or the Annelidæ to the rest of the Articulata, or the Selachians to the true Fishes and the Reptiles, at the same time, containing organic features which separate each of them as a type from the others.

In order that no confusion may arise here, I would state most explicitly that I do not consider the Ctenophora as one of the orders of Acalephæ, but deem them to be a class by themselves, equal in value to either of the classes of Radiata, whether Polypi, Acalephæ, or Echinodermata, and standing next in rank to the Echinodermata. The division of the alimentary system of Ctenophora into *two portions*, as among Polypi, is sufficient to separate them from the Acalephæ, since the typical form of the corresponding system in the latter is a *unity*; moreover, the position and peculiar relations of the tentacles of Ctenophora are hardly of less importance, in these considerations, as distinctive characters. I cannot conceive that the Ctenophora may be included in the same classific type with the Acalephæ without doing violence to correlative ideas such as are expressed in the organism of the former; and much less can I admit that they have the most distant relation to the Polypi, excepting that, like the latter, they are Radiates. The same kind of arguments that have been used to show that Ctenophora and Polypi belong to one class might, with equal justice, be advanced to prove that the Acalephæ are Polypi. We must not mistake a similarity for an identity, any more than that the cry of a child would identify it with a cat, because their voices sound alike, and cannot always be distinguished the one from the other by any single faculty of our senses.

The following tabular view presents at a glance the relations of the *Lucernariæ* to the other orders of Acalephæ, and at the same time indicates the position of the Ctenophora among the other classes of Radiata.

Polypi.	Acalephæ.	Ctenophora.	Echinodermata.
	Steganophthalmata.		
	Lucernariæ.		
	Gymnophthalmata.		

IV.—*On* Amœba princeps *and its Reproductive Cells, compared with* Æthalium, Pythium, Mucor, *and* Achlya. By H. J. Carter, F.R.S. &c.

[Plate III.]

During the month of April, 1863, I found *Amœba princeps*, Ehrenb., plentifully distributed in a shallow stagnant pool filled with dead leaves and fresh green confervoid Algæ, forming part of a chain of such pools, which, connected by a dribbling little stream, extended, for about half a mile in length, from a heath-bog, which it drained, to a little rivulet in the neighbourhood.

Although this *Amœba* is the largest freshwater species known, and stands figured in my journal at its commencement, viz. in 1854, as well as, at intervals, in many other places up to the present time, I have never until lately given the amount of attention to it that I have long since done to the other freshwater Rhizopoda, both naked and testaceous; nor in the present instance, probably, should I have gone further, had I not discovered in it cells which must be assumed to be reproductive, and had I not been recently studying the family of Fungi called "Myxogastres" with reference to the observations of M. A. de Bary, who found them so nearly allied to *Amœba* that he has proposed for them the name of "Mycetozoa"*.

Well acquainted, therefore, with most of the Myxogastres which have been described, but more especially with that species called *Æthalium*, I took the first opportunity which presented itself of comparing its structure with that of the largest form of *Amœba*; and hence my late study of *A. princeps*, of which I have only time now to give the results. The observations were all made on *Amœbæ* which had not been kept in confinement beyond four or five days.

It may be remembered by those who have read my "Notes on the Organization of Infusoria, &c."†, that I have therein

* Ann. Nat. Hist. vol. v. p. 233 (1860).
† *Ibid.* vol. xviii. p. 115 (August, 1856).

proceeded upon a certain nomenclature of their parts generally; and I shall pursue the same course here in the description of *A. princeps* specially.

The minimum and maximum size of *A. princeps* may be set down, according to my observations, at $\frac{1}{450}$th and $\frac{1}{25}$th of an inch in length, respectively, the breadth being a little less. Of course, these measurements may be exceeded either way; but I have not met with any larger or smaller specimens in which the distinguishing character of the nucleus, which will be presently mentioned, could be detected.

The most conspicuous features of *A. princeps* (Pl. III.), when it is large, are its size and the number of granules it contains, in both of which characters it much exceeds any other *Amœba* with which I am acquainted. Its form, of course subject to protean changes, is for the most part limaceous, or once or twice branched, and its pseudopodia, which are almost always lobed and obtuse, proceed from a posterior end which is normally capped with a tuft of villous prolongations; while the distinguishing character of the nucleus, to which I have above alluded, consists in the nucleolus (fig. 3 *d*) being so much extended over the inner surface of the nuclear cell that it passes beyond the equatorial line of the latter, and thus causes the pellucid halo which is seen round the nucleus of other *Amœbæ* to be absent; that is, the nucleolus, being circular and of much less extent than the hemisphere of the nuclear capsule, in most *Amœbæ*, causes it to appear in them as if surrounded by a transparent area—which, for the reason above stated, is not the case in *A. princeps* at the time when it has attained the $\frac{1}{450}$th part of an inch in length. Besides this, the border of the nucleolus in *A. princeps* at the same period is wavy; and this gives rise to an irregular transparent area in the nucleus or nuclear cell. Whether the nucleolus of *A. princeps* presents the appearance of that in other *Amœbæ* before this period is a matter of little consequence, inasmuch as, below the minimum size mentioned, all *Amœbæ* appear to be alike.

Ehrenberg's* and Dujardin's† figures of *A. princeps* are good representations of it.

Having thus briefly premised a specific description of *A. princeps,* let us now give our attention, severally, to the parts of which it is composed, under the following heads, viz.:—*Pellicula, Diaphane, Sarcode, Moleculæ, Granules, Digestive spaces, Fat-globules, Vesicula, Nucleus, Reproductive cells,* and *Spermatozoids.*

Pellicula.—Inference leads us to the conclusion that there is

* Infusionsthierchen, Atlas, fol., tab. viii. fig. 10 (1838).

† Hist. Nat. des Zoophytes, Atlas, pl. 1. fig. 11.

a pellicle over the surface of *A. princeps*, however thin; and the fact that very frequently, on the application of iodine, the margin becomes of a deep violet colour, while all the other parts of this Rhizopod exhibit nothing but a more or less deep amber tint, seems to confirm it by chemical differentiation.

Such a covering has been demonstrated by Auerbach in *A. bilimbosa**, and more satisfactorily, on account, probably, of the pellicula in this species being more rigid; but Auerbach does not show that it is coloured by iodine, although he figures starch-globules thus turned blue within it. Some years since, too, I pointed out the presence of starch, in all forms, throughout *Spongilla*, which is but a congeries of amœbiform cells. I have also shown that it exists in the chambers of the Foramifera; so that starch may be set down as a common product of the Rhizopoda.

Returning to the pellicula, we must also infer that it is possessed of great elasticity and tenacity, so that it can yield a covering to the pseudopodia almost to any extent (as proved by the actinophorous rays of those Rhizopods which infest the cells of plants remaining after the sarcode has withdrawn itself into an interior or secondary cell); also that it admits of rupture (as in the introduction of food into the sarcode), and yet can heal over rapidly again. Thus it can undergo comparatively unlimited extension even to discontinuity, but possesses no adhesiveness externally, as evidenced by nothing adhering to it which is not seized and kept there by the instinct of the animal.

Furthermore, in *A. princeps* the pellicula is allied to the cell-wall of plants by position, and, from chemical evidence (*i. e.* when treated with iodine), by an amylaceous composition.

Diaphane or *Ectosarc.*—This layer, as in other *Amœbæ*, lies immediately underneath the pellicula, and is distinguished from the sarcode or endosarc within by its greater degree of transparency and peculiar functions; for while the sarcode is clouded and presents a rotatory motion, the diaphane is clear and distinctly endowed with a locomotive and prehensile power.

Analogy and actual observation would lead us to infer that, in certain if not in all instances, the ectosarc has the power of passing *through* the pellicula by rupture of the latter—a fact which becomes most evident when the pellicula is thick and resistant, as in *Amœba bilimbosa*, where it has been demonstrated by Auerbach, especially in his third figure of this species†.

* Siebold und Kölliker's Zeitschr. vol. vii. p. 365, pl. 19. figs. 1–5. (Dec. 1855).

† *Loc. et tab. cit.*

Contractility of the Diaphane.—On one occasion, while looking at a large specimen of *Amœba princeps,* I saw a rotatory animalcule, something like *Furcularia forcipata,* Ehr., come up to and bite it; and immediately after the bite had been given, the surface of the *Amœba* became puckered slowly towards the point bitten. The *Furcularia* then left the *Amœba,* but returned again and inflicted the same kind of injury, when the same evidence of contractility of the surface of the *Amœba* took place; and this was repeated several times, at short intervals, until I was fully convinced that the surface of the *Amœba* manifested the same appearance of irritability as muscular tissue under a similar stimulus. I made at the time a sketch of the *Amœba,* which had a peculiar form of the villous tail; and the whole is introduced in Pl. III. fig. 5, to make the facts connected with it more intelligible and impressive.

Sarcode or *Endosarc.*—This also, as in the other *Amœbæ,* is clouded, from several causes, but more especially from the presence of the *moleculæ* or fine granules, with which it is so densely charged that they seem to occupy half its bulk, and thus give it an amount of opacity which contrasts forcibly with the transparent diaphane. Moreover, the sarcode suspends the granules, digestive spaces and food, fat-globules, vesicula, and nucleus, all of which rotate with it, and, in addition to the rotatory movement especially, also contrast it strongly with the diaphane.

Granules.—These, which far exceed the moleculæ in size, have such a rounded form and dark outline at the commencement that they bear the appearance of organic bodies. But from round they become elliptical, and lastly angular and crystalloid aggregates, based upon an octahedral form, which in some instances is so perfect and so like that of *oxalate of lime,* that, with their pinkish colour and dissolving without effervescence under the influence of nitric acid, I am inclined to think that they are crystals of this salt. (Pl. III. fig. 1 *a,* & *g, h, i.*)

They are present in the youngest as well as in the oldest forms, and in number and size do not appear to bear any constant relation to the age and size of the individual; for they are sometimes more prominent even in young than in old specimens; but, as a general rule, perhaps they keep pace in number and size with the age of the *Amœba*: certainly, however, they do not pass into the crystalloid angular form until the individual is pretty large and well advanced in life. The largest I have met with did not exceed the $\frac{1}{2000}$th part of an inch in length, and was composed of an irregular crystalline aggregate based apparently upon an octahedral form. Their crystalloid form has been long since (1855) figured and pointed out in *Amœba bilimbosa* by Auerbach*.

* Loc. cit. tab. xx. figs. 12, 13.

These "granules" are common to all the freshwater Rhizopoda (including the amœbous cells of *Spongilla*), and for the most part present, at the commencement at least, a greenish tint. Nor are they less common in *Plœsconia, Stylonychia, Paramecium,* and perhaps in all the Protozoa. In *Paramecium Aurelia* they often present an acicular form, in bundles within true cells (if the latter are not globular dilated spaces in the sarcode); and here, too, they dissolve without effervescence under the influence of nitric acid. *Stylonychia,* when becoming encapsuled and taking on the "still form," gets them down towards its posterior extremity, from which they are frequently and finally discharged *en masse* into the capsule, with other refuse, which probably the *Stylonychia* finds it disadvantageous to retain in the sarcode during this passive state of its existence.

In *Æthalium,* one of the Myxogastres to which I have alluded, there is also a great development of small, round, colourless, compound, crystalloid masses, which, from their appearance and ready effervescence under the influence of nitric acid, I infer to be composed of carbonate of lime.

These, probably, are analogous to the "granules" of the Rhizopoda, and the whole, perhaps, to the *raphides* of plant-cells; in which case we have another point of resemblance between *Amœba* and the latter.

Fat-globules (Pl. III. fig. 1 *k*).—I would apply this term to certain yellowish, semiopake, refractive spherules, which appear in considerable number in the sarcode of *Amœba princeps,* and perhaps, more or less, in all the freshwater Rhizopoda. They have always seemed to me much less prominent in appearance in *A. princeps* than the "granules," although frequently exceeding many of the latter in size; but their sphericity, yellowish colour, and semiopacity sufficiently distinguish them from the "granules."

They have also always appeared to me largest and most numerous where the *Amœba* has been most robust; and hence I am inclined to infer that they are analogous to the fat-globules of the plant-cell, more especially to those which occur about the green bands of *Spirogyra* just previous to conjugation of the filaments and spore-formation, evidencing an accumulation here of nutritious matter for this purpose. And I think that I have observed them to be most numerous in *A. princeps* just about the time of the development of the reproductive cells, which will presently be described.

Here then, again, would appear to be another point of alliance with the plant-cell, viz. the presence of these "fat-globules," although not more here perhaps than with any other cell.

Digestive spaces.—Of these I need state no more than that the diaphane of *A. princeps* seizes the nutritious body, whether living or dead, animal or plant, of its own kind or different, surrounds it and encloses it, with a portion of water, within its substance, and then *apparently* opening a way for it into the sarcode, finally transfers it to this organ, where it appears, surrounded by the water taken in with it, in a spherical form, undergoes digestion so far as it admits, and leaves the egesta to be cast off by the diaphane in much the same way (only inverted) as they were incepted.

One point here is remarkable, viz. that while any part in front of the villous or posterior end may enclose a particle of food, it is only, so far as my observation extends (and in this I am confirmed by Dr. Wallich*), the posterior extremity which gives passage to the egesta.

This is the grand difference between *Amœba* and the plant-cell, viz. the inception of crude food, and the evacuation of the egesta.

I would also add another observation here, viz. that the presence of the fragment of food does not necessarily involve the evident presence of a digestive space round it; for frequently the particle appears to be in direct contact with the sarcode. In our comparing, then, *Æthalium* (which always, until just before fructification, does contain particles of foreign and apparently nutritive matter) with *Amœba*, it is not against the similitude that the former should not have any digestive spaces around the particles of foreign matter which it contains, as this does not prove that these foreign particles are not really serving as nutriment. I have not only constantly seen microscopic fragments of what appeared to me to be the nutritious parts of woody structure in the general mass of *Æthalium*, but on pricking its rhizopodous processes, and obtaining the protoplasmic contents, which immediately burst forth and assume a coagulated globular shape, have found the same, when carefully transferred to the field of a microscope, to contain the particles of foreign matter to which I have above alluded. I, therefore, can come to no other reasonable conclusion than that they were taken in by the *Æthalium* for nutrition, as much as the fragments of nutritious matter which are incepted by *Amœba*,—a point which, if satisfactorily proved, entitles the Myxogastres, more than anything else, to claim for themselves the name of "Mycetozoa," which, as already stated, has been proposed for them by M. A. de Bary.

Observations.—Having now described the sarcode and its proper contents, viz. the moleculæ, granules, fat-globules, and digestive spaces, we will defer the vesicula and nucleus for after-

* Ann. Nat. Hist. vol. xi. p. 436 (1863).

consideration, while, for a short time, our attention is directed to the peculiar function of the sarcode and its motion in connexion with that of the diaphane, and also to the theories that have been adduced to account for the wonderful phenomena which they present.

Of the "peculiar and particular function" of the sarcode there can be no doubt, viz. that of digestion; for we may watch this, from the inception of the food, through its being broken down by the solvent process, to the ejection of the refuse. But, by analogy, it would appear to have another function; else why should its rotatory motion go on unceasingly, like that of the protoplasm of the plant-cell, to wit, in *Nitella*, where it is not called upon to exercise the function of digestion? The other function, then, that I would attribute to the sarcode is that of aëration or respiration. In *Æthalium*, the rapidity with which the sarcode and its contents continually rush round the interior of the massive portions, as well as through the minutest arborescent branches, is astonishing; nor does it cease for a moment, under ordinary circumstances, until all is prepared for the last change of form, viz. that for fructification, when life is about to become extinct from everything but the bits of protoplasm wrapt up in the little sporidia, for the future perpetuation of the species. Such is also the case with *A. princeps*, although there are certain short intervals of cessation which take place, *ex. gr.* when this Rhizopod is much disturbed; and it is worthy of notice that the movement in the sarcode at these times does not commence until the diaphane has also commenced to transform the *Amœba*.

As regards the composition of the diaphane and sarcode, Max Schultze some time ago put forward the theory that they were composed of protoplasmic nucleated cells, which, coalescing on the surface, formed the transparent diaphane, but gradually retained more of their cellular individuality inwardly, where they formed the sarcode; so that, in short, the diaphane and sarcode thus pass into each other *.

On the other hand, Reichert, whose observations here are confined to the Foraminiferous Rhizopods, is of opinion that the diaphane or pseudopodia are composed of extremely minute filaments which do *not* coalesce, but, from their plasticity and transparency, adhere to each other with such mutual adaptation that their individual forms cannot be distinguished under circumstances of combination, while they always retain their primitive form under separation †.

* Ann. Nat. Hist. vol. vii. p. 318 (1861); translated from Wiegmann's Archiv, 1860, p. 287.

† Ann. Nat. Hist. vol. x. p. 403 *et seq.* (1862); translated from the 'Monatsbericht der Akad. der Wissenschaften zu Berlin,' 1862, p. 406.

Lastly, Dr. Wallich, in his late interesting and indefatigable study of *A. villosa,* thinks that the diaphane and the sarcode are mutually transformable into each other, as the occasion may require*.

Now, the worst of theories is, that they take up so much time in discussion before they bring out fact; while the best of them is, when multiple, that they prove that the fact is still unknown.

I shall therefore not enter further upon these speculations, as the reader can best form his own opinions of them by reference to the papers which contain them *in extenso,* and will only add, on this subject, that, as the diaphane is formed from the sarcode, it seems to me probable that the former has a distinct structure as well as office, and that, having been produced, it is not reconvertible into any other organ by any process but digestive assimilation. Thus, the leg of a *Plœsconia* has comparatively as much form and as many functions as a crab-claw; but it must not be assumed, because it is as transparent and apparently as structureless as glass, that it is composed of a structureless jelly-like substance which can be made to assume any form and take on any function that the animal chooses,—on the contrary, that it has structure and form, which the microscope, with all its optical powers and chemical tests, cannot at present define—that such structure and form is so inconceivably delicate, and its particles held together with such slight tenacity that, as a bunch of iron-filings kept in apposition by a temporary magnet falls to pieces when the galvanic circle is broken, so does the leg of *Plœsconia* undergo the same kind of disintegration, viz. *diffluence,* when its vitality is withdrawn—and that there is no returning of this leg to the original plasma with which it was formed, except by its destruction and re-assimilation. I, of course, assume that the leg of *Plœsconia* bears the same relation to *Plœsconia* that the pseudopod of the diaphane and pellicula bears to *Amœba,* viz. that it is merely a modified form of the external covering—the one permanent, the other transitory.

Again, there is another point here, with reference to the motion of sarcode, which it would be well to notice, viz. the source from which the rotatory motion is derived. It has already been stated that this motion stops with the cessation of the motion of the diaphane, and *vice versâ.* Is it possible that the sarcode is rolled round by some peculiar undulating movement of the diaphane, after the manner that the uneven wavy surface of the protoplasm in the cell of *Nitella* causes a rotatory movement of the axial fluid? I confess that at present I do not see anything

* Ann. Nat. Hist. vol. xi. p. 370 (1863).

to prove that the sarcode moves round by itself, unless we assume that its analogue the protoplasm of the plant-cell (ex. gr. in *Nitella*) possesses this property; and, bearing on this point, M. Garreau observes:—"In proportion as the merithalli [internodal cells] are developed, this matter [the rotating protoplasm] gets fixed to the primordial membrane, in the formation of which, indeed, it takes part, and which, though adherent to the cell-wall, propels onward the enclosed liquid of the cell, not, as has been suspected, by the aid of vibratile cilia, but by tolerably rapid undulations, similar to those produced on the surface of water ruffled by a gentle breeze"*. The primordial membrane supports the chlorophyll-cells in the internode, and retains them in their fixed position; but when the contents of the internode collapse under injury or death, this membrane leaves the internal surface of the cell-wall, here as well as in the root-cell, where there are no chlorophyll-cells—showing that it is still organized, and analogously placed to the diaphane in *Amœba*. I confess that M. Garreau's meaning is a little obscure here, *i. e.* as to whether by the "liquid of the cell" is meant the "axial fluid" or a remaining rotatory portion of the protoplasm. But his allusion to an undulatory power of a fixed membrane of the cell is distinct. How far his interpretation in this respect pertains to fact remains for future observation to determine.

Such, in conclusion, however, are our difficulties in the right appreciation of physical signs when we come down to this region of organized life, that, unless we can state in a few words the facts which we may wish to establish, it is useless to have recourse to long argumentative theories for this purpose.

In *Æthalium*, although of far greater tenuity than in *Amœba*, and therefore more nearly allied to the protoplasm of the plant-cell, there is still a homogeneous superficial layer corresponding to the diaphane.

Vesicula or *Contracting Vesicle* (Pl. III. fig. 1 *b*).—The normal number in *A. princeps* is one; but there are many smaller ones which act as sinuses around it, and one of these occasionally becomes so enlarged as to look like a second vesicula, yet it also ultimately discharges its contents into the main one. Where the vesicula discharges itself, it again recommences to appear; and there, also, the accessory sinuses may be best seen as they successively become dilated and discharge their contents into the vesicula.

It is a remarkable fact, that although the vesicula is borne round the interior of *A. princeps* with the sarcode to which it

* Ann. Nat. Hist. vol. x. p. 116; translated from 'Ann. des Sc. Nat.' tom. xiii. 1860, p. 189.

belongs, it only discharges itself in the neighbourhood of the villous or posterior end; and such is the case also with the egesta of the digestive spaces; so that one might almost infer that there was a particular aperture through the diaphane and pellicula at this part of the *Amœba* for this special purpose, as we see in most of the other Protozoa, where the vesicula is stationary, and frequently fixed close to the anal aperture.

Towards death the vesicula, growing weak, is not easily refilled, nor do the small sinuses which surround it readily discharge their contents into it; so that by a little pressure, when the group is at the margin, they may be made to pass out into the water without bursting; and at this time, if iodine be applied, each may be seen to retain its cell-form, puckered and tinted yellow by the iodine, although they may be all quite isolated and separated from the rest of the sarcode and from each other (figs. 10 & 11). Again, the fact of the dilatation of the vesicula always taking place at the point where it contracted, and the presence of condensed sarcode round the point of contraction, manifested under the effect of iodine, induce me directly and analogically to consider the vesicula as much a distinct organ in *Amœba princeps* as in other Infusoria. And if the vesicula be distinct, why not the sinuses?

All these dilatations are considered by my friend Dr. Wallich to be extemporized vacuoles. But I am glad to observe that he supports me in the opinion that the vesicula, at all events here, discharges its contents *externally**.

In *Æthalium* the vesicula, although present in the youngest forms, does not appear in the more matured and larger masses, so far as my observation extends.

Nucleus (Pl. III. fig. 3 *b*).—The nucleus in *A. princeps*, as before stated, differs in appearance from that of all the other freshwater Rhizopoda that I have examined, in the absence of a pellucid area round the nucleolus; and this arises, as before stated, from the border of the latter extending so much over the inner surface of the nuclear cell as to pass beyond its equatorial line, where it terminates in an undulating margin, which thus leaves a transparent, irregular area. At least, this is distinctly visible when the *Amœba* is not more than the $\frac{1}{450}$th part of an inch in diameter, viz. the minimum size above mentioned (figs. 3 & 3 *d*, &c.). Whether the nucleolus, before this, is circular and presents the usual pellucid area around it, or not, I do not pretend to determine, but I think it very likely; and then this state and the smallness of the *Amœba* would preclude all possibility of specific distinction: hence I do not think that there is any necessity for us to concern ourselves about the appearance

* *Loc. cit.* p. 441.

of the nucleus in *A. princeps* before it arrives at the size just mentioned.

At this period the nucleus is not larger than a human blood-globule, and the consistence of the nucleolus apparently homogeneous, that is, without granules, and composed of a fine delicate yellowish film of semitransparent plasma, in which state it continues, with the exception of increasing in bulk, up to the time when the *Amœba* has attained about one-tenth of the adult or maximum size, that is, about $\frac{1}{250}$th of an inch long (fig. 3, &c.).

The nucleus at this time may be about $\frac{1}{1200}$th of an inch in diameter; but it now undergoes duplicative division, which ends in the production of *two* nuclei of the same description as the original one, but each $\frac{1}{1800}$th of an inch in diameter (fig. 3 *b* & *f*), after which, subduplicative division appears to go on, until the *Amœba*, in its adult condition and size, may contain upwards of seventy of the kind of cells thus produced.

At the commencement, the division of the daughter nuclei does not appear to be always simultaneous; so that there may be two of $\frac{1}{1800}$th of an inch in diameter present, and one of twice this size, or six of $\frac{1}{1800}$th of an inch in diameter, and one of twice that size (fig. 5 *c*), indicating that the sum, if the large one had been divided, would have been a multiple by two. But however regular this may be at the commencement, as the numbers increase the sums do not agree. Thus I have distinctly counted upwards of 64 but much below 80, and above 32 but not exceeding 45 (figs. 1 & 4): hence the number of these cells present is not always a multiple of two. Still, whatever may be the cause of this, their diameter is, for the most part, constant, viz. the $\frac{1}{1800}$th part of an inch; being as often perhaps slightly elliptical as spherical, they may thus exceed this a little in the long axis; while their number corresponds with the size of the *Amœba*.

At first they are so delicate, and their capsule so undeveloped, that they present the appearance of cells composed of nothing but a fine, delicate, semitransparent, homogeneous plasma (fig. 1 *e*, & *l, m, n*); but as they grow older, this becomes granuliferous; and towards the adult state, there is a distinct capsule, from which (on dying) the granuliferous plasma withdraws itself into an elliptical form (fig. 4 *d*). All this may be more satisfactorily demonstrated by the addition of iodine, which gives the granuliferous plasma a deep amber tint; and I think, in some instances, I have seen it produce a violet one in the capsule, which otherwise remains transparent, uncoloured, and uncollapsed.

On no occasion have I been able to detect a nucleus in these cells, or anything like a germinal vesicle at any period of their existence—perhaps because it has eluded my search.

They roll round the interior of the *Amœba* with the sarcode in which they are suspended; and of course, when present, there is no nucleus to be seen with them (fig. 1). But, as they become matured, the *Amœba* grows slower and slower in its movements, until at last it becomes stationary (fig. 4). The pseudopodous prolongations are then only forced through the pellicula here and there, in a transparent, attenuated state (fig. 4 *c c*), the pellicula is thickened and corrugated, the rotatory motion of the sarcode has nearly ceased, and hardly any food remains in the interior; so that the parent *Amœba* is almost reduced to an effete capsule of reproductive cells. Beyond this point of development I have not been able to follow it, because, when the pseudopodous expansions of the diaphane cease, which is the next step, there is little to distinguish the mass from any other Infusorium in a similar condition.

But I presume, as I have before shown in *A. verrucosa*, &c., that the parent after this becomes wholly effete, and that these cells sooner or later become hatched into as many new *Amœbæ*.

Whether each cell yields one *Amœba* only, or whether the granules become enlarged into polymorphic ciliated cells which ultimately pass into *Amœbæ* respectively, but of smaller size, or whether some of these cells yield one only, and others a group of new *Amœbæ*, is left for future observation to determine. Both ways of propagation are common to the Rhizopoda; but all that I can do here is to show that the largest of our *Amœbæ* produces reproductive cells like the rest, and very similar to those of *Æthalium*.

Two kinds of "spherical corpuscles," also, have been noticed by Dr. Wallich in his *Amœba villosa*, viz. one termed "nucleated," $\frac{1}{3300}$th to $\frac{1}{1600}$th of an inch in diameter, colourless, without capsule, and consisting of a cell of "pale, nearly colourless, granular protoplasm," and the other termed "sarcoblasts," $\frac{1}{2000}$th to $\frac{1}{1650}$th of an inch in diameter, faint yellow, oily-looking at first, then colourless, also without capsule, but "distinctly granular and nearly homogeneous throughout"*.

Dr. Wallich also observed the ejection from *A. villosa* of minute young ones, $\frac{1}{2500}$th to $\frac{1}{1000}$th of an inch in diameter, with all the characters of the parent, even to the "villous tuft"†.

Can the former be the same with the "reproductive cells," &c.

* Ann. Nat. Hist. *l. c.* p. 435, pl. 10. figs. 5 & 6.
† *Ibid.* p. 442, pl. 10. fig. 10.

(fig. 1 *c, d*), which I have described? and could the latter have been some of these cells which had passed into young *Amœbæ* in the body of the parent?

Granulation of the Nucleus (Pl. III. fig. 2).—We come now to what is probably a granular propagative change taking place in the nucleus, without subdivision into the reproductive cells just described.

This change commences a little before the *Amœba* has arrived at half the adult size, and when the nucleus is about $\frac{1}{1800}$th of an inch in diameter. After this, the nucleus increases in bulk, as the granulation which is taking place in the nucleolus becomes more and more coarse and evident, until, towards the adult size above mentioned, it obtains an oval and apparently flattened form, about $\frac{1}{500}$th of an inch long (fig. 2 *f*). The capsule or nuclear cell has now become much thicker, and the granules of the nucleolus, which are spherical bodies composed of yellowish, semiopake, refractive matter, about $\frac{1}{14000}$th of an inch in diameter; but the *Amœba* at this period is as active as in any former part of its existence.

Of the ultimate development here also I am ignorant, but presume that here too the parent membranes become effete, and that the nucleus, bursting, gives freedom to the granules of the nucleolus, in the form of so many polymorphic ciliated cells, which, as in other similar cases, lose their cilia, and finally become reptant young *Amœbæ*.

Spermatozoids.—Lastly we come to this element; and although the act of generation, where there is a combination of the protoplasm of different cells, seems only to be the dividing up of the contents of one cell into smaller portions than that of the other, that the former may be added to the latter after the manner that increments of matter are added to a balance to make up a certain weight or quantity, still it is necessary for us not only to have this unequal division of the protoplasm into separate living organisms, but to see that they bear certain signs which distinguish the ovum and the spermatozoid, and then, if possible, that the two combine, before we be satisfied that such elements are for propagation by this process.

Now, as yet I have never seen (to my knowledge) either one or the other in *A. princeps*. I could perceive no germinal vesicle nor anything like a nucleus in the cells formed by the division of the nucleus; and I do not know what the form or course of the granules of the granulated nucleus may be in *their* ultimate development, or of the granuliferous cells which are seen among the reproductive ones (fig. 1 *d*). But I did see bodies for which I am not able to account, viz.:—

1st. Several granuliferous cells which were with the reproductive cells, but smaller in size. In two or three instances, but not constantly (fig. 1 *d*).

2nd. A single large transparent cell with small granulated nucleus, together with, but much larger than, the reproductive cells. Also not constant (fig. 1 *e*).

3rd. A single cell (containing an effete nucleus and several short bacillar filaments) a little larger than the reproductive cells, but present with them. Only seen in one instance. This looked more like an oscillatorial development inside the cell than one of spermatozoids (fig. 9).

4th. Lastly, I may mention here a spherule like the "fat-globule," which is occasionally discharged from the posterior extremity, and after exit, bursting, shows a distinct capsule, the contents of which separate into a group of minute, swarming molecules, which for some time adhere to the tail of the *Amœba*, and at last gradually, one by one, disappear (fig. 2 *e*).

But when we consider that *Amœba* takes in such a variety of organisms for food, it is evident that we should require in addition to have bodies which have distinct and persistent characters, occurring in the *Amœba* almost constantly, to determine those which do and those which do not form a part of the living animal. Therefore I only record the above observations for what they may be worth, and to show how far I have been able to go in the matter of spermatic development in *A. princeps*.

Villous appendage (Pl. III. fig. 1 *f*).—The villous appendage which marks the posterior end of *A. princeps* has lately been brought into notice by Dr. Wallich, in the species for which he has proposed the designation of "*villosa*"*.

This appendage is figured in my Indian Journal as far back as 1854, also many times since, as before stated, and consists of a number of minute villi, forming a cap-like tuft upon the posterior end of the *Amœba*. In one instance it appears as if it were composed of several long or large villi covered with smaller ones, thus forming as many tufts as there were large villi (fig. 5 *d*). Occasionally these tubular or villous extensions of the ectosarc are dilated into cellular forms, and then they give the posterior end of the *Amœba* a crenulated aspect (fig. 2 *d*), while at other times (although this is but seldom) there is little or no trace of them. They are present in the youngest (fig. 3′) as well as in the oldest active periods of the *Amœba's* life, and appear to be always accompanied by finger-like projections of the endosarc into them. When iodine is applied, they spread out into an even edge, like that of the rest of the *Amœba*. As Dr. Wallich has stated, they appear to have a rootlike or prehensile use. *Hydra viridis* has a tubular structure extending

* Annals, *loc. cit.*

from the endosarc to the external surface of the posterior extremity, to which the villi in *Amœba* may be analogous.

I am not quite certain that they are peculiar to *A. princeps*, although Dr. Wallich permits me to state that he now thinks his *A. villosa* is one and the same with *A. princeps*. Still I have a drawing of an *Amœba* which has them, but does not appear to have the characteristic form of the nucleus of *A. princeps*. If they are confined to *A. princeps*, then they form a good distinguishing feature for this species; but, as I have before stated, they are not always present under the same form, and sometimes not at all.

Instinct.—Low in the scale of organized beings as the Rhizopoda may be considered, there are manifestations of instinct occasionally evinced by them, of the same kind as those in the highest animals. Even *Æthalium* will confine itself to the water of the watch-glass in which it may be placed when away from the sawdust or chips of wood among which it has been living; but if the watch-glass be placed upon the sawdust, it will very soon make its way over the side of the watch-glass and get to it.

Here it should be premised that I regard all organic operations, even the development of the brain itself, as instinctive —that is, produced by the instinct originating in the protoplasm of the primordial germ from which each species may be respectively derived after impregnation. Nay, before, back to the finding of the ovules by their respective spermatozoids, I regard every act of this kind as much an operation of instinct as the building of a bird's nest, or the finding its way back for many miles direct by an animal, to a place from which it has never before been removed, viz. a power which exists before as well as after mind, and is only known by its manifestations.

Thus it is not wonderful that in the Rhizopoda such manifestations should present themselves; but as others may be inclined to call this "automatic," or to interpret them differently, I shall not go further into this matter now than to submit the following facts for consideration:—

On one occasion, while investigating the nature of some large, transparent, spore-like, elliptical cells (fungal?) whose protoplasm was rotating while it was at the same time charged with triangular grains of starch, I observed some actinophorous Rhizopods creeping about them, which had similarly shaped grains of starch in their interior; and having determined the nature of these grains in both by the addition of iodine, I cleansed the glasses and placed under the microscope a new portion of the sediment from the basin containing these cells and Actinophryans for further examination, when I observed that one of the spore-like cells had become ruptured, and that a portion of its protoplasm, charged with the triangular starch-grains, was slightly protruded through the crevice. It then struck me that the Actinophryans had obtained their starch-grains from this source; and while looking at the ruptured cell, an *Actinophrys* made its appearance, and creeping round the cell, at last arrived at the crevice, from which it extracted one of the grains of starch mentioned, and then crept off to a good distance. Presently, however, it returned to the same cell; and although there were now no more starch-grains protruding, the *Actinophrys* managed again to extract one from the interior, through the crevice. All this was repeated several times, showing that the *Actinophrys* instinctively knew that these were nutritious grains and that they were contained in this cell, and that, although each time after incepting a grain it went away to some distance, it knew how to find its way back to the cell again which furnished this nutriment. Fig. 6 is a sketch of this, taken at the time, and here reproduced to make the fact more intelligible and impressive.

On another occasion, I saw an *Actinophrys* station itself close to a ripe spore-cell of *Pythium*, which was situated upon a filament of *Spirogyra crassa*; and as the young ciliated monadic germs issued forth, one after another, from the dehiscent spore-cell, the *Actinophrys* remained by it and caught every one of them, even to the last, when it retired to another part of the field, as if instinctively conscious that there was nothing more to be got at the old place (fig. 7).

But by far the greatest feat of this kind that ever presented itself to me was the catching of a young *Acineta* by an old sluggish *Amœba*, as the former left its parent; and this took place as follows:—

In the evening of the 2nd of June, 1858, in Bombay, while looking through a microscope at some *Euglenæ*, &c., which had been placed aside for examination in a watch-glass, my eye fell upon a stalked and fixed triangular *Acineta* (*A. mystacina*?), around which an *Amœba* was creeping and lingering, as they do when they are in quest of food. But knowing the antipathy that the *Amœbæ*, like almost every other infusorium, have to the tentacles of the *Acinetæ*, I concluded that the *Amœba* was not encouraging an appetite for its whiskered companion, when I was surprised to find that it crept up the stem of the *Acineta* and wound itself round its body. This mark of affection, too much like that frequently evinced at the other end of the scale, even where there is mind for its control, did not remain long without interpretation. There was a young *Acineta*, tender, and without poisonous tentacles (for they are not developed at birth), just ready to make its exit from the parent—an exit which takes place so quickly, and is followed by such rapid, bounding movements of the now ciliated young *Acineta,* that who would venture to say, *à priori,* that a dull, heavy, sluggish *Amœba* could catch such an agile little thing? But the *Amœbæ* are as unerring and unrelaxing in their grasp as they are unrelenting in their cruel inceptions of the living and the dead, when they serve them for nutrition; and thus the *Amœba,* placing itself round the ovarian aperture of the *Acineta,* received the young one, nurse-like, in its fatal lap, incepted it, descended from the parent, and crept off. Being unable to conceive at the time that this was such an act of atrocity on the part of the *Amœba* as the sequel disclosed, and thinking that the young *Acineta* might yet escape, or pass into some other form in the body of its host, I watched the *Amœba* for some time afterwards, until the tale ended by the young *Acineta* becoming divided into two parts, and thus in their respective digestive spaces ultimately becoming broken down and digested (fig. 8, &c.).

A little liberty has been taken in the verbal description of this act to lessen the tediousness of the account; but the facts remain the same, and evince an amount of instinct and determination of purpose which could hardly have been anticipated in a being so low in the scale of organic development as *Amœba.*

Observations.—On comparing the assumed reproductive cells of *Amœba princeps* with those of *Æthalium,* there is the difference that, while in the former they are confined to a few, all of the same size, in the latter they are innumerable and of all kinds of sizes. In the former, again, each cell probably produces but one *Amœba* (although it is true that the granulated protoplasm may produce as many as there are granules in each reproductive cell), while in the latter there is a rapid endogenous development of nuclei and nucleated cells within cells. In adult *Amœba* the reproductive cells are comparatively few and distinct, while in *Æthalium* they form a confused mass, as regards number, size, and contents, which is hurrying on, fungus-like, to the production of an infinitude of sporidia. The apparent absence of a nucleus in the reproductive cells of *A. princeps* (while it is present in all those of *Æthalium*) probably arose from my not having been able to detect it. I can hardly conceive that these cells can be without a nucleus.

Ultimately, the semifluid mass of *Æthalium* gathers itself up together like that of *A. princeps;* its membranes become effete, and, the endogenous cell-development having gone on to its full extent, the parent cells are congregated and dried up together, while their reproductive granules, on passing into the state of sporidia, secrete a hard capsule around themselves respectively, which ultimately becomes of a dark brown colour.

In other forms of the Myxogastres, the mother cells shoot up from the surface of the semifluid mass into pin-head or elongated-capitulated forms, approximated or isolated, of great beauty, where, as in *Diachæa* and *Stemonitis*, there are a central stem and arborescent, reticulated, filamentous branch-works respectively, and in *Trichia* even *elaters*. So that the ultimate development of the Myxogastres, however much it may resemble that of *Amœba* at the commencement, is much more allied to plants in the termination.

The varied outward forms of most exquisite beauty, and the brilliant colours, to say nothing of the intricacy of the internal structure, of the Myxogastres (all developed, as they are, from a repulsive-looking slime at the beginning, but, in its polymorphic power, creeping in long lines, or ramifying in an arborescent anastomosing network, ever changing its shape, and everywhere presenting a rapid circulation of its internal contents, isthmusing itself in one part to disunion, and uniting itself in approaching branches in another, through which the incessant flow of granules takes place directly, as though it had been the work of time and trouble rather than produced faster, almost, than the eye can follow the union), make this group of beings, to whatever class they may ultimately be shown to belong, at once one of the most wonderful and the most exquisitely beautiful on the face of the earth. If any one would rightly understand the behaviour of the protoplasm of the plant-cell in all its varied and perplexing movements, he will find the key in the study of *Æthalium*.

Like, however, as *Æthalium* may be to plants in its ultimate development, its sporidium, as M. A. de Bary has shown, splits and gives exit to a mono- or diplo-ciliated polymorphic cell, with contracting vesicle and nucleus, which ultimately losing its cilia, becomes reptant, and, in this condition, cannot be distinguished from a common *Amœba*; and these small *Amœbæ* again grow into larger ones, which, it may be fairly assumed, finally form masses of slimy *Æthalium*, that may attain many inches in diameter, and reach even a foot in length, before their cell-development is completed and their maturity sufficiently advanced for them to gather themselves up into a cake-like, effete mass filled with the chambers (cells) of sporidia to which I have already alluded—living atoms of the old being, left for the multiplication and perpetuation of the species.

Thus, although *Æthalium* is an animal in the first part of its existence, it, through *Diachæa*, *Stemonitis* &c., and *Trichia* (which, as just stated, produces *elaters* among its sporidia), is thus more nearly allied in the structures of its fructification to the vegetable kingdom.

Forming a still narrower link between the freshwater Rhizopoda and the Myxogastres, are those beings which prey upon the contents of both animal and vegetable cells (viz. protoplasm, fat, and starch), but most noticed because perhaps most evident in the bodies of the Protozoa and in the cells of Algæ.

I showed, many years since, that a mass of rhizopodous (commonly called fungous) cells lived and grew habitually *in* the circulating protoplasm of the cells of Characeæ (in Bombay*), and therefore could only have existed there by nutrition indirectly brought to them through the plant-cell in which they were living; but that the moment anything happened to destroy the vitality of the plant-cell, then they instantly divided the cell-contents among themselves, each enclosing, like an *Amœba*, as much as it could catch; after which, each cell or individual, assuming a spherical or globular form, encapsuled itself, abstracted the nutritious part of the enclosed plant-cell-contents in an inner cell, withdrew its thus enriched protoplasm from the refuse, and, again, forming a third cell, ultimately produced in this (from a granulation of the nucleus ?) a number of mono- and diplo-ciliated polymorphic cells, which, some time after, issuing from the effete parent cells into the water, lost their cilia, and became small reptant amœbous Rhizopods.

Again, in *Spirogyra crassa* I have described an actinophorous Rhizopod which breeds, after the same manner, in the cells of this confervoid Alga at Bombay †. And during the month of April last (1863), I witnessed a similar development in the cells of the same Alga in England; but in this instance the product was purely amœbous, that is, without actinophryan rays. For these species Pringsheim has proposed the generic name of "*Pythium*;" but whether either of those just mentioned is his *P. entophytum* I will not stop to discuss. Be this as it may, they both put forth filamentous root-like prolongations (fig. 7 *b*), so much like *Mucor stolonifera*, Corda, and the mycelium of Fungi, that they are in this respect just as nearly allied to Fungi as the Myxogastres in their way; and yet here there is no doubt that the new brood is produced from nutriment incepted in a crude state, like that of *Amœba*.

Lastly, *Achlya* is so closely allied to *Pythium* that it has been placed by Pringsheim in the same family, while Cienkowski "has confirmed the idea formerly entertained," that *Achlya* is but an aquatic form of *Mucor* ‡.

Now, about two years since, I noticed, among the dark pin-

* Ann. Nat. Hist., vol. xvii. p. 101 (1856).
† *Ibid.*, vol. xix. p. 259 (1857).
‡ Micrographic Dictionary, Griffith and Henfrey.

head fructification of *Mucor stolonifera*, that there were some colourless heads which had not the usual round form, but, on the contrary, were spear-pointed; and when placed under the microscope, it was evident that the mass was composed of a number of spherical cells, which, for want of the usual common capsule, had, by gravitation, descended the stem, and had thus caused the capitulum (peridiole) to present the shape mentioned. After this, on watching the mass, which was in water under a slip of thin glass, I saw that each cell took on the form of an *Amœba*, and in a short space of time the whole bunch were creeping away in different directions, and the entirety of the capitulum had thus become destroyed.

Furthermore, I observed that when the stems or the filaments of the mycelium of this *Mucor* were cut across and pressed under water, their contents issued forth in the form of spherical, plastic, nucleated cells, which, although so delicate that, by the imbibition of water, they soon burst and disappeared, yet retained their form sufficiently long for me to observe in them a certain amount of polymorphism, which, together with their size, bore a close resemblance to the cells which composed the imperfectly formed peridiole. Thus the whole tubular filamentous skeleton of *Mucor* would appear, as in other instances, to be formed upon a group of polymorphic cells. I shall not go into the detail of the formation of the reproductive cells of *Mucor* and *Achlya*. Suffice it to say that in the former the peridiole or capitulum is filled with brown capsuled sporidia, like those of *Æthalium*, while in *Achlya* it is filled with mono- or diplo-ciliated polymorphic cells, which in their primary form are spherical, like those of *Pythium* (fig. 7 *d*).

But each of these forms of *Mucor* has a filamentous mycelium, with the stems (columellæ) of their fructificating heads (peridioles) divided by septa into distinct cells; while *Pythium* has just the same kind of filamentous mycelium, with (when it fructifies under this form) a dilatation at the end of the bunch of root-like filaments into a spore-cell (analogous to the peridiole of *Mucor*), which produces a number of monadic cells like those of *Achlya* (fig. 7).

I do not know what changes the reproductive cells of *Mucor* or *Achlya* may undergo in the first part of their life, but I should think that they were like those of *Pythium* and *Æthalium*, which have been above described.

Thus *Pythium* produces, then, a fungous mycelium, like *Mucor* and *Achlya*, and at the same time that the latter are identical, all three only differ from *Æthalium* and the Myxogastres generally in their internal contents (viz. cells) growing, after a certain period, under a cellulose (?) coat, instead of nakedly, which causes the former to present a plant- or fungus-like constant figure, which, in the Myxogastres, is continually varying up to the moment that they end in a rapid consolidation of their fructifying ingredients. So in *Mucor*, the germinating cells of the peridiole rapidly pass from a colourless plastic form into a hard, dry, dark brown capsuled one; while in *Achlya*, or the aquatic form of *Mucor*, the capsule is colourless, and so evanescent that the young are put forth from the peridiole almost viviparously. It is easy, therefore, to see here why the germs of the aërial form are wrapt up in a dense capsule, while those of the aquatic one do not need any.

But I am straying away from the point, although, from what I have above stated, it will now, I think, be satisfactorily seen that *Æthalium*, for the greater part of its life, lives like *Amœba*, and that, although there may be a little difficulty in proving that the foreign particles seen in the great masses of *Æthalium* have been taken in for food, still *Pythium*, which has a kind of mycelium and is thus intimately allied to *Achlya* (which, again, is but an aquatic development of *Mucor*), does undoubtedly take in crude material for food identically with *Amœba*.

Whether the Myxogastres are entitled to the new name of "Mycetozoa" (proposed for them by M. A. de Bary) under these circumstances, or not, I leave others to determine. There are no absolute lines of demarcation here more than anywhere else, and therefore common sense, aided by progressive knowledge, must be appealed to for decision also here as well as elsewhere.

Although not immediately bearing on the subject, I would just revert to the statement I have made respecting the light which the study of *Æthalium* throws on the behaviour of the protoplasm of the plant-cell; for there is yet another point to be considered, viz. how does the protoplasm obtain an external communication so as to produce materials which are found *outside* the cell-wall and keep up a communication alone with the *external* world, as in the unicellular Algæ, or when in combination with other cells, as in the plant? This important question seems to receive solution from M. Garreau's observations, who states that there are filaments of the protoplasm which pass from the primordial membrane through holes in the cell-wall*; and if this be confirmed, it will lead to such a chain of explanations in the development and habits of the vegetable cell, separate and in combination, as has for some time past been unparalleled by any other similar discovery.

* Ann. Nat. Hist. vol. x. p. 43 (1862); translated from Ann. des Sc. Nat. 1860.

EXPLANATION OF PLATE III.

N.B.—All the figures in this plate are diagrammatic, in so far as it is impossible to give the relative sizes of the different parts of which they are composed, intelligibly, without enlarging them to an extent which would be incompatible with the size of the plates in the 'Annals;' nor is it necessary.

In all the figures of *Amœba*, the ground-shading stands for the sarcode and its moleculæ, while the other specks and dots represent the granules and fat-globules respectively.

Fig. 1. *Amœba princeps*, about $\frac{1}{60}$th of an inch in length, with somewhat less breadth; greatly magnified: *a*, the granules and fat-globules; *b*, vesicula or contracting vesicle; *c*, reproductive cells, upwards of 32, and all $\frac{1}{1800}$th of an inch in diameter; *d*, smaller granuliferous cells; *e*, large globular transparent cell, $\frac{1}{900}$th of an inch in diameter, with small granuliferous nucleus; *f*, villous tail; *g*, *h*, *i*, forms of the granules, the largest about $\frac{1}{2000}$th of an inch long; *g*, aggregated octahedral form; *h*, ditto, still more compound (composed of oxalate of lime?); *i*, elliptical or earlier form of granule; *k*, fat-globules; *l*, *m*, *n*, assumed reproductive cells, more magnified; *l*, oval form; *m*, spherical ditto, both without distinct capsule and without granules; *n*, ditto, under the effect of iodine, showing minute granules, but no capsule.

Fig. 2. Ditto, about $\frac{1}{70}$th of an inch long, representing the "granulation of the nucleus": *a*, the granules; *b*, vesicula; *c*, nucleus, $\frac{1}{700}$th of an inch in diameter, capsular, with nucleolus granulated; *d*, villi of tail, dilated into a vesicular form, giving a crenulated aspect to this part; *e*, spherule, like a fat-globule, occasionally discharged from the tail, and afterwards bursting, when the capsule remains, and the contents appear under the form of a group of swarming little molecules, which adhere for some time to the end of the *Amœba*; *f*, nucleus, of an oval form, $\frac{1}{500}$th of an inch long, more advanced in granulation and from a larger and older specimen of *A. princeps*; granules spherical, and about $\frac{1}{1400}$th of an inch in diameter.

Fig. 3. Ditto, about $\frac{1}{250}$th of an inch long, showing—*a*, vesicula; *b*, nucleus divided into two; *c*, villous tail; *d*, nucleus, much magnified, about $\frac{1}{1200}$th of an inch in diameter, showing its characteristic appearance in *A. princeps*; *e*, transparent area left by the nucleolus; *f*, daughter nuclei, the result of the first division.

Fig. 3′. Ditto, very small specimen, about $\frac{1}{450}$th of an inch long: *a*, vesicula and villous tail; *b*, nucleus.

Fig. 4. Ditto, nearly effete, $\frac{1}{25}$th of an inch in diameter, containing upwards of 74 reproductive cells, each $\frac{1}{1800}$th of an inch in diameter, now consisting of coarsely granular protoplasm within a firm capsule: *a*, granules; *b*, reproductive cells; *c c*, expansions of the diaphane bursting through the thickened pellicula; *d*, reproductive cell, more magnified, under the influence of iodine, showing oval contracted shape of granular protoplasm and spherical cell.

Fig. 5. Ditto, showing—*a*, vesicula; *b*, reproductive cells, among which *c* represents one as yet undivided, which, after division, would make up the number 8; *d*, peculiar form of villous tail; *e*, *Furcularia* biting the *Amœba*. This sketch, as it stands, was made at Bombay, in 1855.

Fig. 6. Fungus(?)-cell, $\frac{1}{400}$th of an inch long, transparent, oval, sometimes subpolymorphic, containing protoplasm (charged with triangular starch-grains) in rotation; *b, Actinophrys* extracting the starch-grains.—Of this extraordinary cell, which was found annually in great abundance, among aquatic plants and Infusoria, in a pool in the island of Bombay, which is dry eight months in the year, I hope to publish much more on a future occasion.

Fig. 7. Spore-cell of *Pythium,* on the outer side of the cell-wall of *Spirogyra*: *a,* spore-cell, containing reproductive, polymorphic, ciliated cells; *b,* root-like part of cell (analogous to the mycelium of *Fungi*) *in* the cell of *Spirogyra*; *c,* cell-wall of *Spirogyra*; *d,* reproductive cell, or polymorphic monad, which has left the spore-cell, on its way to being captured by the *Actinophrys* (*e*), in which there are already three such. Sketch made at Bombay, in 1856.

Fig. 8. *Acineta* (*mystacina*?), surrounded by an *Amœba* while in the act of putting forth its young one: *a,* old *Acineta*; *a',* its nucleus; *b,* young one; *c, Amœba* waiting for the young *Acineta*; *d, Amœba* after having caught the young *Acineta* (*e*); *f,* ditto, one hour and a half afterwards; *g* shows the young *Acineta* divided into two portions, and now being digested in separate spaces. Sketch made at Bombay in 1856.

Fig. 9. Cell, $\frac{1}{1200}$th of an inch in diameter, containing effete nucleus and short bacilliform filaments.

Fig. 10. Isolated cells of the vesicula or contracting-vesicle system immediately after having been pressed out from *Amœba princeps.*

Fig. 11. The same, after exposure to iodine, showing that they retain their cell-wall, which then becomes crenulated.

V.—*On the Raphides of Rubiaceæ.* By George Gulliver, F.R.S., Professor of Anatomy and Physiology to the Royal College of Surgeons.

In the 'Annals' for January last it was mentioned that raphides occur in all the species which I had then examined of this order. Through the courtesy of Mr. W. H. Baxter, who has supplied me with species of *Rubia,* I am now enabled to complete the series, as far as regards the British plants of the order. *Rubia peregrina* and *R. tinctorum* abound in raphides.

Certain orders, as Onagraceæ and Lemnaceæ, may be so readily distinguished from some of their allies by the raphides alone, that even a minute fragment of the plant, either fresh or dried, may be sufficient for the diagnosis, as was shown in the 'Annals' for April last; and now the order Rubiaceæ affords an additional illustration, the value of which may be easily tested as follows. In Professor Babington's excellent 'Manual of Botany,' we find this order, which we have just seen affording raphides, standing between Caprifoliaceæ and Valerianaceæ, two orders which we have found to be equally remarkable as devoid of raphides.

The raphides here meant are the needle-like forms occurring, for the most part in bundles, in the cellular tissue of young, healthy, and growing parts of the plant, particularly in the leaves. There are orders, especially among Monocotyledones, in which the distribution of raphides is very irregular, as might have been inferred from the few observations in the 'Annals' for last January, p. 15. Thus, the first two orders, Trilliaceæ and Dioscoreaceæ, abound in raphides, which are not found in any of our plants of the next order, Hydrocharidaceæ, and yet appear again abundantly in the succeeding order, Orchidaceæ. In Iridaceæ there are long crystals, not like those in the preceding orders just named, but thicker and apparently prismatic in form, and occurring singly instead of in bundles. The orders immediately following, namely, Amaryllidaceæ, Asparagaceæ, and Liliaceæ, abound, again, in true raphides, which are generally, if not regularly, absent from Juncaceæ, Potamogetonaceæ, Cyperaceæ, and Gramineæ. Many instances also occur of some species abounding in, and others devoid of, raphides, in one order, as is the case in Liliaceæ. Hence it would appear that the existing knowledge of the distribution of raphides must be vague, seeing that it is stated, in our latest and best repository of the minute anatomy of plants, the 'Micrographic Dictionary,' that raphides are abundant in Monocotyledones generally. But it is proposed to treat of this subject more particularly in another communication.

The statement in the same Dictionary, that "there are few of the higher plants which do not contain raphides," is entirely at variance with my observations. But perhaps it may be intended in that book to include any kind of crystals, even if resulting from decay or decomposition of the tissues. I found no true raphides in the leaves of the few species examined of such orders, too numerous now to detail, but among which were Ranunculaceæ, Papaveraceæ, Fumariaceæ, Cruciferæ, Violaceæ, Caryophyllaceæ, and Umbelliferæ. Let any one, for instance, compare the abundance of these raphides in the vigorous young leaf-cells of Onagraceæ with the total absence of such raphides in the same part of Lythraceæ and Haloragaceæ, and the difference will be immediately apparent. The varieties of *Fuchsia* and the equally common *Cuphea platycentra*, which are plants at hand even in the humblest collections, will answer this purpose, as well as our native species of the two orders, and afford instructive examples of the facts in question. I have lately found raphide-bearing plants thus characterized in the seed-leaves; so that *Œnothera* and *Epilobium* may be distinguished from their allies of other orders, by raphides alone, even in that rudimentary state of growth!

Edenbridge, June 15, 1863.

VI.—*On two Oceanic Species of Protozoans related to the Sponges.* By James D. Dana*.

The *Sphærozoum* figured below (fig. 1 *a*) was collected by the writer in the Pacific, near latitude 30° N. and longitude 178° W., during a calm, on the 26th of May, 1841.

Fig. 1 *a* represents the gelatinous globule of natural size. The ocean's waters were filled with this species and another represented in fig. 2 *a*. The minute dots covering the globule, one of which is magnified in fig. 1 *b*, were closely crowded, as shown in fig. 1 *a*. In this respect the species differs widely

Fig. 1.

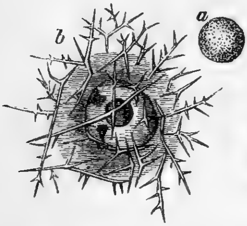
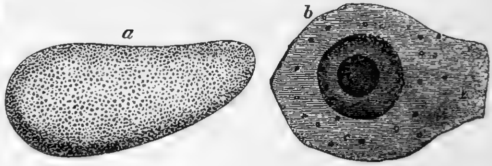


Fig. 2.



from the figure of a species by T. H. Huxley in the 'Annals and Magazine of Natural History,' viii. 433, pl. 16; and as it hence appears to be distinct, the writer has named it *Sphærozoum orientale.* About the dots, or ocelliform spots (zooids), the spicules (supposed to be siliceous) were very numerous and much branched, as in fig. 1 *b*. The general mass had an exceedingly faint bluish tinge; the centre circle of the ocelliform spots was of the same tint, while the ring around was of a very faint ochreous shade. The globules represented on the ocelliform spots in fig. 1 *b* were yellow.

The other species (fig. 2 *a*) had the same general colour, and similar ocelliform spots as to form, colour, and numbers, without the spicules. Figure 2 *b* represents one of the ocelliform spots; the dots in the surrounding mass correspond to minute yellow globules or cells. This species is included with the *Sphærozoum* under the genus *Thalassicolla* of Huxley. This name has been since restricted to Huxley's *T. nucleata,* and the name *Collosphæra* applied to forms much like fig. 2, by Müller. The mass was less firm to the touch than that of the preceding. A fuller examination of this and the related species is required to decide whether the one here figured is new or not.

Both of the species had the power of motion by a movement like expansion and contraction, and also the power of sinking and rising at will in the water. No external opening could be distinguished.

* From the American Journal of Science and Arts, May 1863.

As the species are probably related to the Sponges, as suggested by Huxley, they have considerable interest, and especially the *Sphærozoa*, which, like most Sponges, seem to have the power of secreting silica. The extent to which the ocean, over an area of many square leagues, was crowded with them, suggests that such floating Sponges may have been, in past time, of geological importance as one of the sources of silica for the flint or hornstone and siliceous petrifactions of ancient limestones and other rocks.

These species received from the author but a partial study, as those of another class (oceanic Crustaceans) were engaging his attention at the time. The above figures and descriptions are from coloured drawings made on the spot, and from the notes accompanying them.

VII.—*On the Animals of* Raphaulus, Spiraculum, *and other tube-bearing Cyclostomacea.* By William T. Blanford, A.R.S.M., F.G.S.

No one can have examined carefully a collection of the operculated land-shells of India and South-eastern Asia without remarking the peculiar shelly processes of the peristome or suture which characterize several of the genera. Two principal forms of these processes may be distinguished, viz. (1) sutural tubes, either open at both ends or closed at one extremity, as in the genera *Raphaulus, Spiraculum, Opisthoporus, Alycæus*, &c.; or, (2) incisions in the peristome—simple, as in *Pupina, Registoma*, &c., or accompanied by expansions of the outer lip, as in *Pterocyclos* and *Rhiostoma.* So far as I am aware, no soft parts have hitherto been observed, in the animals of any of the above genera, corresponding to the peculiarities of their shelly coverings. During the past two or three years, I have examined carefully the animals of species belonging to the majority of the above-named forms; and in two instances I have ascertained the existence of an organization to which the processes of the shell are adapted, these two cases being in the genera *Raphaulus* and *Spiraculum*, which, although by no means nearly allied, agree in possessing a sutural tube opening both internally and externally.

By the kindness of Baron F. v. Richthofen, I had, some time since, an opportunity of examining the animals of several specimens of the rare *Raphaulus chrysalis*, Pfr., from Moulmein in Burma. The sutural tube in this species opens internally, a short distance from the peristome, by a small longitudinal slit, and then passes outside the suture to the aperture, where it is deflected upwards, and runs vertically for 2 or 3 millimetres on the exterior of the penultimate whorl, opening to the air at the extremity. I found this tube to be partly lined by a perforated process of the mantle, communicating internally, by means of a passage beneath the shell-muscle, with a very small orifice inside the air-chamber in the neck of the animal, and thus affording free access of the air to the pulmonary cavity, even when the mouth of the shell is hermetically closed by the operculum. The existence of this conformation cannot easily be observed during life*, on account of the manner in which the mantle lines the interior of the shell; but after killing the animal in hot water, and extracting it from the shell, the little free perforated process is distinctly seen, and is then about 2 millim. in length, its dimensions having been, doubtless, much contracted by the hot water.

The genus *Spiraculum* of Pearson was established upon the species *S. hispidum*, P. By Dr. Pfeiffer that species has been referred to *Pterocyclos*, to which it is certainly nearly allied, although there appear to be good reasons for its generic separation. I have never had an opportunity of examining the animal of *S. hispidum*; but in the autumn of 1861 I met with a second species of the same genus in the neighbourhood of Ava (*S. avanum*, mihi). This species is furnished with a small tube similar to that in *S. hispidum*, opening at both ends, internally inside the body-whorl, close to the suture and at a short distance behind the peristome, and externally into the air, the short tube on the exterior of the whorl being free and curved backwards. The individual which I examined was just adult; there was no tubular process of the animal, but it was replaced by a deep notch in the mantle corresponding to the perforation of the shell. It is possible that, in older specimens, this notch may become altered into a more or less perfect tube; but, as the specimen examined was full-grown, this is scarcely probable.

The other tube-bearing genera with open tubes are *Streptaulus*, which can scarcely be considered as generically distinct from *Raphaulus*, and *Opisthoporus*. I have not been able to examine the animals of either of these. The tube in the aberrant genus *Alycæus* opens anteriorly into the body-whorl by a longitudinal slit, as in the other genera; but after running back along the exterior of the suture for a greater or less distance, corresponding with the inflated portion of the last whorl, it is closed at the posterior termination. I have seen the soft parts of several species, including the comparatively large *A. umbonalis*, Bens.,

* This is doubtless the reason that the tubular process of the mantle was overlooked by so careful an observer as Mr. Benson, who, I believe, confined his observations to the living animal. (See Ann. & Mag. Nat. Hist. ser. 3. vol. iv. p. 94.)

but have been unable to detect any organization corresponding to the shelly tube.

It was long since observed by Mr. Benson that no portion of the animal of *Pterocyclos* appeared to correspond with the peculiar incision of the inner, and cowl-shaped process or wing of the outer, peristome. I have examined two or three species* of that genus with precisely the same result. Amongst the Pupinidæ, I have examined the animals of a variety of *Pupina artata,* Bens., and of *Hybocystis gravida,* B., but I could detect no trace of any process similar to that in *Raphaulus.*

The question of the use of these peculiar tubes in several genera of Indian Cyclostomacea, and the reason of their existence in only a few forms belonging to two different families (Cyclophoridæ and Pupinidæ) and by no means closely allied, has always appeared to me of considerable interest. The first and most natural suggestion which would occur to any one is that the tubes in question serve to supply the animal with air when the mouth of the shell is closed by the operculum. But, natural as this explanation seems, and despite its apparent confirmation by the discovery of the perforated process in the animal of *Raphaulus,* as described above, a very short consideration will show the difficulty of accepting it. For if additional means of breathing during æstivation are essential to *Raphaulus* and *Spiraculum,* how do forms so closely allied to them as *Pupina* and *Pterocyclos* contrive to exist without them? And this is the more inexplicable because there are modifications of the shelly portions of those genera which apparently represent the sutural tubes of *Raphaulus* and *Spiraculum,* the close relation of perforations in the body-whorl and slits in the peristome being shown by such genera as *Scissurella, Haliotis,* and *Stomatia, Fissurella* and *Emarginula,* &c. Above all, what explanation can be adopted for the tube in *Alycæus,* perforated throughout its length, but closed at its posterior termination?

It is extremely probable that there is a connexion between the existence of the sutural tubes in the land-shells mentioned and the well-known siphon of *Ampullaria,* which genus, from its habit of æstivating in the dried mud of tanks, and its power of living for months without water, may almost be considered as an amphibious mollusk, and which approaches the Cyclostomacea most closely in the form of the animal. Another siphon-bearing species is *Camptonyx,* Bens., allied to *Otina,* which is by most conchologists classed with the amphibious Auriculaceæ, and I have recently obtained in Western India another generic type

* Amongst others, *Pterocyclos pullatus,* Bens., from Pegu, *P. nanus,* B., from the Nilgiris, and a species (a variety, perhaps, of *P. Albersi,* Pfr.) from Arrakan.

similarly furnished. It is closely affined to *Camptonyx*, being intermediate between that genus and *Succinea*. The two last-named shells æstivate attached to rocks. I am inclined to think it possible that links yet remain to be discovered between all the siphon- and tube-bearing genera, in which the peculiar organization, common under various modifications to all of them, is more clearly adapted to the animal's mode of existence than in the cases mentioned. It is extremely probable that such links may have existed and have become extinct. We can on this hypothesis easily conceive that their living representatives or, on the theory of Darwin, their modified descendents possess the organization, in a more or less perfect condition, which was essential to their predecessors, but is no longer equally necessary to their own existence, and that, in short, the various apertural slits and imperforate tubes of *Pterocyclos, Pupina, Alycæus*, &c., must be regarded in the same light as rudimentary organs. By this hypothesis, also, we can understand the appearance of the more perfect conditions for communication between the atmosphere and the lung-chamber of the animal in widely separated forms, while others closely allied to each of them are more or less deficient in all traces of a similar organization, and the occurrence of a gradual passage from tube-bearing genera to others totally destitute of any modification of the peristome or suture is perfectly natural. The tube of *Spiraculum* becomes an incision in the peristome in *Pterocyclos*, the Burmese forms of which are closely allied to species of *Cyclophorus* like *C. calyx*, Bens., which have a thickened operculum and a minute rudimentary wing-shaped projection of the outer lip, close to the suture; and from these forms, again, there is a passage to discoid species, like *C. stenostomus*, Sow., with perfect peristomes. In the same way we may pass from *Raphaulus*, through *Pupinella* and *Pupina*, to *Registoma*, and finally to *Callia*, and through *Cataulus* to *Megalomastoma*. To the subject of the affinities of these various genera, however, and especially of the aberrant *Alycæus*, I hope to refer in a future communication.

Bombay, May 1863.

BIBLIOGRAPHICAL NOTICES.

A List of the Birds of Europe. By Professor J. H. Blasius. Reprinted from the German, with the author's Corrections. Norwich: Matchett & Stevenson. London: Trübner & Co. 1862.

Professor J. H. Blasius, of Brunswick, is well known to the scientific world as one of our very highest authorities on European Vertebrates. His Manual of the Mammals of Central Europe is certainly the best of modern works on this subject; and the second volume of the same series, in which he proposes to treat of the Birds, has long been anxiously expected by naturalists who devote their attention to this class of animals. It is, we presume, a *résumé* of the species, as arranged in this forthcoming work, that Prof. Blasius has lately printed in Germany "for his private use." In the present 'List,' therefore, which has been "reprinted from the German original," and specially amended by the author for the English edition, we have the arrangement likely to be followed in Prof. Blasius's long-expected volume.

So many changes take place every year in the nomenclature and arrangement of Birds, even of those that are found in the circumscribed area of Europe, that a new list of species is from time to time very necessary to the naturalist. We are, therefore, much indebted to Mr. Alfred Newton for supplying this convenient and well-arranged Catalogue, which, there is little doubt, will fulfil the translator's expectations of being "of service to those who are interested in the study of European ornithology." The total number of *species* "breeding in or regularly visiting Europe," as recognized in Prof. Blasius's present list, is 420. Those which have only "strayed in accidentally, and have for the most part been observed but once," are inserted in their proper places in the list, but are distinguished by their names being printed in italics, and by bracketed numbers. This category includes 103 species, raising the total number of authentic *species* (according to Prof. Blasius's views of that much-disputed term) which occur within the limits of Europe to 523. Besides these, Prof. Blasius enumerates 55 "varieties commonly considered as species," and amongst these we observe are located the British forms *Motacilla Yarrellii, Budytes flaveolus, Tetrao scoticus,* &c., which Prof. Blasius considers inseparable specifically from their Continental prototypes *Motacilla alba, Budytes flava,* and *Tetrao albus,* &c. Ornithologists may or may not agree with Prof. Blasius in these views, but it is quite certain that the differences which separate these nearly allied forms are not equal in amount to those that are found between species (such as *Turdus musicus* and *Turdus viscivorus*) universally recognized as distinct, and that the judgment of so great an authority as Prof. Blasius on the subject must be received with respect. Finally, the species that have been asserted to occur in Europe, "on doubtful authority," are included in the catalogue, with notes of interrogation appended, and a reference is given to the works wherein they are noticed as having been obtained within its limits. In this part of the list only Mr. Newton has introduced some additional matter, by adding, for the information of his fellow-countrymen, a few references, "chiefly relating to rarer captures in England."

On the whole, we may state that, in spite of certain peculiarities in the nomenclature (with which we cannot agree), we consider this to be the most complete and most satisfactory of all the lists of the Birds of Europe hitherto published.

Flora of Edinburgh ; being a List of Plants found in the Vicinity of Edinburgh. By J. H. Balfour, Professor of Botany. 12mo. Edinburgh : A. & C. Black. 1863.

Flora of Marlborough : with Notices of the Birds and a Sketch of the Geological Features of the Neighbourhood. By the Rev. T. A. Preston. 12mo. London : Van Voorst. 1863.

These two little books are published with a very similar object: they propose to assist the student in his search after plants,—in one case, the students of the University of Edinburgh, in the other the boys at the great school called Marlborough College. It is curious to remark that the schoolmaster aims at a higher standard when writing for his boys than the Professor when providing a book for his University students. Are we to deduce from this an idea of the relative mental attainments possessed by the two classes? We should be ashamed to make such a deduction. What, then, is the cause of the Professor giving us simply a list of plants, without any of the additional matter now expected from local floras, not even telling us in which counties his localities are placed; and the schoolmaster following the example set by our best modern local floras in all the respects admissible by the circumstances of his district? We make no attempt to answer the question.

Dr. Balfour's radius of twenty miles round Edinburgh traverses a rich country, offering much variety of soil and situation. He should have given a sketch of its geology, surface, and meteorology; and might well have divided it into several districts, and attempted a complete flora of each.

Mr. Preston has obtained from a friend an interesting outline of the geology of his area, has divided a circular space of six miles radius from Marlborough into four districts, and endeavoured to work out the botany of each. He has produced a book far more likely to be valuable to his readers than that of Dr. Balfour to the students of his class; for Mr. Preston's book is by much the more likely of the two to direct attention to matter other than the simple names of the plants. Doubtless, to the mere collector, each will prove of use, and fulfil their objects; and we hope that we may look upon the Flora of Edinburgh as the forerunner of a more elaborate and scientific work from the pen of its excellent and learned author.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 19, 1863.—Major-General Sabine, President, in the Chair.

"On Peculiar Appearances exhibited by Blood-corpuscles under the influence of Solutions of Magenta and Tannin." By William Roberts, M.D., Physician to the Manchester Royal Infirmary.

The object of the following paper is to give an account of certain observations which seem to indicate that the cell-wall of the vertebrate blood-disk does not possess the simplicity of structure usually attributed to it.

It is well known that the blood-corpuscles, when floating in their own serum, or after having been treated with acetic acid or water, appear to be furnished with perfectly plain envelopes, composed of a simple homogeneous membrane, without distinction of parts. But, as will appear from the observations here to be related, when the blood is treated with a solution of magenta (nitrate of rosaniline) or with a dilute solution of tannin, the corpuscles present changes which seem irreconcilable with such a supposition.

Attention is first asked to the effects of magenta. When a speck of human blood was placed on a glass slide and mixed with a drop of a watery solution of magenta*, the following changes were observed. The blood-disks speedily lost their natural opacity and yellow colour; they became perfectly transparent, and assumed a faint rose-colour; they also expanded sensibly, and lost their biconcave figure. In addition, a dark-red speck made its appearance on some portion of their periphery. The pale corpuscles took the colour much more strongly than the red; and their nuclei were displayed with great clearness, dyed of a magnificent carbuncle-red. Many of the nuclei were seen in the process of division, more or less advanced; and in some cells the partition had resulted in the production of two, three, or even four distinct secondary nuclei.

These appearances were first observed in freshly-drawn blood from the finger. Subsequently blood from the horse, pig, ox, sheep, deer, camel, cat, rabbit, and kangaroo was examined in like manner. The effect on the red corpuscles (to which all the observations hereinafter recorded are exclusively confined) was in each instance the same as in human blood.

The nucleated blood-disks of the oviparous classes, when treated similarly, yielded analogous results. The coloured contents were forthwith discharged; the central nucleus came fully into view, and assumed a deep-red colour; the corpuscles expanded, they lost something of their oval form, and approached nearly, or sometimes quite, to a circular outline. Lastly, there appeared on the periphery a dark-red macula, of a character and position resembling that seen on the mammalian blood-disk. Such a macula was detected in the fowl, in the frog, and in the dace and minnow.

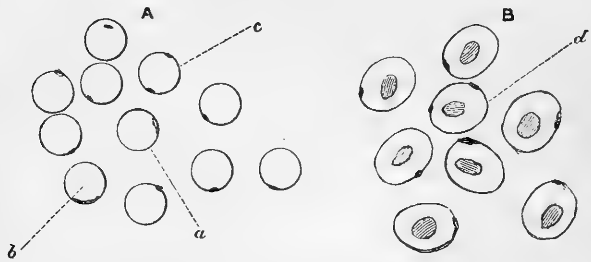
Owing, however, to the large quantity of molecular matter floating in the serum, and which was coloured by the magenta, difficulties were found in preparing specimens which carried conviction that the macula in question was not an adhering granule. It was also found that it required a nice adjustment of the relative quantities of the solution and of the blood to bring it out. It was only when the right proportions were hit, and especially when the disks were made to roll over in the field of the microscope, that the existence of a

* The solution I found to answer best in these experiments was a nearly saturated solution of nitrate of rosaniline, made by boiling the salt in water, and filtering after it had stood twenty-four hours, then diluting slightly with water to prevent precipitation.

coloured particle organically connected with the cell-wall could be satisfactorily made out. The best specimens were prepared from human blood drawn in the fasting-condition, and from the blood of a kitten two days old.

From well-prepared specimens of human blood the following particulars were gathered (see fig. 1, A) :—Nearly every disk possessed the parietal macula ; it could be distinctly recognized in nine-tenths of them ; and in several of those in which it was not at first visible, it came into view as the corpuscles revolved in the field.

Fig. 1.



A. Human blood ; B. Fowl's blood, treated with magenta.

The macula was clearly situated in the cell-wall, and not in the interior of the corpuscle. Usually it appeared as if imbedded or set in the rim of the disk, like the jewel in a diamond ring ; but sometimes it occupied various positions on the flat surfaces, and when so placed, the spot was difficult or impossible to detect.

It commonly presented a thickly lenticular shape ; sometimes it was square, and occasionally in appearance vesicular (fig. 1, A, *a*). In some instances, and especially in long-kept specimens, the particle was seen to stand out on the outline of the disk like an excrescence. Still more rarely, instead of a spot, a thick red line ran round the circumference for a quarter or a third of its extent (fig. 1, A, *b*).

As a rule it was extremely minute, covering generally not more than a twentieth or thirtieth of the circumference ; but there was a considerable variation in its magnitude and distinctness. Very rarely two specks could be seen ; but the occurrence of adhering granules rendered the verification of this point extremely difficult.

This description applies, so far as the inquiry has yet been prosecuted, to the mammalian blood-disk generally, making allowances for differences in size. In the camel the macula occupied indifferently any part of the oval outline.

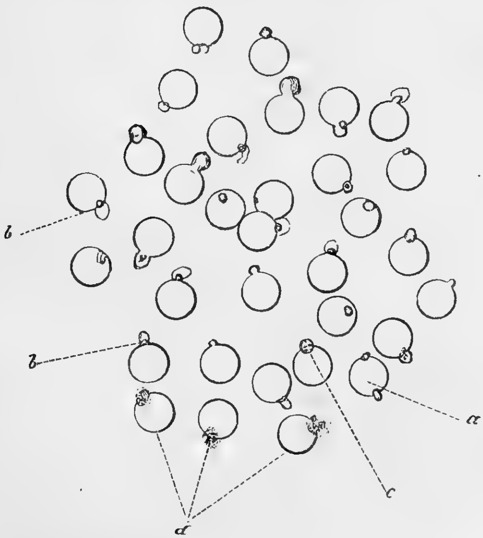
Among the oviparous classes, the blood of the fowl, frog, dace, and minnow has been most fully examined (see fig. 1, B) ; but the blood of the sparrow, duck, goose, and turkey was also searched, as well as that of the newt and carp.

In all of these a tinted particle appeared, more or less constantly, in the cell-wall, when the corpuscles were treated with magenta*. The presence of a central nucleus in these classes caused the macula to be invisible more frequently than in mammalia, inasmuch as it suffered eclipse when situated over or under the central nucleus.

In the fowl, dace, and minnow it was found easy to bring out the parietal macula; in the fish two spots were not unfrequently seen. The macula was situated indifferently on any part of the periphery; and sometimes it projected from the surface. When happily prepared, the specimens were even beautiful. The central nucleus was dyed of the finest red; and on the delicate outline of the cell-wall hung the red parietal macula, offering a not altogether fanciful resemblance to the astronomical figures representing the moon coursing in its orbit round the earth.

At this stage of the inquiry it was conceived that an improved demonstration might be obtained by fixing the dye with a mordant, and then subjecting the corpuscles to a lavatory process, so as to get rid of the floating granules which so much interfered with the view. For this purpose a solution of tannin (which is one of the mordants for magenta used in the arts) was employed; and some advantage

Fig. 2.



Human blood after the action of tannin.
a. Double pullulation.
b, *b*. Hooded modification.
c. Outline of the cell seen continuously through the pullulation.
d. Bursting of the pullulations independently of destruction of the cell.

* In order to bring out the best results, it was found requisite to modify the strength and quantity of the solution for the different kinds of blood. This doubtless depended upon the varying densities of the liquor sanguinis and cell-contents in different animals.

was found therein. When a solution of tannin, of 3 grains to the ounce of water, was added to blood that had already been dyed with magenta, it was found that the parietal maculæ had their colour intensified, and that they became more conspicuous objects. The investigation was, however, not pushed any further in this direction, for it was found that tannin alone produced an even more remarkable effect than magenta. To this effect I now desire to draw particular attention.

When a solution of tannin, of the strength of 3 grains to the ounce, was applied to human blood, or to that of the horse, ox, sheep, pig, or cat, the blood immediately became turbid; and when a drop was placed under the microscope the corpuscles were found greatly changed, as represented in fig. 2.

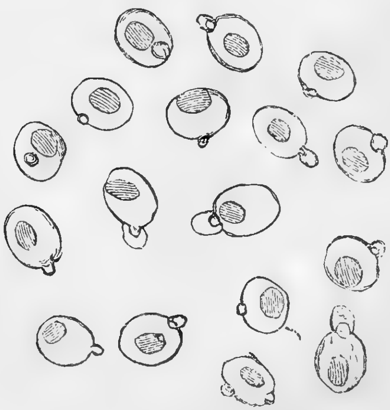
Each corpuscle appeared to have thrown out a bright, highly refractive bud or projection on its surface. The projections were usually about a fourth part of the size of the corpuscle on which they were fixed; but they varied considerably. Some were only minute bright specks in the cell-wall; others were half or even two-thirds as large as the corpuscle itself. Very rarely (in mammalian blood) two such projections were seen; and as rarely a corpuscle was devoid of any.

The projections were commonly round or dome-shaped, bordered by a deeply refractive outline. Frequently a minute, apparently vesicular body could be seen within this outline; and then the projection presented a curiously hooded aspect (fig. 2, *b*, *b*). In a urinary deposit from a lad twelve years of age, containing pus and blood, nearly every blood-disk presented the hooded appearance after the addition of tannin.

The blood of the fowl, turkey, duck, and goose showed exactly analogous phenomena with the same reagent (see fig. 3).

The projection had sometimes the hooded character with a vesi-

Fig. 3.



Blood of fowl after the action of tannin.

cular body within ; sometimes the projection offered no such distinction of parts. It was situated indifferently on any part of the periphery. In all the birds examined a second projection was as rare as in mammalia.

Of fish, the dace, minnow, and carp were examined. The tannin-solution produced a similar effect to that seen in the fowl—with this difference, that a large number of corpuscles had two projections instead of one. In the carp, double and single projections occurred in about equal proportions ; in the minnow, double projections were all but universal. The second projection was situated sometimes at the opposite pole of the disk, sometimes in near proximity to its fellow, or at any point between. Very rarely, a third projection was seen in the dace.

In the blood of the frog there was a strong tendency to the indefinite multiplication of the projections ; two, three, four, and even five would rise in succession on the surface of the disk. It appeared, too, not unfrequently as if the entire outer membrane of the cell was detached from the parts beneath and raised into eight or ten unequal elevations, giving the outline of the disk an irregularly crenate appearance*.

The formation of these singular projections, or *pullulations*, on the blood-disks could be watched without difficulty by placing a drop of the tannin-solution beneath the covering glass, and permitting a little blood to insinuate itself into the solution under the microscope. As the blood flowed in and mingled with the tannin, the corpuscles were observed gradually to enlarge, and then *suddenly*, without previous warning, to shoot out the projection. As a rule, it does not appear to grow afterwards. The phenomenon was finely seen in the defibrinated blood of the fowl after it had been allowed to sink through a column of syrup (sp. gr. 1025) in a test-tube. Fowl's blood washed in this way was mixed, in a little glass, with about five times its volume of the tannin-solution, and a drop immediately put under the microscope. The disks first enlarge and become rounded, and the central nucleus comes into view. In thirty or forty seconds the pullulation begins ; and each corpuscle, with instantaneous rapidity and without previous sign, throws out its bud. The disk itself suffers not the least disturbance during this act ; it preserves its symmetry unchanged, as if it had no concern, beyond that of proximity, with the sudden apparition on its surface.

No visible rupture of the cell-wall took place. The circular outline of the latter could sometimes be distinctly followed through the projection (fig. 2, *c*) ; and as the altered corpuscles revolved in the field of the microscope, the projection appeared to be organically connected with it, but to form no part of its cavity. In the human

* There is a certain adjustment of the proportions between the tannin-solution and blood required to bring out the effects described in this paper ; but the proper proportions are, practically, very easily found after a few trials for each kind of blood. In mammalian blood, one drop of blood mixed in a conical glass with four or five of the solution generally answered perfectly. Any considerable excess of blood or solution above these proportions caused destruction of the corpuscles.

blood-disks the application of acetic acid, soon after the tannin, caused, on two occasions, the pullulations gradually to subside, and finally to disappear; and then the disk resumed its original circular outline. I failed to produce this "redux" effect in the fowl; and did not always succeed with human blood, probably because the change produced by the tannin had gone too far.

The modification noted under the term "hooded" appearance depends, I believe, upon secondary conditions of concentration and quantity of the tannin-solution in comparison to the blood. When the hooded condition has been watched in the act of occurrence, it was noticed that the outer hood was shot out *first*; and instantly after this the highly refractive vesicular body made its appearance within. The contents of the hood (excluding the vesicular body) appeared usually to refract the light like the body of the cell, or even less strongly; sometimes, however, more strongly.

The effect of tannin did not cease with the production of the elevations just described. At first the cells and their projections preserved their elasticity; but after a while (a few minutes, or several hours, according to the proportions used) the corpuscles and their projections became solid, and they could be cracked by pressure under the microscope like starch-granules. More slowly the same destruction overtook the corpuscles spontaneously; and this significant fact was observed in the course of it:—sometimes the cell ruptured before the projection, the latter persisting as a bright granule amid or near the débris; sometimes, on the other hand (in the horse), the projection broke up before the disk to which it was attached. In this latter case, the hood (if there were any) broke up first into a scattered nebula of granular appearance, and then the nucleolus-like body within burst into three or four bright fragments (fig. 2, *d*). This train of events seemed to remove all doubt as to the complete isolation of the projection from the cavity of the disk. Last of all, the disk itself began to crack; in a few days all my specimens were thus destroyed.

In addition to magenta and tannin, the following substances were tried, but they did not produce phenomena in the least analogous with the foregoing:—gallic acid, ferrocyanide of potassium, santonine, sulphate of magnesia, alcohol and water, solutions of carbolic acid, of atropine, morphia, iodine, sugar, gum, glycerine, and infusion of coffee.

A solution of picric acid produced the appearance of a parietal particle like that brought out by magenta, except that it was not coloured. An exactly similar appearance was on one occasion observed in blood-corpuscles in the urine of a patient with acute Bright's disease.

When magenta was applied after the process of pullulation had taken place, the projections were found to take the dye strongly, and especially the vesicular body within the hood. By this proceeding beautiful and remarkable objects for microscopical examination were obtained. In the fowl, dace, and minnow the projection was tinted earlier than the central nucleus—probably from its more ready access to the pigment. The explanation of these appearances presents great difficulties, and in the present state of the inquiry can only be offered provisionally.

The effect of the magenta-solution is not merely to tint, and so render visible a very minute body. In watching the effect of magenta, the first thing observed is that the natural yellowish colour of the disk is discharged, and that a faint rose-tint is assumed in its stead. The disks at the same time lose their biconcave shape. The parietal macula is rather "brought out" than revealed, and the action of the solution is, to a very great extent, of a simply osmotic character.

The action of the tannin-solution is likewise in the main of a similar nature, but modified in some very peculiar manner. Its first operation is to cause the corpuscle to enlarge by imbibition, and this goes on progressively until at length the cell is destroyed. If the solution be strong, this destruction supervenes at once. The tannin also unites with the cell-contents and coagulates them, imparting to the corpuscle, finally, a solid consistence. The conditions of the imbibition are disturbed by the previous application of magenta; for no pullulation, or at most only traces, occurs when the corpuscles are treated *first* with magenta and *then* with tannin.

The bearing of these observations on the current views respecting the structure of the vertebrate blood-disk is important. They seem to warrant the inferences drawn in the two following paragraphs:—

1. The exact identity of the appearances produced in the blood-disks of the ovipara with those observed in the mammalian corpuscles lends strong support to the view that these corpuscles are homologous as wholes; and that the mammalian blood-disk is not the homologue of the nucleus of the coloured corpuscle of the ovipara, as was conceived by Mr. Wharton Jones.

2. The observations likewise lead to the belief that the envelope of the vertebrate blood-disk is a duplicate membrane; in other words, that within the outer covering there exists an interior vesicle which encloses the coloured contents, and, in the ovipara, the nucleus.

Dr. Hensen* of Kiel had already in 1861 convinced himself, from wholly different observations, that the blood-corpuscles of the frog possess such a structure. On this view the blood-corpuscle is anatomically analogous to a vegetable cell, and the inner vesicle corresponds to the primordial utricle.

The present observations indicate, by direct proof, a duplication at only one, or at most two points in the blood-disks of mammals and birds. Nevertheless certain appearances, occasionally observed, favour the notion of a complete duplication (fig. 1, *b*).

The admission of this hypothesis, however, scarcely removes the difficulties sufficiently to permit a tenable explanation to be offered of the appearances described in this paper. Yet, as it may prove suggestive to some other inquirer, I will not suppress what appears

* Zeitschrift für wissensch., Zoologie, Band xi. p. 263.

to me the explanation least open to objections. It might be conceived that the cells enlarged by imbibition, until at length the less distensible inner membrane gave way, and permitted an extravasation of a portion of the cell-contents between it and the outer membrane, its own continuity being in the meanwhile instantaneously restored by cohesion of the ruptured borders*. In this way a microscopic drop of the cell-contents would be lodged between the outer and inner membrane, and completely severed from the general cell-cavity. The peculiar modification spoken of as the "hooded" appearance might be due to imbibition of fluid between this microscopic drop and the outer envelope.

The chief difficulties in the way of this explanation arise out of the differences of nature which appear to exist between the projection and the general cell-contents of which it is supposed to be a detached portion. The projection refracts light much more highly than the cell-contents; it also is deeply dyed by magenta, whereas the cell-contents are only very feebly so.

In conclusion, it may be added that important advantages may be expected from the use of magenta in histological researches. Its inert chemical character, its prodigious tinting power, and its solubility in water eminently fit it for such a purpose. It will probably prove of especial use in bringing into sight objects which otherwise evade the visual organs from their absolute colourlessness and transparency, and from the equality of their refraction with the medium in which they exist.

ZOOLOGICAL SOCIETY.

June 24, 1862.—E. W. H. Holdsworth, Esq., F.L.S., in the Chair.

On the Breeding of the Nutcracker (Nucifraga caryocatactes). By Alfred Newton, M.A., F.L.S., F.Z.S.

About six months ago (P. Z. S. 1861, pp. 396–7), I expressed a hope of being able before long to give the Society some more certain information with respect to the breeding of the Nutcracker (*Nucifraga caryocatactes*). In that I hope I have not been altogether disappointed.

The nest and young bird now exhibited (the latter still showing traces of its original downy clothing) have been received by me within the last few days from my excellent friend Herr Pastor P. W. Theobald of Copenhagen, to whom I think the Society will join with me in hearty congratulations on his success in obtaining these decisive facts in regard to the nidification of this mysterious bird, and whose zeal in the quest of zoological discovery fully deserves, in my opinion, all the praise that can be accorded to it.

* In the same manner as a soap-bubble when bisected, instead of collapsing, forms, in virtue of the adhesiveness and fluidity of its envelope, two new and perfect bubbles. That the cell-wall of the blood-disk possesses some such endowment seems highly probable. I have on several occasions witnessed, after adding magenta, the total extrusion of the nucleus, both in the frog and in the newt, without the least collapse of the corpuscles.

Believing, however, that the Pastor will himself publish fuller details of this interesting capture, I will only briefly recount the information with which he has supplied me.

It appears that, previously to the summer of 1860, a forester in the island of Bornholm had satisfied himself that the Nutcracker was in the habit of breeding there annually. He had seen it every month in the year from May to November inclusive; and this intelligence being communicated to Herr Theobald, that gentleman made an expedition to the island, but without finding the special object of his search—a nest of the bird. This present spring, however, the Pastor, accompanied by two of his friends, HH. Erichsen and Fischer, both keen oologists, visited Bornholm a second time; and one of their achievements I have now the pleasure of making known to you. Writing from that island, on the 30th of May last, Herr Theobald says:—

"Returning to the result of our ornithological expedition, I can tell you that, after many days' inquiries, we succeeded in finding two nests of *Caryocatactes*, the young birds flying near them. As we presumed, we came too late for getting the eggs; but I think we have advanced a good deal, and after this discovery we dare be almost sure of receiving them next year. Our gentle and clever host, the forester Rosen, who now knows the time and manner of nidification of this bird, may be considered a guarantee for our hopes.

"We have thought it might be of interest to you to possess an undoubtedly genuine nest of *Caryocatactes*, and also a young bird in the first plumage; we therefore send you one nest and one skin. Both the nests are of the same size and construction. They were in fir-trees (*Pinus rubra*), not very private, but rather easy to find. It is likely that the young birds had left the nest perhaps eight days. None of them moved, except with difficulty, among the branches; and one of them fell on the ground. The old birds cried, but only sometimes, with an anxious voice that was not unlike a Magpie's, and then all was silent again. In the neighbourhood of the nest, where the birds had been previously observed, we found on the rocky ground a good number of freshly cracked hazel-nuts; and as no nut-trees grow there, the birds must fetch them from a distance of an English mile at least. We are inclined to think that they collect them in autumn and secure them in a private spot; and perhaps it is on this account also that the bird, whose economy is very hidden, is seldom to be seen in the breeding-time.

"As I have already mentioned, the nest is not of the most difficult class to find. It is not built on the top [of the tree], but close to the stem, about 25 or 30 feet high. The bird is an early breeder, but can scarcely have eggs before the beginning of April.

"Now you have the nest wherein the young birds were lately hatched, and a young bird in its first plumage. Next year we hope to send you very well authenticated eggs."

I have only to conclude by mentioning that the nest, as will be seen on examination, is of large size, some five or six inches in thickness, with an outside diameter of about a foot, and a shallow depression of six inches across; but the cup was probably a good deal deeper before its brim was subjected to the weight of the young birds. It is composed outwardly of sticks and twigs, among which I recognize those of the larch, spruce, and birch. These latter show the period at which it must have been built, as the buds, though enlarged, had not burst. It has a thick lining of grass, which appears to have been plucked while growing. The very small bits of moss and lichen do not seem to have been intentionally added, but to have adhered to the other materials. The down with which the nestling has been covered, and of which traces may be observed on a few of the back-feathers, is of a dark-brownish grey, as is usual among the *Corvidæ*. The first plumage much resembles that of the adult, being, however, duller in colour and with the white tear-like spots less conspicuous; but the quill-feathers of the wings and tail are not so entirely destitute of metallic reflexions as some authors lead one to imagine.

Whether the Nutcracker builds the whole structure for itself, or only furnishes the forsaken nest of some other animal, I do not know. This and other particulars we shall probably soon learn from Pastor Theobald himself; and I need scarcely say I look forward with the greatest interest to the clearing up of our doubts as to what its eggs are really like.

On some points relating to the Anatomy of the Humming-bird (Trochilus colubris). By Edwards Crisp, M.D., F.Z.S., etc.

The recent dissection of the above-named bird has induced me to place an account of some parts of its anatomy before the Society, believing that the communication will not be devoid of interest.

I am indebted to Mr. Gould for the Humming-bird, which he captured in America, and brought alive to this country; but it lived only a few days after its arrival.

It had been preserved in spirits for some time before I examined it, and therefore the weight may not have been exactly the same when first captured, but I believe that the difference would be very slight. I have, in the accompanying drawing, depicted the bird with and without its skin. I have also represented the skeleton and all the viscera by measurement.

The bird (a female) weighed 61 grains; its length from beak to tail 4 inches, the bill being three-fourths of an inch, the tail 1 inch; from the extremity of each wing, when extended, $4\frac{1}{4}$ inches. Tail-feathers ten; wing-feathers in all sixteen, the first the longest.

On removing the skin, the bird, as represented in the drawing, had a very plump, solid appearance, the pectoral muscles being of very large size: they weighed 12 grains, being nearly one-fifth the weight of the bird. The extremities of the os hyoides, as in the Woodpeckers, reached the anterior part of the head. The thoracic and abdominal viscera, when viewed *in situ*, presented nothing abnormal either in form or position. I failed to discover a gall-bladder.

The brain weighed 3 grains, forming a large proportional amount to the body ($\frac{1}{20}$); the alimentary canal measured $3\frac{1}{2}$ inches.

The crop membranous and capacious; the gizzard moderately thick, with a soft cuticular lining. A small elevated spot was observed (under the microscope) on the surface of the rectum, which probably was the rudimentary appendix.

The trachea consisted of about sixty rings, and the left bronchus of forty—the latter being nearly the length of the trachea. The ovary very small. The os hyoides long and very muscular, extending, as before stated, to the space between the orbits. The tongue from the base of the os hyoides fourteen lines in length, the bifid portion being eight lines. This latter part appeared to be composed of two elastic cylinders having a membranous web on their inner sides; these webs towards their extremities, as seen in the drawing, present a shreddy, torn appearance, the torn portions being of a triangular shape, their bases towards the cylinders. These cylinders were not hollow, but composed of a solid cartilaginous material. The eyes measured two lines in diameter, and weighed about one grain.

Skeleton.—The enormous depth of the sternum in this little bird at once excites attention. The sternum is of a triangular shape, its anterior and deepest portion measuring four lines, its length $6\frac{1}{2}$ lines: the cervical vertebræ twelve, the coccygeal five, ribs seven; flat, broad, and thin. The depth of the sternum and the great proportional size of the pectoral muscles probably exceed those of any other bird, judging from the sterna of several hundred species of birds that I have inspected. The humerus very short, one line; carpus two lines; metacarpus two lines; phalanges $3\frac{1}{4}$ lines; femur two lines; tibia four lines; tarsus $1\frac{1}{2}$ line; longest toe three lines; the claws curved and sharp. *The bones of this bird did not contain air.*

Remarks.—I have been somewhat minute in the description of the measurements of the skeleton, because it is only by comparison with the skeletons of other birds that any practical and useful results can be arrived at. The shortness of the humerus is one remarkable feature; and in this respect there is a great resemblance to the same bone in the Swifts (*Cypselinæ*). It is curious that this bone in our common Swift (*Cypselus apus*), although of very small size, contains air. By some it will be thought singular that the very swift-flying bird the Humming-bird should have no air in its bones; but when we consider, as I have stated in my papers upon this subject in our 'Proceedings' (1857, pp. 9 and 215), that the bones of two of our swiftest-flying birds—the Swallow and Martin—contain no air, the absence of it in the bones of this bird will appear less remarkable. In the first paper alluded to (p. 12), I have stated that Professor Owen, in his 'Lectures on Comparative Anatomy,' vol. ii. p. 34, remarks that the Swifts and Humming-birds are said "*to have air in every bone of the skeleton, down to the phalanges of the claws.*"

I repeat this because several physiologists and lecturers on comparative anatomy still adhere to the old doctrine of the presence of air in the bones of all birds; and on asking a celebrated physiologist whether he believed that the bones of birds contained air; his reply was, "Has a bird a brain?"

Professor Owen, in the Lectures on Birds that he is now delivering at the Government School of Mines, as reported in 'The Medical Times and Gazette,' May 24, 1862, p. 537, says,—"In the swift Humming-birds and in other birds of flight, the air permeates the interior of every bone of the skeleton."

Brisson and Lesson, as quoted by Sir W. Jardine, state that "the tongue of the Humming-bird is composed of two muscular tubes, joined together for the greater part of their length, towards the tip broadened or swelling, and, according to Lesson, terminated in a spoon-like point on the upper surface. They assist in retaining the different substances, which are immediately conveyed to the opening of the œsophagus by the contractility of the tubes." Sir W. Jardine says that he has "confirmed this statement, as far as the examination of the moistened parts would allow." He adds, "Our own examination of the tongue of the *Trochilus moschitus*, relaxed with warm water, gave the appearance of a fimbriated opening at the tip, having the exterior margin of each fork set with recurved, sharp-pointed, pliable spines, as if to assist its viscidity in securing any substance seized by them."

It is possible that in the different species of *Trochilidæ* the tongue, like the beak and tail-feathers, may differ somewhat; but I believe it will be found that the cylinders are not hollow, and that the recurved spines spoken of by Sir W. Jardine are shreds of the membranous part of the tongue detached by maceration. The somewhat feather-like tongue of these birds is probably used chiefly for dipping into the nectar, and for detaching the small insects upon the flowers, the rapid motion of the organ enabling the bird to obtain a large supply of nourishment in a short time.

The examination of recent specimens will be necessary to decide the question as to the tubular character of the tongue; but there is one thing tolerably certain, viz. that the food of these birds is chiefly insects, and does not consist of the nectar of flowers only, as was formerly supposed.

Nov. 11, 1862.—Professor Huxley, F.R.S., V.P., in the Chair.

Observations on the living Aye-aye in the Zoological Gardens. By A. D. Bartlett.

The subject of the following remarks is a fine adult female of the Aye-aye (*Chiromys madagascariensis*), which arrived in this country on the 12th of August last. On the voyage, this animal produced a young one, which lived about ten days. On arriving here she was in poor condition and very feeble; she soon, however, began to feed freely, and has now considerable strength, as is shown by the timber destroyed in the cage in which she is kept.

This animal is much blacker, and appears larger, than the male of this species now in the British Museum; the long hairs on the back of the neck, extending to the lower part of the body, have white points; these white points are thickest above, and become less numerous towards the limbs and tail, which appear quite black; the hairs of the tail, however, are white or grey at the roots (this can only be observed by separating them); the chin and throat are dirty white, which colour extends over the chest; the short hairs on the face are a mixture of dirty grey and white; the long hairs are black; the eyes light brown, surrounded by dark-coloured hairs; the nose and muzzle are of a dirty flesh-colour; the lips pink; the ears, shining black, and naked, but thickly studded with small protuberances; the feet and toes are sooty black, with the under surface and claws lighter, inclining to flesh-colour. The situation of the mammæ is remarkable: they are two in number, and placed at the lowest part of the abdomen (the animal differing in this respect entirely from the Lemurs and Bats, the teats of which are on the breast).

The Aye-aye sleeps during the day; and the body is then generally curved round and lying on its side, the tail is spread out and flattened over it, so that the head and body of the animal are almost entirely covered by the tail.

It is only at night that the Aye-aye exhibits any activity. I hear her crawling about and gnawing the timber when, to me, all is perfectly dark; and I have been surprised to find that upon the introduction of a light, directed to the face of the animal, she does not exhibit any signs of uneasiness, but stretches out her arm and tries to touch the lamp with her long fingers. She frequently hangs by her hind legs, and in this position cleans and combs out her large tail, using the slender hook-like third finger with great rapidity, reminding one strongly of the movements of the large Bats (*Pteropus*). This skeleton-like finger is used with great address in cleaning her face and picking the corners of the eyes, nose, mouth, ears, and other parts of her body; during these operations the other fingers are frequently partially closed.

In feeding, the left hand only is used, although she has the full use of her right one. The mode of taking her food requires careful attention, in consequence of the very rapid movement of the hand during the process. The fourth finger (which is the longest and largest) is thrust forward into the food, the slender third finger is raised upwards and backwards above the rest, while the first finger or thumb is lowered so as to be seen below and behind the chin; in this position the hand is drawn backwards and forwards rapidly, the inner side of the fourth finger passing between the lips, the head of the animal being held sideways, thus depositing the food in the mouth at each movement; the tongue, jaws, and lips are kept in full motion all the time. Sometimes the animal will advance towards and lap from the dish like a cat, but this is unusual. I have never heard her utter any cry, or produce any vocal sound, during the many hours at night in which I have watched her habits, nor has she appeared shy or angry at my presence.

With reference to food, this creature exhibits no inclination to take any kind of insects, but feeds freely on a mixture of *milk, honey, eggs,* and any *thick, sweet, glutinous fluid,* rejecting meal-worms, grass-hoppers, the larvæ of wasps, and all similar objects. Consequently I am inclined to think that this animal is not insectivorous. Its large and powerful teeth lead me to infer that it may possibly wound trees, and cause them to discharge their juices into the cavity made by its teeth; and that upon this fluid it probably feeds. This appears to me the more likely, as I observe that our specimen returns frequently to the same spot on the tree which she had previously injured. I am also strengthened in my opinion by noticing the little attention paid by the animal to its food. It does not watch or look after it; for I have on several occasions removed the vessel containing its food during the time the animal was feeding, and the creature continued to thrust its hand forward, as before, upon the same spot—though after a while, finding no more food, she discontinued, and moved off to search for more elsewhere. This apparently stupid act is so unlike the habits of an animal intended to capture or feed on living creatures that I am inclined to believe that the Aye-aye feeds upon inanimate substances. I have frequently seen it eat a portion of the bark and wood after taking a quantity of the fluid food.

The excrement of this animal much resembles the dung of small rabbits, being in separate nearly round balls.

On a New Bird from the Island of Madagascar. By Dr. G. Hartlaub, For. Memb.

Cuculus Rochii, sp. nov. *Supra ardesiacus; gutture pallidius cinereo; pectore et abdomine in fundo albo-flavicantibus, fasciis rarioribus angustis nigricantibus; subalaribus flavescenti-albidis, tenuissime ardesiaco fasciolatis; subcaudalibus ochraceis, maculis nonnullis nigris; rectricibus nigris, maculis rarioribus minutis albis prope scapam notatis, omnium apicibus albis; ala extus unicolore, nigricante, remigum pogoniis internis albo fasciatis vel postice transversim maculatis; maxilla nigricante; mandibula flava, apice obscura; pedibus flavis.*

Long. 10–11″; rostr. a fr. 8‴; al. 5″ 11‴; caud. 5″ 7–8‴.

Syn. "*Cuculus canorus*, L., common at Madagascar," Desjardins, P. Z. S. 1832, p. 111. *C. tenuirostris*, Jules Verreaux, MS. (*olim*).

Nearly allied to certain Indian species, but in all probability distinct. In an old MS. of my friend Jules Verreaux I find an accurate description of this species, under the often misused name of *Cuculus tenuirostris*.

Named after Dr. S. Roch, who accompanied the mission sent last year by the Government of Mauritius to that of Madagascar.

Nov. 25, 1862.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

Notice of two New Species of Batagur in the Collection of the British Museum. By Dr. J. E. Gray.

Dr. Günther, who is re-examining the Indian Tortoises in the British Museum, has drawn my attention to two young specimens of the genus *Batagur*, which he believes to be different from those that I have hitherto described; and as there appears every reason to believe that they indicate species that have not hitherto been recorded in the Catalogue, I shall proceed to describe them provisionally until we receive more adult representatives of them. They both belong to the subgenus called *Kachuga*, as defined in my 'Catalogue of Shield Reptiles in the British Museum' (p. 35).

BATAGUR PICTA.

Pale grey-brown, with three interrupted dark brown streaks on the back, and a more or less triangular dark brown spot on the front margin of the marginal shields; beneath uniform pale yellow. Nuchal shield none. The first vertebral plate oblong, four-sided, rather longer than broad; the second, third, and fourth six-sided, second and third as long as broad, the fourth rather longer than broad. The margin entire, bent up behind. The pectoral and anal plate as long as broad. Head (when dry) pale olive, blackish on each side.

Hab. Borneo, Sarawak (*Wallace*).

Length 11, width 8½ inches. Not full-grown, and with large intercostal spaces on the sides, showing that this species grows to a much larger size.

BATAGUR ELLIOTI.

Young state. Pale grey-brown, one-coloured when dry; the hinder margin strongly and acutely serrated. Nuchal shield broad, short. Second, third, and fourth vertebral shields strongly keeled, and ending in an acute prominence; the first square, rather broader than long; second and third six-sided, broader than long; fourth six-sided, longer than broad. Underside uniform pale yellow. The gular plate triangular; the pectoral and anal shorter than broad. The head dusky brown; temple and beak yellow, with a blackish streak from the nostril to the orbit, and continued behind from the orbit over the tympanum.

Hab. Southern India, River Kistna (*Walter Elliot*).

The specimen is very young, with very large narrow intercostal spaces, showing that it grows to a considerable size. It is known from all the other species by its sharp dentated margin. This character may be obliterated in the adult specimens; but I am not aware that it occurs in any other young *Batagur*, and we have most of the described species in a young state. The specimen here described was procured from Mr. Warwick, the dealer, without any habitat. But Dr. Günther has shown me a drawing, which has been sent to him by my excellent friend Mr. Walter Elliot, of Wolfelee, with the above habitat attached to it, which is so like the specimen described as almost to lead to the supposition that it was made from the same individual. From the drawing we not only learn the habitat, but also that the colour of the living animal is very like that of the dry specimen.

MISCELLANEOUS.

Some Notes on Acclimatized Animals.
By Dr. J. E. Gray, F.R.S. &c.

On my making some observations on the desirableness of obtaining information with respect to the acclimatization of domestic animals in different parts of the world, and especially in our distant colonies, at the British Association Meeting at Cambridge, last year, the Committee of the Natural-History Section recommended, and the General Committee adopted the proposition, that a Committee should be formed, consisting of Dr. Sclater, Mr. Alfred Newton, Mr. Wallace, and myself, to report on the acclimatization of Domestic Quadrupeds and Birds, and how they are affected by migration.

The following circular has been prepared by Mr. Wallace, and adopted by the Committee, and is being extensively circulated, in the hope of obtaining replies which will enable the Committee to form their report on authentic information; and I can only say that I shall be most happy to receive information on any of the points which any of the readers of the 'Annals' may have the kindness to forward to me or to the other members of the Committee.

"Points of Inquiry to which the Attention of Persons resident in extra-European Countries is especially requested.

"A.—*As to Domesticated Animals which are also indigenous to the Country.*

"1. Ascertain what animals indigenous to the country are domesticated in it.

"2. What external differences exist between the wild and domesticated races?

"3. Do the domesticated intermix with the wild animals?

"4. Can perfect domestication be produced in the wild individual?—if so, in what length of time, and through what means?

"5. Do the offspring of the domesticated animals in any case show a tendency to return to the wild state?

"6. Where perfect domestication only takes place in the second or future generations, state what particulars of the progress you can ascertain.

"B.—*As to Domesticated Animals which have been introduced from other Countries.*

"7. Give a list of the domesticated animals of this class in the country.

"8. Ascertain, if possible, the date when any of these were first introduced.

"9. State, in the case of each animal, whether fresh importations are still frequently or occasionally occurring.

"10. State what external differences exist between any of these animals and those of the same species in Europe.

"11. State what differences are observable in the nature of their food, in their habits, their longevity, and their fecundity.

"12. State if any, and what, peculiar diseases occur; or, if any diseases to which they are liable in Europe are absent.

"13. State if crosses between European and native races are *more* or *less* productive than when both parents are of native race; and state what differences are observable in the offspring in the two cases.

"14. Observe what changes occur when domesticated animals from other countries are first introduced; and do these changes occur in the individuals imported, or only in their offspring?

"C.—*Special Inquiries relating to the more common Domestic Animals.*

"15. *Sheep.*—When sheep are introduced from another country, does the quality of the wool change in the individual or in the progeny? what time is required to effect the change? Is any difference perceptible in very young lambs? or at what age does it take place? are they covered with wool or hair? does the altitude of the station have any effect?

"16. *Horses.*—Do *introduced* or *native* races of horses breed most freely? are crosses between the two advantageous? do stripes or bands on the back, legs, shoulders, or faces of horses ever occur? and in all cases where such stripes occur, ascertain if the parentage is pure or mixed.

"17. *Cattle.*—Are there any truly native races of cattle in the country? do they breed freely with foreign cattle? are the hybrid offspring fertile, and capable of forming a hybrid race without any second cross with either of the parent stocks?

"18. *Dogs.*—When wild dogs occur, is there any evidence to show if they are truly indigenous species, or a race escaped from domestication? do they intermix with domesticated races? and are the offspring perfectly fertile?

"19. *Ducks and Geese.*—When an indigenous race of ducks or geese is domesticated in the country, experiments of great value on the phenomena of hybridity can be made. The point to be ascertained is whether the cross between a pure native and pure foreign breed produce offspring which are capable of propagating their kind for several generations without any further intermixture with either of the parent races. To carry out this experiment fairly, two persons should co-operate, each breeding a number of hybrids and then exchanging their males, so as to avoid breeding too closely in-and-in. This should be done at each successive generation, and the fertility and character of the offspring accurately noted. Persons with facilities for such experiments would confer a boon on natural science by carrying them out with as many different races as possible. The experiments need not be confined to ducks, though they offer many advantages, from the ease with which they may be everywhere obtained, and their greater propensity to cross than in the case of most other animals.'

British Museum, June 21, 1863.

Note on the Wombats living in the Gardens of the Zoological Society. By Dr. P. L. Sclater.

Dr. Gray does not appear to have noticed that the Wombat described by him in the last Number of the 'Annals' (p. 458) as *Phascolomys Angasii* had previously been named by Mr. Gould, in his Introduction to the 'Mammals of Australia,' *Phascolomys niger*. I may also remark that, one of the specimens of *P. lasiorhinus* in the Gardens having died, I sent the skull to Mr. Flower, who has kindly compared it with the typical skull in the collection of the Royal College of Surgeons upon which Prof. Owen founded his *P. latifrons*. Mr. Flower pronounces it quite distinct, and much more nearly resembling that of the common *P. ursinus*. It would appear, therefore, that we have yet to become acquainted with the external form of *P. latifrons*, unless it shall turn out that *P. niger*, Gould, or *P. setosus* of Dr. Gray (figured by Mr. Gould as *P. latifrons*) shall prove to possess a skull with the peculiar characters pointed out by Prof. Owen in his description of the skull of *P. latifrons*.

On the Functions of the Vessels of Plants. By M. Gris.

After referring to the different opinions held by botanists regarding the functions of the vessels, some maintaining that, although containing only air at most seasons, they are filled with sap in the spring, whilst others hold that, when once formed, they contain only air, the author indicates a means of settling the question by the use of Fehling's solution. This liquid, which is used to determine the presence of glucose, contains sulphate of copper, soda, and tartrates of soda and potash; remains limpid when boiled alone; but if a very small quantity of glucose be added to it, a red precipitate of protoxide of copper is produced; and this, when examined under the microscope, is seen to consist of small flakes of a deep brown or almost black colour. If a few drops of sap be added instead of glucose, the same precipitate of protoxide of copper is observed.

On plunging for a few moments into the boiling solution thick fragments of the wood of the chestnut, beech, poplar, laburnum, &c., at the commencement of the spring, and cutting thin sections from the heart of these fragments for examination with the microscope, it will be seen that an abundant precipitate of protoxide of copper clothes the inner face of the large vessels, so that their course through the thickness of the woody layers is indicated even to the naked eye, or with a simple lens, by very perceptible reddish threads.

As the precipitate is generally very abundant in the cells of the medullary rays, the author thinks we may conclude, from this experiment, that the so-called lymphatic vessels (at all events in spring) contain a sap of a nature closely analogous to, if not identical with, that which is found in the cellular elements of these stems, and that the precipitate of protoxide of copper is probably caused in both instances by the presence of glucose in the sap.

The author has extended his investigations to some herbaceous plants, and proposes communicating his results to the Academy of Sciences very shortly. He mentions as one of them, that the spiral fibres of the reticulated, annular and spiro-annular, and other similar vessels also present in their interior a red precipitate, formed of small flakes, of a blackish-brown colour when observed under a high power, and apparently identical with that mentioned above. This fact appears to confirm the views of M. Trécul on the structure of these fibres.—*Comptes Rendus*, June 1, 1863, p. 1048.

The Mode of Development of the Marginal Tentacles in the free Medusoids of some Hydroida. By A. Agassiz.

M. Agassiz has investigated a point hitherto neglected in the development of the medusoids, namely, the mode of appearance of their marginal tentacles. Each medusoid has really originally a limited number of tentacles, which is subsequently increased by the successive appearance of several series of new tentacles. The series of tentacles in these Acalephæ may be compared to the cycles of septa in the Zoantharian polypes; and, in fact, their order of appearance coincides in certain cases with that of the visceral chambers of the polypes, although the exceptions to this rule are very numerous. It is also to be observed that in the Zoantharia the number of chambers of the first cycle is almost always six. In the Acalephs the number of tentacles of the first series is, on the contrary, extremely variable. For a great number of genera M. Agassiz has drawn up formulæ showing the order of succession of the tentacles of different series.

Certain Acalephs are singular, such as the medusoids of some *Tubulariæ*. That of *Corymorpha pendula*, for example, has only a single tentacle of the first series. The tentacles of the second series are two in number, and placed at the extremities of a diameter perpendicular to that corresponding with the tentacle of the first series. The third series consists of a single tentacle, opposite to that of the first series.—*Proc. Boston Soc. Nat. Hist.*, August 1862; *Bibl. Univ.*, 1863; *Bull. Scient.*, p. 161.

On the Question whether Diatoms live on the Sea-bottom at great Depths. By Wm. Stimpson, M.D.

In a paper on the Diatomaceæ found in mud collected at great depths from the bottom of the sea off the coast of Kamtschatka, in soundings made by the North Pacific Expedition under Commander Rodgers (Silliman's Journal, ser. 2. vol. xxi. p. 284), the late lamented Professor Bailey made the following remark:—"The perfect condition of the organisms in these soundings, and the fact that some of them retain their soft parts, indicate that they were very recently in a living condition; but it does not follow that they were living when collected at such immense depths." My attention has recently been called to this subject by the perusal of an account of the recent discoveries of animal life in various forms at depths vastly greater than had been previously suspected,—for instance, at 1400 fathoms by Torell, at 1000 and 1500 fathoms by Milne-Edwards, and at 3000 fathoms by Dr. Wallich. The question of the nature of the food of these abysmal animals is one of great interest; and I wish to place on record, in advance of the publication of the Report of the Expedition, the results of my examination of the specimens alluded to by Prof. Bailey, when they were freshly taken from the water.

In the sounding taken at the depth of 2700 fathoms, in lat. 56° 46′ N., long. 168° 18′ E., Lieut. Brooke used, for the armature of his lead, three quills, each about three inches in length, fastened together, and placed in such a position that, when the lead struck the bottom, the quills would be forced perpendicularly into it, and thus become filled with mud from a stratum a few inches below the general surface of the sea-bottom. The experiment was successful, the quills coming up compactly filled with mud of the usual character occurring at such depths in such latitudes. One of the quills, having been submitted to me for microscopic examination, was carefully wiped and cut in two at the *middle*, in order to secure for examination a specimen as nearly as possible free from any chance admixture from the water near the surface. In this specimen I found an abundance of Diatoms, some of which, apparently *Coscinodisci*, appeared to me to be undoubtedly living, judging from their fresh appearance and the colours of their internal cell-contents.

It is exceedingly doubtful whether sufficient light can penetrate to so great a depth to afford the stimulus which these vegetable organisms are supposed to require for their existence and multiplication. On the other hand, it is by no means certain that some amount of light does not so penetrate; and if we deny the existence of vegetable life in these abysses, it will be difficult to account for the existence there of animals which must ultimately derive their sustenance from the vegetable kingdom. The supply which they might obtain from the dead bodies of those organisms which die at the surface, and slowly sink through two or three miles of water to the bottom, seems totally insufficient; for Dr. Wallich has proved that the animals (starfishes, for instance) not only exist at those depths, but exist in great numbers. We would call the attention of those who may have an opportunity of obtaining specimens of the bottom at great depths, to the great importance of a microscopic examination of these specimens as soon as taken from the sea. Fresh water should, of course, be used in spreading the mud upon the slide.—*Silliman's Journal*, May 1863.

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VIII.—*Species considered as to Variation, Geographical Distribution, and Succession.* By Prof. Asa Gray*.

It is well known to botanists that M. DeCandolle has been assiduously engaged in the elaboration of the order Cupuliferæ for the 'Prodromus,' and has had before him the authentic types of almost every published species, and an amount of materials as to many of them which, so far as dried specimens may serve, leaves little to be asked. A less inspiring task could hardly be assigned to a botanist than the systematic elaboration of the genus *Quercus* and its allies. The vast materials assembled under DeCandolle's hands, while disheartening for their bulk, offered small hope of novelty. The subject was both extremely trite and extremely difficult. Happily, it occurred to DeCandolle that an interest might be imparted to an onerous undertaking, and a work of necessity be turned to good account for science, by studying the Oaks in view of the question of *Species*.

What this term *Species* means, or should mean, in natural history, what the limits of species, *inter se* or chronologically, or in geographical distribution, their modifications, actual or probable, their origin, and their destiny,—these are questions which surge up from time to time; and now and then, in the progress of science, they come to assume a new and hopeful interest. Botany and zoology, geology and what our author, feeling the want of a new term, proposes to name *Epiontology*†,

* From Silliman's American Journal for May 1863.

† A name which, at the close of his article, DeCandolle proposes for *the study of the succession of organized beings*, to comprehend therefore palæontology and all included under what is called geographical botany and zoology, the whole forming a science parallel to geology,—the latter devoted to the history of unorganized bodies, the former to that of or-

all lead up to and converge into this class of questions, while recent theories shape and point the discussion. So we look with eager interest to see what light the study of the Oaks, by a very careful, experienced, and conservative botanist, particularly conversant with the geographical relations of plants, may throw upon the subject.

The course of investigation in this instance does not differ from that ordinarily pursued by working botanists; nor, indeed, are the theoretical conclusions other than those to which a similar study of other orders might equally have led. The Oaks afford a very good occasion for the discussion of questions which press upon our attention, and perhaps they offer peculiarly good materials, on account of the number of fossil species.

Preconceived notions about species being laid aside, the specimens in hand were distributed, according to their obvious resemblances, into groups of apparently identical or nearly identical forms, which were severally examined and compared. Where specimens were few, as from countries little explored, the work was easy, but the conclusions, as will be seen, of small value. The fewer the materials, the smaller the likelihood of forms intermediate between any two, and, what does not appear being treated upon the old law-maxim as non-existent, species are readily enough defined. Where, however, specimens abound, as in the case of the Oaks of Europe, of the Orient, and of the United States, of which the specimens amounted to hundreds, collected at different ages, in varied localities, by botanists of all sorts of views and predilections, here alone were data fit to draw useful conclusions from. Here, as DeCandolle remarks, he had every advantage, being furnished with materials more complete than any one person could have procured from his own herborizations, more varied than if he had observed a hundred times over the same forms in the same district, and more impartial than if they had all been amassed by one person with his own ideas or predispositions. So that vast herbaria, into which contributions from every source have flowed for years, furnish the best possible data—at least are far better than any practicable amount of personal herborization—for the comparative study of related forms occurring over wide tracts of territory. But as the materials increase, so do the difficulties. Forms which appeared totally distinct approach or blend through intermediate gradations; characters stable in a limited number of instances,

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ganized beings, as respects origin, distribution, and succession. We are not satisfied with the word, notwithstanding the precedent of *palæontology*, since *ontology*, the science of being, has an established meaning as referring to mental existence, *i. e.* is a synonym or a department of metaphysics.

or in a limited district, prove unstable occasionally, or when observed over a wider area; and the practical question is forced upon the investigator, What here is probably fixed and specific, and what is variant, pertaining to individual, variety, or race?

In the examination of these rich materials, certain characters were found to vary upon the same branch, or upon the same tree, sometimes according to age or development, sometimes irrespective of such relations or of any assignable reasons. Such characters, of course, are not specific, although many of them are such as would have been expected to be constant in the same species, and are such as generally enter into specific definitions. Variations of this sort DeCandolle, with his usual painstaking, classifies and tabulates, and even expresses numerically their frequency in certain species. The results are brought well to view in a systematic enumeration.

(1.) Of characters which *frequently* vary upon the same branch: upwards of a dozen such are mentioned.

(2.) Of those which *sometimes* vary upon the same branch: a smaller number of these are mentioned.

(3.) Those so rare that they might be called monstrosities.

Then he enumerates characters, ten in number, which he has never found to vary on the same branch, and which, therefore, have better claim to be employed as specific. But, as among them he includes the duration of the leaves, the size of the cupule, and the form and size of its scales, which are by no means wholly uniform in different trees of the same species, even these characters must be taken with allowance. In fact, having first brought together, as groups of the lowest order, those forms which varied upon the same stock, he next had to combine similarly various forms which, though not found associated upon the same branch, were thoroughly blended by intermediate degrees.

"The lower groups (varieties or races) being thus constituted, I have given the rank of *species* to the groups next above these, which differ in other respects, *i. e.* either in characters which were not found united upon certain individuals, or in those which do not show transitions from one individual to another. For the Oaks of regions sufficiently known, the species thus formed rest upon satisfactory bases, of which the proof can be furnished. It is quite otherwise with those which are represented in our herbaria by single or few specimens. These are *provisional species*—species which may hereafter fall to the rank of simple varieties. I have not been inclined to prejudge such questions; indeed in this regard I am not disposed to follow those authors whose tendency is, as they say, to reunite species. I never reunite them without proof in each particular case; while the botanists to whom I refer do so on the ground of analogous variations or transitions occurring in the same genus or in the same family. For example, resting on the fact that *Quercus Ilex, Q. cocci-*

fera, Q. acutifolia, &c. have the leaves sometimes entire and sometimes toothed, upon the same branch, or present transitions from one tree to another, I might readily have united my *Q. Tlapuxahuensis* to *Q. Sartorii* of Liebmann, since these two differ only in their entire or their toothed leaves. From the fact that the length of the peduncle varies in *Q. robur* and many other Oaks, I might have combined *Q. Seemanni,* Liebm., with *Q. salicifolia,* Nees. I have not admitted these inductions, but have demanded visible proof in each particular case. Many species are thus left as provisional; but in proceeding thus, the progress of the science will be more regular, and the synonymy less dependent upon the caprice or the theoretical opinions of each author."

This is safe and, to a certain degree, judicious, no doubt, as respects published species. Once admitted, they may stand until they are put down by evidence, direct or circumstantial. Surely a species may rightfully be condemned on good circumstantial evidence. But what course does DeCandolle pursue in the case, of every-day occurrence to most working botanists having to elaborate collections from countries not so well explored as Europe, when the forms in question, or one of the two, are as yet unnamed? Does he introduce as a new species every form which he cannot connect by ocular proof with a near relative from which it differs only in particulars which he sees are inconstant in better-known species of the same group? We suppose not. But if so, little improvement for the future upon the state of things revealed in the following paragraph can be expected.

"In the actual state of our knowledge, after having seen nearly all the original specimens, and in some species as many as 200 representatives from different localities, I estimate that, out of the 300 species of *Cupuliferæ* which will be enumerated in the 'Prodromus,' two-thirds at least are *provisional* species. In general, when we consider what a multitude of species were described from a single specimen, or from the forms of a single locality, of a single country, or are badly described, it is difficult to believe that above one-third of the actual species in botanical works will remain unchanged."

Such being the results of the *want* of adequate knowledge, how is it likely to be when our knowledge is largely increased? The judgment of so practised a botanist as DeCandolle is important in this regard; and it accords with that of other botanists of equal experience.

"They are mistaken," he pointedly asserts, "who repeat that the greater part of our species are clearly limited, and that the doubtful species are in a feeble minority. This seemed to be true so long as a genus was imperfectly known, and its species were founded upon few specimens—that is to say, were provisional. Just as we come to know them better, intermediate forms flow in, and doubts as to specific limits augment."

DeCandolle insists, indeed, in this connexion, that the higher the rank of the groups, the more definite their limitation, or, in other terms, the fewer the ambiguous or doubtful forms,—that genera are more strictly limited than species, tribes than genera, orders than tribes, &c. We are not convinced of this. Often, where it has appeared to be so, advancing discovery has brought intermediate forms to light, perplexing to the systematist. "They are mistaken," we think more than one systematic botanist will say, "who repeat that the greater part of our natural orders and tribes are absolutely limited," however we may agree that we will limit them. Provisional genera, we suppose, are proportionally hardly less common than provisional species; and hundreds of genera are kept up on considerations of general propriety or general convenience, although well known to shade off into adjacent ones by complete gradations. Somewhat of this greater fixity of higher groups, therefore, is rather apparent than real. On the other hand, that varieties should be less definite than species, follows from the very terms employed. They are ranked as varieties rather than species, just because of their less definiteness.

Singular as it may appear, we have heard it denied that spontaneous varieties occur. DeCandolle makes the important announcement that, in the Oak genus, the best-known species are just those which present the greatest number of spontaneous varieties and subvarieties. The maximum is found in *Q. robur*, with twenty-eight varieties, all spontaneous. Of *Q. Lusitanica* eleven varieties are enumerated, of *Q. Calliprinos* ten, of *Q. coccifera* eight, &c. And he significantly adds that "these very species which offer such numerous modifications are themselves ordinarily surrounded by other forms provisionally called species because of the absence of known transitions, or variations, but to which some of these will probably have to be joined hereafter." The inference is natural, if not inevitable, that the difference between such species and such varieties is only one of degree, either as to amount of divergence or of hereditary fixity, or as to the frequency or rarity, at the present time, of intermediate forms.

This brings us to the second section of DeCandolle's article, in which he passes on, from the observation of the present forms and affinities of Cupuliferous plants, to the consideration of their probable history and origin. Suffice it to say that he frankly accepts the inferences derived from the whole course of observation, and even contemplates with satisfaction a probable historical connexion between congeneric species. He accepts and, by various considerations drawn from the geographical distribution of European *Cupuliferæ*, fortifies the conclusion (long ago arrived at by Edward Forbes) that the present species, and even some of their varieties, date back to about the close of the Tertiary epoch, since which time they have been subject to frequent and great changes of habitation or limitation, but without appreciable change of specific form or character,—that is, without profounder changes than those within which a species, at the present time, is known to vary. Moreover he is careful to state that he is far from concluding that the time of the appearance of a species in Europe at all indicates the time of its origin. Looking back still further into the Tertiary epoch, of which the vegetable remains indicate many analogous, but few, if any, identical forms, he concludes, with Heer and others, that specific changes of form, as well as changes of station, are to be presumed. And finally, that "the theory of a succession of forms through the deviation of anterior forms is the most natural hypothesis, and the most accordant with the known facts in palæontology, geographical botany, and zoology, of anatomical structure and classification; but direct proof of it is wanting; and moreover, if true, it must have taken place very slowly—so slowly, indeed, that its effects are discernible only after a lapse of time far longer than our historic epoch."

In contemplating the present state of the species of *Cupuliferæ* in Europe, DeCandolle comes to the conclusion that, while the Beech is increasing, and extending its limits southward and westward (at the expense of *Coniferæ* and Birches), the common Oak, to some extent, and the Turkey Oak decidedly, are diminishing and retreating,—and this wholly irrespective of man's agency. This is inferred of the Turkey Oak from the great gaps found in its present geographical area, which are otherwise inexplicable, and which he regards as plain indications of a partial extinction. Community of descent of all the individuals of species is of course implied in these and all similar reasonings.

An obvious result of such partial extinction is clearly enough brought to view. The European Oaks (like the American species) greatly tend to vary; that is, they manifest an active disposition to produce new forms. Every form tends to become hereditary, and so to pass from the state of mere variation to that of race; and of these competing incipient races some only will survive. *Quercus robur* offers a familiar illustration of the manner in which one form may, in the course of time, become separated into two or more distinct ones.

To Linnæus this Common Oak of Europe was all of one species. But of late years the greater number of European botanists have regarded it as including three species, *Q. pedunculata*, *Q. sessiliflora*, and *Q. pubescens*. DeCandolle looks with satisfaction to the independent conclusion which he reached from a long and patient study of the forms (and which Webb, Gay, Bentham, and others had equally reached), that the view of Linnæus was correct, inasmuch as it goes to show that the idea and the practical application of the term *species* have remained unchanged during the century which has elapsed since the publication of the 'Species Plantarum.' But, the idea remaining unchanged, the facts might appear under a different aspect, and the conclusion be different, under a slight and very supposable change of circumstances. Of the twenty-eight spontaneous varieties of *Q. robur* which DeCandolle recognizes, all but six, he remarks, fall naturally under the three subspecies, *pedunculata*, *sessiliflora*, and *pubescens*, and are therefore forms grouped around these as centres; and, moreover, the few connecting forms are by no means the most common. Were these to die out, it is clear that the three forms which have already been so frequently taken for species would be what the group of four or five provisionally admitted species which closely surround *Q. robur* (see p. 85) now are. The best example of such a case, as having in all probability occurred through geographical segregation and partial extinction, is that of the Cedar, thus separated into the Deodar, the Lebanon, and the Atlantic Cedars—a case admirably worked out by Dr. Hooker two or three years ago*.

A special advantage of the *Cupuliferæ* for determining the probable antiquity of existing species in Europe, DeCandolle finds in the size and character of their fruits. However it may be with other plants (and he comes to the conclusion generally that marine currents and all other means of distant transport have played only a very small part in the actual dispersion of species), the transport of acorns and chestnuts by natural causes across an arm of the sea, in a condition to germinate (and much more the spontaneous establishment of a forest of oaks or chestnuts in this way), DeCandolle conceives to be fairly impossible in itself, and contrary to all experience. From such considerations, *i. e.* from the actual dispersion of the existing species, with occasional aid from Post-tertiary deposits, it is thought to be shown that the principal *Cupuliferæ* of the Old World attained their actual extension before the present separation of Sicily, Sardinia, and Corsica, or of Britain, from the European continent.

This view once adopted, and this course once entered upon, has to be pursued further. *Quercus robur* of Europe, with its

* Nat. Hist. Review, January 1862; see Sillimann's Journal, ser. 2. vol. xxiv. p. 148.

bevy of admitted derivatives, and its attending species only provisionally admitted to that rank, is very closely related to certain species of Eastern Asia, and of Oregon and California—so closely that "a view of the specimens by no means forbids the idea that they have all originated from *Q. robur*, or have originated, with the latter, from one or more preceding forms so like the present ones that a naturalist could hardly know whether to call them species or varieties." Moreover there are fossil leaves from diluvian deposits in Italy, figured by Gaudin, which are hardly distinguishable from those of *Q. robur*, on the one hand, and from those of *Q. Douglasii*, &c., of California, on the other. No such leaves are found in any Tertiary deposit in Europe; but such are found of that age, it appears, in North-west America, where their remote descendants still flourish. So that the probable genealogy of *Q. robur*, traceable in Europe up to the commencement of the present epoch, looks eastward and far into the past on far distant shores.

Q. Ilex, the Evergreen Oak of Southern Europe and Northern Africa, reveals a similar archæology; but its presence in Algeria leads DeCandolle to regard it as a much more ancient denizen of Europe than *Q. robur*; and a Tertiary Oak (*Q. ilicoides*), from a very old Miocene bed in Switzerland, is thought to be one of its ancestral forms. This high antiquity once established, it follows, almost of course, that the very nearly related species in Central Asia, in Japan, in California, and even our own Live Oak with its Mexican relatives, may probably enough be regarded as early offshoots from the same stock with *Q. Ilex*.

In brief, not to continue these abstracts and remarks, and without reference to Darwin's particular theory (which DeCandolle at the close very fairly considers), if existing species, or many of them, are as ancient as they are now generally thought to be, and were subject to the physical and geographical changes (among them the coming and the going of the Glacial epoch) which this antiquity implies—if in former times they were as liable to variation as they now are—and if the individuals of the same species may claim a common local origin, then we cannot wonder that "the theory of a succession of forms by deviations from anterior forms" should be regarded as "the most natural hypothesis," nor at the general advance made towards its acceptance in some form or other.

The question being, not how plants and animals originated, but how came the existing animals and plants to be just where they are and what they are, it is plain that naturalists interested in such inquiries are mostly looking for the answer in one direction. The general drift of opinion, or at least of expectation, is exemplified by this essay of DeCandolle; and the set and force of the current are seen by noticing how it carries along naturalists of widely different views and prepossessions, some faster and further than others, but all in one way. The tendency is, we may say, to extend the law of continuity, or something analogous to it, from inorganic to organic nature, and in the latter to connect the present with the past in some sort of material connexion. The generalization may, indeed, be expressed so as not to assert that the connexion is genetic, as in Mr. Wallace's formula: "Every species has come into existence coincident both in time and space with preexisting closely allied species." Edward Forbes, who may be called the originator of this whole line of inquiry, long ago expressed a similar view. But the only material sequence we know, or can clearly conceive, in plants and animals is that from parent to progeny; and, as DeCandolle implies, the origin of species and that of races can hardly be much unlike, nor governed by other than the same laws, whatever these may be.

The progress of opinion upon this subject in one generation is not badly represented by that of DeCandolle himself, who is by no means prone to adopt new views without much consideration. In an elementary treatise, published in the year 1835, he adopted and, if we rightly remember, vigorously maintained, Schouw's idea of the double or multiple origin of species, at least of some species—a view which has been carried out to its ultimate development only perhaps by Agassiz, in the denial of any necessary genetic connexion among the individuals of the same species, or of any original localization more restricted than the area now occupied by the species. But in 1855, in his 'Géographie Botanique,' the multiple hypothesis, although in principle not abandoned, is seen to lose its point, in view of the probable high antiquity of existing species. The actual vegetation of the world being now regarded as a continuation, through numerous geological, geographical, and more recently historical changes, of anterior vegetations, the actual distribution of plants is seen to be a consequence of preceding conditions and geological considerations; and these alone may be expected to explain all the facts, many of them so curious and extraordinary, of the actual geographical distribution of the species. In the present essay, not only the distribution, but the origin, of congeneric species is regarded as something derivative: whether derived by slow and very gradual changes in the course of ages, according to Darwin, or by a sudden inexplicable change of their Tertiary ancestors, as conceived by Heer, DeCandolle hazards no opinion. It may, however, be inferred that he looks upon "natural selection" (which he rather underrates) as a real but insufficient cause; while some curious remarks (pp. 57, 58) upon the number of monstrosities annually produced, and the possibility of their enduring, may be regarded as favourable to Heer's view.

As an index to the progress of opinion in the direction referred to, it will be interesting to compare Sir Charles Lyell's well-known chapters of twenty or thirty years ago, in which the permanence of species was ably maintained, with his treatment of the same subject in a work just issued in England, which, however, has not yet reached us.

A belief in the derivation of species may be maintained along with a conviction of great persistence of specific characters. This is the idea of the excellent Swiss vegetable palæontologist, Heer, who imagines a sudden change of specific type at certain periods; and it perhaps is that of Pictet. Falconer adheres to somewhat similar views in his elaborate paper on Elephants, living and fossil, in the 'Natural History Review' for January 1863. Noting that "there is clear evidence of the true Mammoth having existed in America long after the period of the northern drift, when the surface of the country had settled down into its present form," and also in Europe so late as to have been a cotemporary of the Irish Elk, and, on the other hand, that it existed in England so far back as before the deposition of the Boulder Clay, also that four well-defined species of fossil Elephant are known to have existed in Europe, that "a vast number of the remains of three of these species have been exhumed over a large area in Europe, and, even in the geological sense, an enormous interval of time has elapsed between the formation of the most ancient and the most recent of these deposits, quite sufficient to test the persistence of specific characters in an Elephant," he presents the question, "Do, then, the successive Elephants occurring in these strata show any signs of a passage from the older form into the newer?"

To which the reply is, "If there is one fact which is impressed on the conviction of the observer with more force than any other, it is the persistence and uniformity of the characters of the molar teeth in the earliest known Mammoth and his most modern successor......Assuming the observation to be correct, what strong proof does it not afford of the persistence and constancy, throughout vast intervals of time, of the distinctive characters of those organs which are most concerned in the existence and habits of the species? If we cast a glance back on the long vista of physical changes which our planet has undergone since the Neozoic epoch, we can nowhere detect signs of a revolution more sudden and pronounced, or more important in its results, than the intercalation and sudden disappearance of the glacial period. Yet the 'dicyclotherian' Mammoth lived before it, and passed through the ordeal of all the hard extremities it involved, bearing his organs of locomotion and digestion all but unchanged. Taking the group of four European fossil species above enumerated, do they show any signs in the successive deposits of a transition from the one form into the other? Here, again, the result of my observation, in so far as it has extended over the European area, is, that the specific characters of the molars are constant in each, within a moderate range of variation, and that we nowhere meet with intermediate forms."......Dr. Falconer continues (p. 80):—

"The inferences which I draw from these facts are not opposed to one of the leading propositions of Darwin's theory. With him, I have no faith in the opinion that the Mammoth and other extinct Elephants made their appearance suddenly, after the type in which their fossil remains are presented to us. The most rational view seems to be, that they are in some shape the modified descendants of earlier progenitors. But if the asserted facts be correct, they seem clearly to indicate that the older Elephants of Europe, such as *E. meridionalis* and *E. antiquus*, were not the stocks from which the later species, *E. primigenius* and *E. africanus*, sprang, and that we must look elsewhere for their origin. The nearest affinity, and that a very close one, of the European *E. meridionalis* is with the Miocene *E. planifrons* of India, and of *E. primigenius* with the existing Indian species.

"Another reflection is equally strong in my mind—that the means which have been adduced to explain the origin of species by 'natural selection,' or a process of variation from external influences, are inadequate to account for the phenomena. The law of phyllotaxis, which governs the evolution of leaves around the axis of a plant, is as nearly constant in its manifestation as any of the physical laws connected with the material world. Each instance, however different from another, can be shown to be a term of some series of continued fractions. When this is coupled with the geometrical law governing the evolution of form, so manifest in some departments of the animal kingdom (*e. g.* the spiral shells of the Mollusca), it is difficult to believe that there is not in nature a deeper-seated and innate principle, to the operation of which natural selection is merely an adjunct. The whole range of the Mammalia, fossil and recent, cannot furnish a species which has had a wider geographical distribution, and passed through a longer term of time, and through more extreme changes of climatal conditions, than the Mammoth. If species are so unstable, and so susceptible of mutation through such influences, why does that extinct form stand out so signally a monument of stability? By his admirable researches and earnest writings, Darwin has, beyond all his cotemporaries, given an impulse to the philosophical investigation of the most backward and obscure branch of the biological sciences of his day: he has laid the foundations of a great edifice; but he need not be surprised if, in the progress of erection, the superstructure is altered by his successors, like the Duomo of Milan from the Roman to a different style of architecture."

Entertaining ourselves the opinion that something more than natural selection is requisite to account for the orderly production and succession of species, we offer two incidental remarks upon the above extract.

First, we find in it, in the phrase "natural selection, or a process of variation from external influences," an example of the very common confusion of two distinct things, viz. *variation* and *natural selection*. The former has never yet been shown to have its cause in "external influences," nor to occur at random. As we have elsewhere insisted, if not inexplicable, it has never been explained: all we can yet say is, that plants and animals are prone to vary, and that some conditions favour variation. Perhaps in this Dr. Falconer may yet find what he seeks: for "it is difficult to believe that there is not in [its] nature a deeper-seated and innate principle, to the operation of which natural selection is merely an adjunct." The latter, which is the *ensemble* of the external influences, including the competition of the individuals themselves, picks out certain variations as they arise, but in no proper sense can be said to originate them.

Secondly, although we are not quite sure how Dr. Falconer intends to apply the law of phyllotaxis to illustrate his idea, we fancy that a pertinent illustration may be drawn from it in this way. There are two *species* of phyllotaxis, perfectly distinct, and, we suppose, not mathematically reducible the one to the other,—viz. (1), that of alternate leaves, with its varieties; and (2) that of verticillate leaves, of which opposite leaves present the simplest case. That, although generally constant, a change from one variety of alternate phyllotaxis to another should occur on the same axis, or on successive axes, is not surprising, the different sorts being terms of a regular series—although, indeed, we have not the least idea as to how the change from the one to the other comes to pass. But it is interesting, and in this connexion perhaps instructive, to remark that, while some dicotyledonous plants hold to the verticillate (*i.e.* opposite-leaved) phyllotaxis throughout, a larger number (through the operation of some deep-seated and innate principle, which we cannot fathom) change abruptly into the other species at the second or third node, and change back again in the flower, or else effect a synthesis of the two species in a manner which is puzzling to understand. Here is a change from one fixed law to another, as unaccountable, if not as great, as from one specific form to another.

An elaborate paper on the vegetation of the Tertiary period, in the south-east of France, by Count Gaston de Saporta, published in the 'Ann. Sc. Nat.' in 1862 (vol. xvi. pp. 309–344) which we have not space to analyse, is worthy of attention from the general inquirer, on account of its analysis of the Tertiary flora into its separate types—Cretaceous, Austral, Tropical, and Boreal—each of which has its separate and different history; and for the announcement that "the *hiatus* which, in the idea of most geologists, intervened between the close of the Cretaceous and the beginning of the Tertiary appears to have had no existence, so far as concerns the vegetation; that in general it was not by means of a total overthrow, followed by a complete new emission of species, that the flora has been renewed at each successive period; and that while the plants of Southern Europe inherited from the Cretaceous period more or less rapidly disappeared, as also the austral forms, and later the tropical types (except the Laurel, the Myrtle, and the *Chamærops humilis*), the boreal types, coming later, survived all the others, and now compose, either in Europe, or in the north of Asia, or in North America, the basis of the actual arborescent vegetation. Especially "a very considerable number of forms nearly identical with Tertiary forms now exist in America, where they have found, more easily than in our [European] soil (less vast and less extended southward), refuge from ulterior revolutions." The extinction of species is attributed to two kinds of causes—the one material or physical, whether slow or rapid, the other inherent in the nature of organic beings, incessant, but slow, in a manner latent, but somehow, assigning to the species, as to the individuals, a limited period of existence, and, in some equally mysterious but wholly natural way, connected with the development of organic types—"by *type* meaning a collection of vegetable forms constructed upon the same plan of organization, of which they reproduce the essential lineaments with certain secondary modifications, and which appear to run back to a common point of departure."

In this community of types, no less than in the community of certain existing species, Saporta recognizes a prolonged material union between North America and Europe in former times. Most naturalists and geologists reason in the same way, some more cautiously than others; yet perhaps most of them seem not to perceive how far such inferences imply the doctrine of the common origin of related species.

For obvious reasons such doctrines are likely to find more favour with botanists than with zoologists. But with both the advance in this direction is seen to have been rapid and great, yet to us not unexpected. We note also an evident disposition, notwithstanding some endeavours to the contrary, to allow derivative hypotheses to stand or fall upon their own merits, to have, indeed, upon philosophical grounds, certain presumptions in their favour, and to be, perhaps, quite as capable of being turned to good account as to bad account in natural theology*.

Among the leading naturalists, indeed, such views, taken in the widest sense, have one (and, so far as we are now aware, only one) thoroughgoing and thoroughly consistent opponent, viz. M. Agassiz.

Most naturalists take into their very conception of a species, explicitly or by implication, the notion of a material connexion resulting from the descent of the individuals composing it from a common stock, of local origin. M. Agassiz wholly eliminates community of descent from his idea of species, and even conceives a species to have been as numerous in individuals and as widespread over space, or as segregated in discontinuous spaces, from the first as at a later period.

The station which it inhabits, therefore, is with other naturalists in nowise essential to the species, and may not have been the region of its origin. In M. Agassiz's view the habitat is supposed to mark the origin, and to be a part of the character, of the species. The habitat is not merely the place where it is, but a part of what it is.

Most naturalists recognize varieties of species; and many, like DeCandolle, have come to conclude that varieties of the highest grade, or races, so far partake of the characteristics of species, and are so far governed by the same laws, that it is often very difficult to draw a clear and certain distinction between the two. M. Agassiz will not allow that varieties or races exist in nature, apart from man's agency.

Most naturalists believe that the origin of species is supernatural, their dispersion or particular geographical area natural, and their extinction, when they disappear, also the result of physical causes. In the view of M. Agassiz, if rightly under-

* What the Rev. Principal Tulloch remarks in respect to the philosophy of miracles has a pertinent application here. We quote at secondhand:—

"The stoutest advocates of interference can mean nothing more than that the Supreme Will has so moved the hidden springs of nature that a new issue arises on given circumstances. The ordinary issue is supplanted by a higher issue. The essential facts before us are a certain set of phenomena, and a Higher Will moving them. How moving them? is a question for human definition, the answer to which does not and cannot affect the divine meaning of the change. Yet when we reflect that this Higher Will is everywhere reason and wisdom, it seems a juster as well as a more comprehensive view to regard it as operating by subordination and evolution, rather than by interference or violation."

stood, all three are equally independent of physical cause and effect, are equally supernatural.

In comparing preceding periods with the present and with each other, most naturalists and palæontologists now appear to recognize a certain number of species as having survived from one epoch to the next, or even through more than one formation, especially from the Tertiary into the Posttertiary period, and from that to the present age. M. Agassiz is understood to believe in total extinctions and total new creations at each successive epoch, and even to recognize no existing species as ever contemporary with extinct ones, except in the case of recent exterminations.

These peculiar views, if sustained, will effectually dispose of every form of derivative hypothesis.

Returning for a moment to DeCandolle's article, we are disposed to notice his criticism of Linnæus's "definition" of the term *species* (Phil. Bot. No. 157), "Species tot numeramus quot diversæ formæ in principio sunt creatæ," which he declares illogical, inapplicable, and the worst that has been propounded. "So, to determine if a form is specific, it is necessary to go back to its origin, which is impossible. A definition by a character which can never be verified is no definition at all."

Now, as Linnæus practically applied the idea of species with a sagacity which has never been surpassed and rarely equalled, and, indeed, may be said to have fixed its received meaning in natural history, it may well be inferred that in the phrase above cited he did not so much undertake to frame a logical *definition* as to set forth the *idea* which, in his opinion, lay at the foundation of species, on which basis A. L. Jussieu did construct a logical definition : "nunc rectius definitur perennis individuorum similium successio continuata generatione renascentium." The fundamental idea of species, we would still maintain, is that of a chain, of which genetically connected individuals are the links. That, in the practical recognition of species, the essential characteristic has to be *inferred*, is no great objection, the general fact that like engenders like being an induction from a vast number of instances, and the only assumption being that of the uniformity of nature. The idea of gravitation, that of the atomic constitution of matter, and the like, equally have to be verified inferentially. If we still hold to the idea of Linnæus, and of Agassiz, that existing species were created independently and essentially all at once at the beginning of the present era, we could not improve the propositions of Linnæus and of Jussieu. If, on the other hand, the time has come in which we may accept, with DeCandolle, their successive origination, at the commencement of the present era or before, and even by derivation from other forms, then the "in principio" of Linnæus will refer to that time, whenever it was, and his proposition be as sound and wise as ever.

In his 'Géographie Botanique' (ii. 1068–1077) DeCandolle discusses this subject at length, and in the same interest. Remarking that of the two great facts of species, viz. *likeness among the individuals* and *genealogical connexion*, zoologists have generally preferred the latter*, while botanists have been divided in opinion, he pronounces for the former as the essential thing, in the following argumentative statement:—

"Quant à moi, j'ai été conduit, dans ma définition de l'espèce, à mettre décidément la ressemblance au-dessus des caractères de succession. Ce n'est pas seulement à cause des circonstances propres au règne végétal, dont je m'occupe exclusivement; ce n'est pas non plus afin de sortir ma définition des théories et de la rendre le plus possible utile aux naturalistes descripteurs et nomenclateurs, c'est aussi par un motif philosophique. En toute chose il faut aller au fond des questions, quand on le peut. Or, pourquoi la reproduction est-elle possible, habituelle, féconde indéfiniment, entre des êtres organisés que nous dirons de la même espèce? Parce qu'ils se ressemblent et uniquement à cause de cela. Lorsque deux espèces ne peuvent, ou, s'il s'agit d'animaux supérieurs, ne peuvent et ne veulent se croiser, c'est qu'elles sont très-différentes. Si l'on obtient des croisements, c'est que les individus sont analogues; si ces croisements donnent des produits féconds, c'est que les individus étaient plus analogues; si ces produits eux-mêmes sont féconds, c'est que la ressemblance était plus grande; s'ils sont féconds habituellement et indéfiniment, c'est que la ressemblance intérieure et extérieure était très-grande. Ainsi le degré de ressemblance est le fond; la reproduction en est seulement la manifestation et la mesure, et il est logique de placer la cause au-dessus de l'effet."

We are not at all convinced. We still hold that genealogical connexion, rather than mutual resemblance, is the fundamental thing—first on the ground of fact, and then from the philosophy of the case. Practically, no botanist can say what amount of dissimilarity is compatible with unity of species; in wild plants it is sometimes very great, in cultivated races often enormous. DeCandolle himself informs us that the different variations which the same oak-tree exhibits are significant indications of a disposition to set up separate varieties, which, becoming hereditary, may constitute a race; he evidently looks upon the extreme forms, say of *Quercus robur*, as having thus originated; and on this ground (inferred from transitional forms), and not from their

* Particularly citing Flourens: "La ressemblance n'est qu'une condition secondaire; la condition essentielle est la descendance: ce n'est pas la ressemblance, c'est la succession des individus, qui fait l'espèce."

mutual resemblance, as we suppose, he includes them in that species. This will be more apparent should the discovery of the transitions which he leads us to expect hereafter cause the four provisional species which attend *Q. robur* to be merged in that species. It may rightly be replied, that this conclusion would be arrived at from the likeness step by step in the series of forms; but the cause of the likeness here is obvious. And this brings in our "*motif philosophique.*"

Not to insist that the likeness is, after all, the variable, not the constant element,—to learn which is the essential thing (resemblance among the individuals, or their genetic connexion), we have only to ask which can be the cause of the other.

In hermaphrodite plants (the normal case), and even as the question is ingeniously put by DeCandolle in the above extract, the former surely cannot be the *cause* of the latter, though it may, in case of crossing, offer *occasion.* But, on the ground of the most fundamental of all things in the constitution of plants and animals, the fact, incapable of further analysis, that individuals reproduce their like, that characteristics are inheritable*, the likeness is a direct natural consequence of the genetic succession; and it is logical to place the cause above the effect.

We are equally disposed to combat a proposition of DeCandolle's about genera, elaborately argued in the 'Géographie Botanique,' and incidentally reaffirmed in his present article, viz. that genera are more natural than species, and are more correctly distinguished by people in general, as is shown by vernacular names. But we have no space left in which to present some evidence to the contrary.

Here we must abruptly close our long exposition of a paper which, from the scientific position, ability, and impartiality of its author, is likely at this time to produce a marked impression. We would also direct attention to an earlier article in the same important periodical (viz. in the Bibl. Univ. for May 1862), on the European Flora and the Configuration of Continents in the Tertiary Epoch, a most interesting abstract of, and commentary on, the introductory part of Heer's 'Flora Tertiaria Helvetiæ,' as re-edited and translated into French by Gaudin, with additions by the author.

* See Silliman's Journal, ser. 2. vol. xxix. (March 1860) p. 165, for the enunciation of this obvious principle.

IX.—*On the Species of* Chelymys *from Australia, with the Description of a new Species.* By Dr. J. E. Gray, F.R.S.

In establishing this genus, the only species then known had a distinct nuchal plate, and the existence of this plate is made part of the generic character. We have since received two specimens of the shell of a Tortoise, without the animals, which has all the other characters and appearance of the genus, but is destitute of the nuchal shield; so I am inclined to amend the generic characters by leaving out this particular, and to use the presence or non-existence of the nuchal shield as a sectional or specific character; and we have received other specimens of the species with the nuchal shield, which have further illustrated the species, and show that this shield is always present in it.

The species will then stand thus:—

* *Nuchal shield broad and well developed; hinder margin entire.*

1. *Chelymys Macquaria*, Gray, Cat. Shield Reptiles, 57.

This animal presents two varieties, differing in the height of the back and the width of the hinder marginal shields. Specimens brought by the same collectors, probably from the same locality, offer considerable variation in this respect, and appear to form a series of gradations from one variety to the other. The higher and more solid specimens are of the smallest size; but we have very depressed broad margins in the young specimens as well as the more adult ones, the latter being twice the size.

The solid, higher varieties may be only of different sexes, or they may even prove to be species when more is known of their habitation and habits; indeed I should be inclined to consider them so now if we had not received both varieties from Capt. W. Chambers and Mr. Cuming as coming from the same locality.

They vary considerably in the form of the gular shield: in the small, solid, high-shelled variety it is broad and short; in some of the older of the larger depressed specimens it is equally short and broad; in the younger depressed specimens it is narrow, linear elongate.

** *Nuchal shield none; hinder margin dentated.*

2. *Chelymys dentata.*

Shell ovate, wider behind; hinder margin dentated; side edge revolute. Nuchal shield none. Back with a slight nodule at the hinder part of the vertebral shields. The first vertebral shield broader than long, the rest longer than broad; the fourth the longest, rather urn-shaped, the margin shelving.

Younger shell: back slightly keeled; the margin more expanded, nearly horizontal; the vertebral plates broader than long, the fourth the largest, with five even sides.

Hab. N. Australia; Upper Victoria, in Beagle's Valley. (Mr. Macgillivray.)

"Native name, 'Billymurry.' It was caught with grass-hoppers, and the stomach contained *Pandanus*-seeds."

The gular shield in both the specimens is narrow, elongate, extending down between the front edge of the second pair of sternal shields.

This species is at once known from the former by the form of the nodulose keel on the vertebral plates, and by the dentated hinder margin, as well as by the absence of the nuchal shield.

X.—*Notice of a new Species of* Pelomedusa *from Natal.* By Dr. J. E. Gray, F.R.S. &c.

Hitherto there have been only two species of *Pelomedusa* recorded—one from the Cape of Good Hope, which has been long known, and the other from Abyssinia, where it was discovered by Dr. Edward Rüppell; and they are so distinct from one another in the form of the ventral shield that each has been considered the type of a distinct subgenus, viz. *Pentonyx* and *Pelomedusa.* The British Museum received from Mr. Sargeant, the Commissioner for Natal in the International Exhibition, two specimens of the genus from Natal. They belong to the same subgenus, and are very like the species from the Cape; yet they seem to offer characters which mark them as distinct species, or at least very distinct local varieties.

In the Cape species, or *Pelomedusa subrufa,* the head is moderate (but they seem to vary in its size, perhaps in the two sexes), and there are only a few small scales between the hinder outer edge of the crown-shield and the upper edge of the temple-shield, and the front one of these scales is over the middle of the temple-shield.

In the Natal species, which may be called *Pelomedusa nigra,* the head is larger and more depressed, and there are several scales between the outer hinder edge of the crown-shield and the temple-shield; and the front scale of the series is narrow, and in the front part of the suture near the orbit which separates these two shields.

When I published the 'Catalogue of the Shield Reptiles,' (1855, p. 53), I separated a specimen which I had obtained from Mr. Warwick, as a variety of *P. subrufa,* thus: "Black, grey-spotted; shields all with close, rather granular, radiating ridges and concentric grooves; areola small." I am now informed that this specimen came from Natal; and in the above character it agrees with the two specimens received from Mr. Sargeant; while in all the specimens of *P. subrufa* which I have seen, the shell is more or less rufous brown, often very pale, and the shields are smooth, with only a few distant concentric narrow lines, or they are all over smooth, as if worn and polished.

The three Natal specimens agree also in the under side of the margin being black, with triangular white portions on the inner hinder edge of each shield, and the sternum is black or blackish brown. From this distribution of the colours, I believe that the "*Pentonyx du Cap*," figured by M. Auguste Duméril in the 'Archives du Muséum,' is this species.

I have no doubt of these being distinct species, not only on account of their colour, but also on account of the difference in the scales on the crown, which is very similar to the difference that separates the Natal from the Madagascar *Sternothærus*.

XI.—*Contributions to an Insect Fauna of the Amazon Valley.* COLEOPTERA : LONGICORNES. By H. W. BATES, Esq.

[Continued from vol. ix. p. 458.]

Subtribe ACANTHOCINITÆ.

Group *Lagocheirinæ*.

Genus LAGOCHEIRUS (Dej. Cat.), Thomson.

Thomson, Classif. des Cérambyc. p. 9.

Body of large size, broad, oblong, slightly convex. Antennæ stout, half as long again as the body, and of nearly equal length in both sexes; the sixth joint in the males having a tubercle beneath its apex, surmounted by a pencil of stiff hairs; the basal joint is as long as the third, gradually thickened from the base, and in both sexes toothed beneath at the apex. Thorax obtusely tuberculated on its disk, and with large conical lateral tubercles. Elytra very broad at the shoulders, gradually and slightly tapering to the apex, which latter is briefly truncated. Thighs abruptly clavate; basal joint of the tarsi not much longer than the second.

The females have not elongated ovipositors and sheaths; the terminal abdominal segments, however, are much longer in the females than in the males. In one of the two species which I have examined (*L. araneiformis*) both the ventral and dorsal segments have their apical edges excised, whilst in the other (*L. fasciculatus*) they are entire. The males have their anterior tarsi ciliated.

1. *Lagocheirus araneiformis*, Linnæus.

Cerambyx araneiformis, Linn. Syst. Nat. ii. p. 625; Drury, Illustr. ii. t. 35. f. 4.
Acanthoderes araneiformis, Serv. Ann. Soc. Ent. Fr. iv. p. 30.

L. oblongus, postice modice attenuatus: thoracis tuberculis lateralibus acutis: elytris nigro fasciculatis, olivaceo-griseis, macula magna laterali triangulari fusco-nigra lineisque transversis pallidis ornatis: tarsis articulis duobus basalibus griseis, duobus apicalibus nigris nitidis. Long. 7–11 lin. ♂ ♀.

This is a well-known and widely distributed insect. I found it occasionally at most stations on the banks of the Amazons, from Pará to Peru: it is also a native of Guiana, the West Indian Islands, and the Island of Tahiti, where, according to M. Vesco*, it is common, the larva inhabiting the trunks of *Spondias dulcis*. It is not stated whether the Tahitian examples differ from those of America; those of the West Indian Islands form a tolerably distinct local variety. The species, however, has probably been introduced by the agency of man into the distant Polynesian island.

2. *Lagocheirus fasciculatus*, White.

Trypanidius fasciculatus, White, Cat. Long. Col. Brit. Mus. ii. p. 377, pl. 9. f. 9.

L. oblongus, postice valde attenuatus: thoracis tuberculis lateralibus obtusis: elytris nigro fasciculatis, olivaceo-griseis, maculis duabus lateralibus triangularibus (altera magna, altera parva) fasciaque lata pallida ornatis: tarsis ochraceis, articulo ultimo apice nigro. Long. 8–9½ lin. ♂ ♀.

Not uncommon at Ega, Upper Amazons, on dead branches in the forest, in company with *Acrocinus trochlearis* and other wood-eating Coleoptera. The tubercle at the tip of the sixth antennal joint of the males is much larger in this species than in *L. araneiformis*. The figure given in White's Catalogue represents a female.

Genus Leptostylus.

Leconte, Journ. Acad. Nat. Sc. Philad. n. s. ii. p. 168.

Syn. *Amniscus*, Dej. Cat. (part.).

The chief characters given by Leconte as distinguishing this from the allied genera are the shortness of the basal joint of the posterior tarsi and the tuberculose surface of the thorax, whose sides are simply prominent instead of being armed with a tooth or spine. The genus consists of a number of small-sized species more nearly allied to *Lagocheirus* than to *Leiopus* and *Acanthocinus*, being of compact, oval, convex form, and having short

* Léon Fairmaire, Coléoptères de la Polynésie, p. 88.

legs with thighs abruptly clavate. The basal joint of the posterior (as well as the other) tarsi is scarcely longer than the second; the thorax is very much narrower than the elytra, and its surface is studded with obtuse tubercles, the lateral tubercles in some of the species being scarcely visible, and in none spiniform: the elytra are also tuberculated or uneven, and are not spined at the apex. Most of the species which I have examined have the basal joint of the antennæ much flattened beneath; and in all, the apex of the same joint is produced beneath into a short tooth. The elytra are generally fasciculated, but have not very distinct centrobasal ridges.

Leptostylus appears to be closely related to *Erphæa* of Erichson (Consp. Ins. Peruana, p. 144), differing chiefly in the absence of acute lateral thoracic tubercles.

1. *Leptostylus pleurostictus*, n. sp.

L. oblongo-ovatus, subconvexus, tomento cinereo-brunneo vestitus: thoracis dorso quinquetuberculato: elytris multifasciculatis, lateribus macula magna nigro-fusca ornatis. Long. 4½ lin.

Head clothed with tawny-brown pile. Antennæ not much longer than the body, brown; basal joint (except the tip) and base of the remaining joints grey. Thorax with five distinct dorsal tubercles; the lateral tubercles short, conical, obtuse, and accompanied, near the front angle on each side, by a smaller one: greyish or hoary, a lateral spot behind the tubercle dark brown. Elytra ovate, not narrowed before three-fourths of their length; apex very briefly, obtusely, and obliquely truncate: surface coarsely punctured (except near the tip), and furnished with numerous small tubercles arranged in three irregular rows, and surmounted each by a pencil of short bristles pointing towards the apex: the colour is ashy or greyish brown, a large dark brown patch occupying each side from the base to the middle, and an indistinct oblique whitish belt traversing the middle of each elytron. Underneath and legs brownish, varied with grey. The sterna are all plane.

Occurred sparingly at Ega on slender dead branches.

2. *Leptostylus cretatellus*, n. sp.

L. oblongus, subconvexus, tomento canescente vestitus: elytris linea laterali nigra, macula magna apicali fusca: thoracis dorso indistincte tuberculato. Long. 3½ lin.

Head clothed with grey pile. Antennæ grey, spotted with brown. Thorax uneven above; tubercles indistinct, the lateral ones conical, obtuse, placed behind the middle; the colour is hoary white, the fore part of the disk having two small dark brown spots. Elytra oblong, sharply and obliquely truncated at the apex; surface punctured, and furnished with three faint raised lines, on which rise a few small elevations, surmounted each by a minute pencil of black hairs; the colour is hoary white, except at the apex, which has a large brown spot remounting in an angle on the suture; the sides near the base have also a thick blackish line. Legs and underside greyish, varied with brown.

One example taken at Obydos.

3. *Leptostylus ovalis*, n. sp.

L. curtus, ovatus, convexus, nigrinus: thoracis dorso trituberculato, tuberculis lateralibus obtusis. Long. 3 lin.

Head olive-grey, with minute black spots. Antennæ with the three basal joints dark grey, speckled with black; the remainder grey, with the tips blackish. Thorax with an elevation on the front part of the disk, surmounted by three obtuse tubercles; the lateral tubercles very obtuse: punctured, scantily clothed with dark grey pile irrorated with black. Elytra short, ovate, very briefly truncated at the tip, coarsely punctured, and furnished with rows of small tubercles, each surmounted by a short pencil of black hairs; the colour is sooty black, with scanty dark grey pile, but towards the apex the grey pile forms a patch speckled with black. Beneath iron-grey, slightly shining. Legs grey, speckled with black.

Found at Obydos and Pará, on slender dead twigs.

4. *Leptostylus obscurellus*, n. sp.

L. elongato-ovatus, fuliginosus: thorace brevi, dorso inæquali, tuberculis lateralibus prominentibus. Long. 3 lin.

Head clothed with sooty pile; antennæ of the same hue, with the bases of the joints (after the third) pallid. Thorax small compared with the elytra; disk very uneven, the depressed parts coarsely punctured, the lateral tubercles prominent; colour sooty. Elytra elongate-ovate, the broadest part being about two-thirds their length, the tip not perceptibly truncate; their surface is thickly punctured, and is furnished with a few small tubercles or ridges crested with hairs, as in the allied species; the colour is sooty, with a few spots of white pile on the disk, sometimes forming a patch near the apex. Beneath grey; legs sooty, varied with grey; base of the thighs pallid.

Taken on slender dry twigs, in the suburbs of Santarem.

Group *Leiopodinæ*.

Genus Amniscus (Dej. Cat.).

Besides the species taken to form the genus *Leptostylus*, the vague group standing in collections under the yet uncharacterized name of *Amniscus,* Dejean, comprises others which might conveniently bear this title, as they differ in many respects from the types of *Leptostylus.* These have an elongated and subdepressed form, with the basal joint of the posterior tarsi equal to the two following united. They form a connecting link between *Leptostylus* and *Alcidion,* differing from the latter in having the elytra oblong without prominent shoulders, instead of the triangular form, broad and elevated at the base, which so well distinguishes *Alcidion.* The thorax is tubercular on the disk, as in *Leptostylus,* and its sides are simply prominent in the middle, without acute or spiniform lateral tubercles. The elytra are briefly truncated or rounded at the apex. The thighs are abruptly clavate. In the only species which I have been able to examine closely, the apical segment of the abdomen is conical and somewhat produced in both sexes; but in the male both dorsal and ventral segments are truncated or slightly emarginated at the tip, whilst in the female the dorsal segment is obtusely pointed.

Alcidion polyrhaphoides of White (Cat. Long. Col. Brit. Mus. p. 394, pl. 10. f. 6) may be cited as the type of the genus *Amniscus* as here defined. In this and the species I have to describe the basal joint of the antennæ is abruptly clavate near the tip; but it is doubtful whether this will prove to be a generic character, as some species of *Alcidion* also have the same feature, whilst their nearest allied species have the joint of the same shape as the generality of the Acanthocinitæ. The joint, although abruptly clavate, is of the same relative length as in the rest of the allied genera, and it presents also, near the tip on the underside, the small dentiform process which is characteristic of the subtribe.

Amniscus pictipes, n. sp.

A. oblongus, testaceo-rufus, nigro canoque variegatus: thoracis dorso trituberculato, tuberculis anticis fortiter elevatis: elytris prope basin bifasciculatis. Long. $3\frac{1}{2}$ lin. ♂ ♀.

Head yellowish, spotted with black. Antennæ reddish, joints tipped with black; basal joint swollen beneath near the apex, the latter toothed. Thorax with three tubercles in a triangle on the disk, the two anterior very prominent; lateral tubercles obtuse; the colour is brown testaceous, with two black dorsal stripes. Elytra oblong, gradually narrowed from the middle to the tip, which latter is not truncated; the surface is thickly punctured, especially towards the base, and in the place of the centro-basal ridge there is a large pencil of black hairs; the rest of the surface even; the colour is testaceous brown, with the base and a few scattered marks blackish, an indistinct whitish line obliquely crossing the disk. Body beneath testaceous, clothed with pile of the same colour. Legs and tarsi reddish, spotted with grey and black.

One example, taken at S. Paulo, Upper Amazons. The species also inhabits South-eastern Brazil, specimens from Rio Janeiro (taken by Mr. Squires) not differing from the Amazonian example except in being rather duller in colour.

Genus Alcidion (Dej. Cat.), Thomson.

Thomson, Classif. des Cérambyc. p. 12.

Char. emend. Thorax free from tubercles on the disk, or at most but slightly uneven, its sides unarmed. Elytra broad and convex at the base, thence narrowing in a nearly straight line to the apex, with the surface sloping equally in that direction; the apex truncated and toothed or spined, and the centrobasal ridges more or less prominent. Apical segments of the abdomen and ovipositor not produced in the female. Thighs abruptly clavate; basal joint of the tarsi generally longer than the two following united.

As above defined, the genus *Alcidion* will comprise a considerable number of species distinguished from *Amniscus* by the peculiar shape of the elytra, and from other allied genera by the thorax wanting the lateral spines. It is divisible into two groups,—one of which is distinguished by the species having a raised line along the whole length of the elytra on each side, from the centro-basal ridge to the external apical angle; and the other by the absence of these lines, the centrobasal ridges at the same time being very prominent. The Amazonian species belong wholly to the second group*.

* *A. latum* (Thomson, *l. c.*), of Mexico, seems to belong to the first group; also *Leiopus emeritus* (Erichson, Conspectus Ins. in Peruana, p. 147) of Eastern Peru. The two following should also be added:—

A. bispinum (Dej. Cat.). Modice elongatum, apud humeros latum, postice declivum et attenuatum, fusco-testaceum griseo olivaceoque variegatum. Caput nigrum. Antennæ fusco-testaceæ, articulo basali subiter clavato, clava infra barbata. Thorax griseo-olivaceus. Elytra apice sinuato-truncata, angulo interno acuto, externo longe mucronato, supra utrinque bicarinata, carinis lævibus, interstitiis punctatis, carina centro-basali nigro penicillata; grisea olivaceo varia, fascia pone basin nigricante. Subtus testaceum, sternis nigricantibus. Pedes testacei, griseo maculati. Long. $3\frac{1}{2}$ lin. *Hab.* Rio Janeiro.

A. lineatum, n. sp. Elongatum, apud humeros minus latum, olivaceo-fulvum, olivaceo-fusco varium. Caput olivaceum, vertice fusco bipunctato. Antennæ fusco-testaceæ, articulo basali sensim clavato, infra planato et barbato. Thorax medio fusco bivittatus. Elytra valde elongata, punctata, apice sinuato-truncata, angulo interno acuto, ex-

1. *Alcidion oculatum*, n. sp.

A. oblongum, postice modice attenuatum, tomento cervino subsericeo vestitum: thorace maculis duabus nigro-fuscis, albo marginatis: elytris lateribus acute carinatis, dorso lævibus, utrinque fascia discali interrupta nigro-fusco ornatis. Long. $3\frac{3}{4}$ lin.

Head and thorax tawny brown; disk of the latter with two short blackish lines, narrowly margined with whitish. Antennæ dusky, base of each joint from the fourth pallid; basal joint gradually clavate, the outline waved beneath. Elytra prominent at the shoulders, gradually narrowed to three-fourths of their length, then more quickly so to the apex, which is briefly and very obliquely truncate, without spines: the sides are acutely carinated; the dorsal carina is effaced, but the centro-basal ridge is very prominent, and crested with hairs; the surface is punctured (except near the apex); the colour is tawny or violaceous brown, with a slight silky gloss, having on the disk behind the middle a short blackish-brown fascia, bordered on the basal side with pale ashy; a small linear mark of the same colour is seen also near the suture towards the apex, and the suture, disk, and lateral margins have rows of small dark spots. Beneath tawny ashy. Legs testaceous; thighs varied with ashy; tibiæ black at the base and apex; tarsi with the middle joints black.

Ega; on slender dead branches in the forest.

2. *Alcidion triangulare*, n. sp.

A. breve, postice valde attenuatum, fulvo-griseum: thorace fusco bimaculato: elytris medio irregulariter cinereo fasciatis, apicem versus cinereo strigosis, apice breviter oblique sinuato-truncatis. Long. $3\frac{1}{2}$ lin.

Head dusky; antennæ testaceous brown, apices of the joints from the third black, basal joint waved beneath. Thorax tawny brown; disk with two round blackish spots, sometimes wanting. Elytra gradually narrowed from shoulders to apex, which latter is very obliquely sinuate-truncate; the sides acutely carinated from the shoulder, the carina effaced before the apex; surface even and punctured, the centro-basal ridge extremely prominent and destitute of hairs: the colour is tawny brownish, with a very indistinct, waved, ash-coloured fascia across the middle, the apical part being silky brownish, streaked with ashy. Beneath and legs testaceous brown; base and apex of tibiæ and middle joints of tarsi blackish.

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terno obtuse dentato; carina dorsali tenui et acutissima, centrobasali parum prominente, lateribus discoque etiam carinatis, carinis obtusis et abbreviatis. Subtus nigricans; pedibus fuscis. Long. $5\frac{1}{2}$ lin. *Hab.* Venezuela.

Var. *Paraënse,* rather more robust; the surface and sides of elytra more thickly punctured, and the apex simply truncated, without sinuation.

This was rather a common insect at Ega, on dead twigs. The variety was found at Pará.

3. *Alcidion latipenne,* n. sp.

A. crassum, postice modice attenuatum, apice transverse sinuato-truncatum: elytris humeris valde productis lateribusque carinatis. Long. 4–6 lin. ♀ ♂.

Head dusky; antennæ testaceous brown; base of all the joints from the third pallid. Thorax much broader than long, surface uneven, tawny brown, silky, with a V-shaped dusky mark behind, joining two dusky spots on the sides of the scutellum. Elytra very broad and convex at the base, gradually narrowed to the apex, which is broadly and transversely sinuate-truncate, with the external angles somewhat produced; the shoulders are very prominent, and from the acute edge of each commences the lateral carina, which extends nearly to the apex; the surface is even and moderately punctured, the colour being reddish or tawny brown, slightly streaked here and there with ashy, especially in the middle, and having rows of small dusky specks, a large violet-brown spot lying on the deflexed margin beneath the shoulders. Beneath and legs testaceous brown.

Ega, and on the banks of the Cuparí, a branch of the Tapajos.

4. *Alcidion interrogationis,* n. sp.

A. valde elongatum, postice parum attenuatum, carneo-griseum sericeum: elytris apice longe mucronatis, litura nigra signum interrogationis simulante ornatis. Long. 5½ lin.

Head brown; antennæ dusky, base of joints from the third pallid, the first joint strongly waved. Thorax tawny, sides black, and disk with a black mark shaped like a horse-shoe. Elytra elongated, quickly narrowed behind the shoulders, then widening slightly, afterwards towards the apex again narrowed, the apex itself being rather broad and sinuate-truncate, the internal angle dentiform, the external one produced into a lengthened spine; the shoulders are acute, and from their edge commences the lateral carina, which is very prominent, but is so placed as to leave the deflexed portion of the elytra beneath it visible from above; the surface is rather thickly punctured in the middle towards the base, sparingly so in other parts; the centro-basal ridges are short, but extremely elevated, hooked posteriorly, and surmounted by a crest of black hairs; the colour is grey, with a rosy tint in some lights, and towards the apex there is on the disk of each a black curved line and spot resembling the note of interrogation. Legs (especially the posterior thighs) elongated; like the under surface of the body, they are of a dusky hue.

This elegantly shaped and curiously marked insect occurred only at Ega, on dead branches in the forest.

5. *Alcidion olivaceum,* n. sp.

A. oblongum, postice modice attenuatum, tomento olivaceo signaturis obscurioribus variegato vestitum: elytris apice breviter oblique truncatis, femoribus crassissimis. Long. $5\frac{1}{2}$ lin.

Head dusky; antennæ dusky reddish, base of joints from the third pallid. Thorax olivaceous grey, with a short black streak in the middle of the hind margin. Elytra rather broad at the shoulders, and narrowed curvilinearly thence to the apex, which is briefly and obliquely truncate; the lateral carina is less pronounced than in the last species, but the centro-basal ridges are very prominent; they are hooked behind, although not crested with hairs; the surface is rather uneven, having two faint and obtuse dorsal carinæ, which, however, are effaced shortly behind the middle; the colour is olivaceous grey, varied with small dusky spots which accompany the carinæ, and two oblique discal streaks placed behind the middle. Beneath and legs dusky, varied with grey; base of thighs and tip of tarsi testaceous; the thighs are short and very thickly clubbed.

Ega, Upper Amazons.

6. *Alcidion minimum,* n. sp.

A. parvum, depressum, postice modice attenuatum, fusco-cinereum, fuliginoso maculatum: elytris apice oblique sinuato-truncatis, angulis obtusis, carina centrobasali modice elevata. Long. 2 lin.

Head sooty brown; antennæ with the basal joint strongly flexuous beneath, sooty brown. Thorax smooth, sides rounded, hinder part punctured. Elytra subtrigonal, depressed, with lateral carinæ; centro-basal ridges moderately elevated, and not abrupt posteriorly; apex obliquely sinuate-truncate, angles not produced; the surface (except towards the apex) has a number of large punctures, and is of an ashy-brown colour, with a number of oblong dusky spots on the apical portion. Body beneath and legs dusky; base of thighs and of the first tarsal joint and a ring on the tibiæ pale testaceous.

Taken flying in the evening, banks of the river, S. Paulo, Upper Amazons.

The species, from its small size and general appearance, would consort well with those I have placed in the genus *Ozines*; but the absence of lateral thoracic spines compels us to treat it as a member of the *Alcidion* group *.

[To be continued.]

XII.—*On the Leaf-Cells of the British Species of* Hymenophyllum. By George Gulliver, F.R.S., Professor of Anatomy and Physiology to the Royal College of Surgeons.

A comparative examination of the leaf-cells of this genus seems to be a desideratum, which I can only attempt to supply, at present, as far as regards the British plants.

There is nothing satisfactory on the subject in the works of Sir James Edward Smith and Mr. Sowerby. In the 'English Botany' no mention occurs of the cells; and the figure given of those of *H. Wilsoni* (t. 2686) incorrectly represents the intercellular spaces nearly or quite as large as the cells, though the oval form is truly depicted, but without the slightest indication of any difference in this respect between the two species. The same remark is applicable to the descriptions and plate in the

* The following species also belong to the second section of *Alcidion*:—

A. bicristatum. Elongatum, postice sensim attenuatum, olivaceo-griseum, fusco varium. Caput olivaceum. Antennæ infra parce setosæ, articulo basali angulo inferiore apicali producto, olivaceo-brunneæ, articulis basi pallidis. Thorax dorso obtuse tuberculatus, antice et postice punctatus, olivaceo-griseus, subsericeus. Elytra elongata, depressa, postice sensim attenuata, apice oblique sinuato-truncata, angulis externis productis; lateribus et disco obtuse carinatis; carinis centrobasalibus parum prominentibus, singulis cristis duabus pilorum nigrorum ornatis; elytris utrinque penicillis minutis atris in duplici serie (altera suturali, altera obliqua discoidali) notatis: olivaceo-grisea, tertia parte posteriore saturatiore griseo lineata, marginibus nigro punctatis. Corpus subtus griseum, pedibus olivaceo-griseis nigro punctatis, femoribus basi testaceis. Abdomen fœminæ segmento ultimo dorsali apice attenuato producto, maris rotundato medio emarginato. Long. 5 lin. ♂ ♀. *Hab.* Rio Janeiro. (Coll. Squires.)

A. trivittatum. Elongatum, depressum, postice sensim attenuatum, brunneo-sericeum, vittis et maculis fusco-atris ornatum. Caput fuscum. Antennæ rufescentes, articulis basi pallidis, articulo basali æqualiter clavato. Thorax rotundatus, dorso æqualis, olivaceo-brunneus, sericeus, vittis latis tribus atro-fuscis velutinis (una centrali, alteris lateralibus) marginem anticum haud attingentibus ornatus. Elytra elongata, depressa, apice sinuato-truncata, angulis internis acutis, externis valde productis, humeris parum prominentibus, lateribus utrinque acute flexuoso-carinatis; disco æqualia; carina centrobasali valde prominente, brevi, nuda; rufescenti-brunnea, certo visu carnea nitentia, passim punctata et fusco maculata; lateribus prope basin fuliginosis; disco pone medium plaga atro-fusca antice utrinque linea obliqua grisea marginata ornato. Corpus subtus nigricanti-sericeum. Pedes nigricantes, tibiis et tarsorum articulo primo cano annulatis. Long. 5 lin. *Hab.* Venezuela.

very recent book on British Ferns by Messrs. Sowerby and Johnson. Sir William Jackson Hooker, in his 'Genera Filicum' (1842), in like manner merely gives a figure, by Mr. Bauer, of the cells of the same species, better than that in the 'English Botany,' but still with the intercellular passages too large. Four species of *Hymenophyllum* are figured and described in the 'Century of Ferns' (1854), by the same author; but no information is given about the cells; nor does any appear in the works either of Mr. Francis, Mr. Newman, Professor Babington, or Mr. Bentham. Even the great books of Mr. Moore and Mr. Lowe contain no notice of any variety or difference in these leaf-cells. Hence it might be inferred that they are all alike, or not worth notice in the several species of this interesting genus. But it will presently be shown how probable it is that the form and size of the leaf-cells may afford good distinctive characters, even in the absence of the fruit and of well-grown leaves; and perhaps Sir W. J. Hooker had seen the difference as regards size merely, since of *H. Wilsoni*, in the fourth edition of the 'British Flora,' he remarks, "more rigid and with larger reticulations than the last."

Of these plants Mr. Newman says, "In retaining the two as distinct species I merely bow to the opinion of better botanists than myself;" while in the second edition of 'English Botany' it is stated, "Were not the fructification so remarkably different, *H. Wilsoni* could scarcely be considered a distinct species;" and lastly, Mr. Bentham describes this as a variety merely of *H. Tunbridgense*. But Sir W. J. Hooker, Professor Babington, and other high authorities seem to have no doubt that these plants are really different species; and this view is supported by the observation of Mr. F. Clowes of Windermere, that "all the fronds of *H. Tunbridgense* are annual, while those of *H. Wilsoni* go on growing from year to year."

My own observations, having been confined to two tufts of the plants, are only presented as a suggestion for further comparative examination of their leaf-cells, when, should the difference prove to be regular and constant, it is to be hoped that the shape and size of these cells will in future form part of the descriptive characters of both the British and exotic species.

H. Tunbridgense.—Leaf-cells round, or nearly so, with an average diameter of $\frac{1}{571}$ of an inch.

H. Wilsoni.—Leaf-cells oval, with an average long diameter of $\frac{1}{308}$ and short diameter of $\frac{1}{615}$, the mean of the two diameters being $\frac{1}{410}$ of an inch.

Thus, besides their much larger size, the form of the cells is distinctly oval in *H. Wilsoni*; and the diagnostics of the two species might be given merely by the terms *sphærenchyma* and *ovenchyma*.

In both species the sides of the cells are somewhat flattened from mutual pressure; and the intercellular passages are either very narrow or not easily seen when the parts are quite moist.

Fig. 1. Fig. 2.

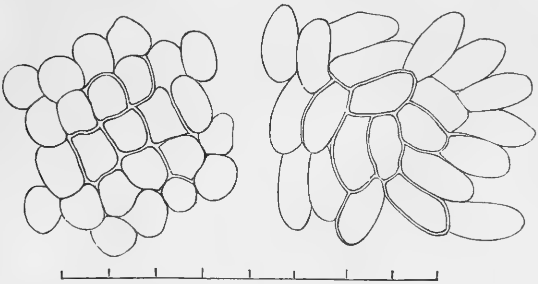

Fig. 1. Outlines of leaf-cells of *H. Tunbridgense*.
Fig. 2. The same of *H. Wilsoni*.

[Both drawn to the one scale of $\frac{1}{500}$th of an inch.]

Edenbridge, July 9, 1863.

XIII.—*On the Value of the Distinctive Characters in* Amœba. By G. C. Wallich, M.D., F.L.S., &c. &c.

In a series of papers published in the 'Annals and Magazine of Natural History' for April, May, and June, 1863, I adverted to the absolute necessity of long-continued and daily observation whensoever it is desired to elucidate the characters and vital phenomena which appertain to the lowest and, at the same time, the most minute forms of organic existence—my remarks on this head having been specially prompted by the truly Protean aspects under which *Amœba villosa* presented itself to my notice.

A fourth month's close study of that form has not only lent additional force to my previous descriptions, but, whilst it enables me to speak with still greater confidence on the subject, it also demonstrates in a striking degree, as I shall presently show, the fallacy of attempting to arrive at a correct knowledge of the characters and ever-varying phases of such an organism under a less laborious and protracted examination.

After the last paper of my series was completed, namely, on the 20th of May, Mr. Carter called on me; and for the first time I made the acquaintance of a naturalist whose researches amongst the lower forms of animal life have always been justly regarded as well worthy of attention. On a subsequent occasion, I endeavoured to exhibit to him, as far as his time permitted, the characters of *Amœba villosa* as then observable in living specimens taken from my aquarium, dwelling strongly, however, on the marked changes which had already taken place in them under the unfavourable conditions of long captivity.

Courting, as I have avowedly done, the fullest scrutiny into the characters and vital phenomena of the Rhizopods alluded to in my descriptions, I confess I was by no means prepared to find that, under an evident misapprehension of my meaning, the view entertained by me throughout my protracted survey of the *Amœba villosa* (namely, that probably many, if not all, of the previously described forms of *Amœba* are referable to, and constitute mere phases of, this the most highly developed type*) should have been adduced in support of the statement that *Amœba villosa* is now regarded by me as identical with *A. princeps* only.

That such has never been my belief may be gathered both from my own account of the first-named species, and from a note appended to the *résumé* of my papers by Mr. H. J. Slack, which appeared in the July Number of the 'Intellectual Observer,' simultaneously with Mr. Carter's notice on *A. princeps* in the 'Annals.'

Much as I regret the necessity of having to become the critic of Mr. Carter's opinions, in order that I may adequately sustain my own, I must state my reasons for declining to subscribe to many of the conclusions at which he has arrived. These reasons will appear whilst I endeavour to establish the four following propositions:—

1. That it is entirely opposed to usage and rule to change the name under which an object shall have been, for the first time, accurately described.

2. That the characters of *Amœba villosa*, as first brought to notice by me in the three published papers to which allusion has been made, are sufficiently important and distinct from those of any previously described form to warrant their being regarded as typical.

3. That certain characters regarded by Mr. Carter as of primary importance, and typical of *A. princeps* (Ehr.) as now *reconstituted* by him, are distinctive of *A. villosa* as already described by me.

4. That the interpretation put by Mr. Carter upon certain other characters which are common to all the *Amœbæ* is negatived by the strongest evidence.

With regard to the first of these propositions, I beg to state

* See note at commencement of my first paper in the 'Annals,' No. 64, for April 1863, p. 287.

at once, and distinctly, that in speaking of the most important and previously undescribed characters of *A. villosa*, I specially allude—(1) To the presence of a villous organ, and the varied phases it assumes as occasion may require. (2) The invariable situation of this organ with reference to the rest of the body, so as to indicate a definite posterior and anterior portion. (3) The well-marked prehensile office of the villi. (4) The extrusion of effete matter through an aperture* in the midst of the villous region. (5) The occasional extrusion of vacuolar vesicles by a similar aperture. (6) The occasional circulatory movement † of the nucleus and contractile vesicle along with the rest of the endogenous as well as exogenous contents of the body. (7) The circumstances under which one or both of the above organs remain, as it were, fixed in the vicinity of the villous region. (8) The discharge, externally, of the contents of the contractile vesicle through an aperture within the same region. (9) The occasional extrusion of perfectly formed minute individuals, also through an aperture in the villous region. (10) The projection of pseudopodia from every portion of the surface except the villous region. (11) The movements always in a direction opposite to the situation of the villous region. (12, and last) The possibility of completely detaching the membranous-walled nucleus from the parent mass by pressure, without laceration or destruction of its wall.

I confidently affirm that none of these characters had been described in any published work whatever, prior to my description of them in the 'Annals' for April, May, and June last.

As regards the first proposition, I may be permitted to observe that, in 1856, I detected an *Amœba* in Lower Bengal, which I am now satisfied was identical with *A. villosa* or a variety of it. This was figured in the first part of my work on the 'North-Atlantic Sea-Bed,' and referred to cursorily in the 'Annals' for April last (p. 290). But, putting this fact out of

* MM. Claparède and Lachmann have stated their belief in the possible existence of an *oral* aperture in *Amœba*, and its actual existence in *Podostoma*. But they have not noticed, as far as I am aware, the occurrence of anything like an excretory orifice always showing itself at one determinate portion of the body.

† In one sense, this character may not be regarded as new, since the permanent relation of the nucleus and contractile vesicle to the rest of the body, whilst moving, has been clearly pointed out in some varieties of *Amœba* by those excellent observers, MM. Claparède and Lachmann. But they appear not to have associated this character with any distinct and permanent differentiation of a determinate portion of the body. What I desire to indicate is the twofold character—these organs at one time remaining fixed near the villous region, at another *not* holding any definite relative position either to any particular portion of the body or to each other.

the question, inasmuch as the Bengal form has not been specially described, in order to render evident the true value attached to all unpublished researches, I need only quote the subjoined extract from the 'Report of the Committee of the British Association for 1842, appointed to consider the rules by which the nomenclature of zoology may be established on a uniform and permanent basis:'—

"Unless a *species* or group is intelligibly defined when the name is given, it cannot be recognized by others, and the signification of the name is consequently lost. Two things are necessary before a zoological term can acquire any authority, viz. *definition* and *publication*. Definition properly implies a distinct exposition of essential characters; and in all cases we conceive this to be indispensable, although some authors maintain that a mere enumeration of the component species, or even of a single type, is sufficient to authenticate a genus. To constitute *publication*, nothing short of the insertion of the above particulars *in a printed book* can be held sufficient." * * * "Nor can any unpublished descriptions, however exact, claim any right of priority till published, and then only from the date of their publication. The same rule applies to cases where groups or species are published, but not defined. Therefore (§ 12) *a name which has never been clearly defined in some published work should be changed for the earliest name by which the object shall have been so defined.*"

Here, then, it will be seen that, independently of the very secondary question as to priority in discovery of the essential characters which I believe indicate the typical *Amœba*, the really important point for determination (namely, the validity or otherwise of the definition assigned by the original founder of the species *A. princeps*, as embracing *A. villosa*) is not left in doubt for a moment. And hence, although the characters so assigned to *A. princeps* must be held as insufficient for the definition of *A. villosa*, those assigned by me to the latter form are such as to embrace every character previously assigned to *A. princeps*. Under these circumstances, I apprehend it is quite unnecessary for me, in view of the rule just quoted, further to discuss the grounds upon which I am reluctantly compelled to object to the course followed by Mr. Carter in making a new definition for *A. princeps* so as to embody the characters of the all-important organ to which attention was directed by me in my late papers. The statement at page 43 of Mr. Carter's paper in the 'Annals' for July, namely, that "the villous appendage which marks the posterior end of *A. princeps* has lately been brought to notice by Dr. Wallich in the species for which he has proposed the designation of *A. villosa*," in the absence of any intimation of the fact that both the discovery and the name are mine, coupled with the remark which immediately follows as to having figured the villous appendage in his "Indian Journal" * so far back as

* Of course I am writing under the impression that by the term "Indian Journal" is meant a private and unpublished journal.

1854, and the declaration, at the commencement of the paper, that the same nomenclature should be adopted as he had used in papers published in 1856, necessitates the inference that I had adopted his name without the usual and due acknowledgment. Whilst distinctly stating that neither of these conclusions is reconcilable with the facts of the case, I would express my conviction that, as Mr. Carter could not intentionally have conveyed such an impression, he will be the foremost to eradicate it, more especially when I point out that any one unacquainted with my notices in the 'Annals' for April, May, and June last, perusing his paper of July, could not fail to regard every one of the characters peculiar to these *Amœbæ* as having been brought to notice for the first time by Mr. Carter. Moreover it will be seen, on a careful comparison of our respective statements, that, although he does not indicate whose opinions he is endeavouring to controvert*, the previously unknown nature of the characters conclusively point to mine.

Although satisfied from Mr. Carter's statement in the last Number of the 'Annals,' that the *Amœba* met with by him in Bombay, in 1854, was in all probability the same form he now describes under the name of *A. princeps*, it is very certain, from what he wrote regarding the typical characters of *Amœba* in 1856 and 1857 (due reference to which will be made hereafter), that he did not regard them as sufficiently distinct to demand special notice; otherwise it is difficult to conceive how he failed to furnish a record of them in any of his published papers from 1854 to July 1863. For it is necessary to mention that, in a paper by Mr. Carter, entitled "Notes and Corrections on the Organization of Infusoria, &c.," which appeared so recently as the year 1861 (Ann. Nat. Hist. ser. 3. vol. viii. p. 281), no reference was made to any modification of his opinions on the points now at issue.

Having thus stated my reasons for thinking it would have been but just had Mr. Carter adduced under the same specific designation whatever further information he possessed concerning an organism which cannot be regarded as distinct from *Amœba villosa*, it is due to myself to state explicitly (with reference to my declaration that many of the so-called species of *Amœba*, if not all of them, are referable to a single specific type) that although of opinion that *A. bilimbosa, A. radiosa, A. princeps, A. Rœselii*, and other varieties are nothing more than imperfectly developed phases of *A. villosa*, inasmuch as none of the striking characters pointed out by me as appertaining to *A. villosa* had been indicated in any of the published defini-

* Had Mr. Carter done so, the necessity for these observations would have been altogether spared me.

tions of these forms, and there were no grounds for assuming that one of these varieties approached more nearly to it than the rest, I had no alternative but to designate my new form by a new specific name—leaving it to be determined hereafter whether *Amœba princeps* and those other forms which have received distinct specific appellations, on trivial differences in their configuration, are or are not mere transitional phases of the most highly developed type, namely, *A. villosa* *.

Fortunately the means of verifying or refuting every statement advanced by me with regard to *A. villosa*, both in matters of fact and deduction, are at hand, and will become more and more abundant as soon as favourable habitats for this Rhizopod shall be discovered. But should any lingering doubt remain as to the impropriety of altering the original definition of *A. princeps*, in order to render it conformable with the characters observable in *A. villosa*, it is only necessary to refer to Mr. Carter's declaration † that "Ehrenberg's ‡ and Dujardin's § figures are good representations of" *A. princeps*, and to beg the reader to examine the plates and definitions here alluded to. On doing so, he will find that neither in the figures themselves nor in the letter-press definition accompanying them is reference made to a single character on which I have based the typical stability of *A. villosa* ||.

* The following extract from Mr. Carter's supplementary paper on "the Infusoria of Bombay," published in 1857, will show that, whilst he is fully alive to the necessity of re-naming an imperfectly defined form, he has put the principle into practice on differences of structure which bear no comparison, in point of importance, with those now assigned to *Amœba villosa*:—"*Euglypha pleurostoma* is very like Ehrenberg's *Difflugia Enchelys* and Dujardin's *Trinema acinus*; but not being identical with the *figure* given of the former, and though often presenting three radiated prolongations like the latter, but by no means so constantly, it becomes necessary to give it a name." (Ann. Nat. Hist. ser. 2. vol. xx. p. 35.)

† Ann. Nat. Hist. July 1863, p. 31.

‡ Infusionsthierchen, Atlas, fol., tab. 8. fig. 10 (1838).

§ Hist. Nat. des Zoophytes, Atlas, plate 1. fig. 11.

|| I subjoin the definitions in question:—"*A. princeps. A.* major dilute flavicans, sextam lineæ partem repens, processibus variabilibus, numerosis, cylindricis, crassis, et apice rotundatis." (Ehrenberg's Infusionsthierchen, p. 126.)

"*A. princeps*, majeure. Large de 0·37 à 0·60, blanc jaunâtre. Remplie de granules qui refractent la lumière, et se portent ou refluent dans les expansions successivement formées, lesquelles sont très-diaphanes à l'extrémité et souvent très-longues" (Dujardin, Hist. Nat. des Zoophytes, 1841, Paris); whilst appended to the plate is the subjoined remark, distinctly indicating that, irrespectively of the granules, there was nothing to show the direction in which the animal might be moving:—"Elle est avancée à la fois ses deux branches en y poussent la substance glutineuse dont elle est formée avec les granules nombreux et variés qui s'y trouvent engagés et qui montrent bien la direction du mouvement" (*loc. cit.*).

Mr. Carter, at page 37 of his paper, says, "Now, the worst of theories is, that they take up so much time in discussion before they bring out fact; while the best of them is, when multiple, that they prove that the fact is still unknown." Again, at page 38, "Unless we can state in a few words the facts we may wish to establish, it is useless to have recourse to long argumentative theories for this purpose,"—the first remark following immediately on Mr. Carter's reference to my view regarding the reciprocal convertibility of the *ectosarc* and *endosarc*—not of "diaphane" and "sarcode," as he, no doubt inadvertently, puts it.

These remarks may be true in the abstract; but it will, I think, be allowed that, in describing objects visible only under the microscope, theories are unavoidable, inasmuch as the determination of the appearances and offices of each part depends more or less on interpretation. In non-microscopic objects, differences of interpretation as to actual appearances can rarely take place, whatever may be the case as regards deductions based on them. But emanating as these strictures do from an author whose writings are so singularly fertile in speculative physiology, they might perhaps advantageously have been avoided, more especially since I do not advance my view touching the reciprocal convertibility of endosarc and ectosarc as a bare speculation, but as a theory supported by evidence so strong that I have little doubt it will be very generally accepted.

Having, for the present, disposed of the question involving a principle of scientific nomenclature, I would request attention to matters of actual observation. And, in order to facilitate reference, it shall be my endeavour to comment on the various subjects, as far as possible, in the order in which they are treated in Mr. Carter's recent paper.

After stating that he met with *Amœba princeps* in April 1863, and his intention of applying to it specially the nomenclature proposed by him in his "Notes on the Organization of the Infusoria of the Island of Bombay" (1856), Mr. Carter says,

> "The most conspicuous features of *A. princeps*, when it is large, are its size and the number of granules it contains, in both of which characters it much exceeds any other *Amœba* with which I am acquainted. Its form, of course subject to Protean changes, is for the most part limaceous, or once or twice branched; and its pseudopodia, which are almost always lobed and obtuse, *proceed from a posterior end which is normally capped with a tuft of villous prolongations*; while the *distinguishing character of the nucleus* .... consists in the nucleolus being so much extended," &c. &c., as to cause "the pellucid halo which is seen round the nucleus of other *Amœbæ* to be absent."

If the usual practice of stating specific characters in the order of their importance can be taken as a criterion of their value, the villous organ must evidently be regarded as holding no very prominent position in the form under definition. But although this organ is noticed in the leading "specific description" given by Mr. Carter of *A. princeps*, it is altogether omitted in the enumeration of "the parts of which that form is composed," to which attention is drawn immediately afterwards *; whilst the description of this most essential organ, deferred almost to the close of that portion of the paper which treats of *A. princeps*, and until the general features common to all *Amœbæ* have been discussed (Annals, July, p. 43), is introduced under the head "*Villous appendage*," with the subjoined remark:—

"The villous appendage which marks the posterior end of *A. princeps* has lately been brought into notice by Dr. Wallich, in the species for which he has proposed the designation of *A. villosa*," it being immediately afterwards added, that this appendage was figured in Mr. Carter's "Indian Journal, as far back as 1854"†. And yet, strangely enough, at page 44, he writes thus: "I am not quite certain that they (the villi) "are peculiar to *A. princeps*;" and he adds, "I have a drawing of an *Amœba* which has them, but does not appear to have the characteristic form of the nucleus of *A. princeps*. *If* they are confined to *A. princeps*, *then* they form a good distinguishing feature for this species; but, as I have before stated, they are not always present under the same form, and *sometimes not at all*" —a most important admission, as will presently appear.

As regards the so-called distinguishing character of *A. princeps* derived from its nucleus, I have only to remark that, when fresh and vigorous, the Hampstead specimens of *A. villosa* exhibited a spherical or slightly oblong nuclear cell-membrane— the nucleus itself being distinctly granular, spherical in outline

* It is worthy of note that, in the 'Annals' for 1856 (ser. 2. vol. xx. p. 33), out of all the various forms of *Amœba*, *A. princeps* is specially named as being closely allied to the sponge-cell, which is figured, and exhibits not a trace of the essential characters of *A. villosa*.

† Without cavilling at mere words, I cannot help thinking that the following expression of Mr. Carter's, coupled with what I am now stating, must engender an idea that he, and not I, pointed out the extrusion of effete matter from an orifice at the posterior portion of the animal:—"One point here is remarkable, viz. that while any part in front of the villous or posterior end may inclose a particle of food, it is only, so far as my observation extends (and in this I am confirmed by Dr. Wallich), the posterior extremity which gives passage to the egesta." (Annals, July, p. 35.) Mr. Carter then gives a reference to my statement to this effect in the previous number of the 'Annals'; but I have to repeat that, as he dwells so pointedly on his previous knowledge of an *Amœba* possessing the *villous* organ, and, after stating his intention of employing a nomenclature previously suggested by himself, employs mine without any acknowledgment, the inference I speak of, however unintentionally conveyed, is inevitable.

from all aspects, and occupying only so much of the vesicular chamber as to leave around it a clear hyaline space or ring, varying from about $\frac{1}{20}$th to $\frac{1}{10}$th of the total diameter of the organ, and that this ring was broadest, in proportion to the total diameter of the nuclear cell, in the smallest specimens.

Without stopping to discuss the propriety of placing in an entirely subsidiary light an organ of such importance as the villous appendage (even granting, for the sake of argument, that it had ever been previously included in any published definition of *A. princeps*), I own myself at a loss to understand how the character, specially alluded to as distinguishing that form from all other freshwater Rhizopods examined by Mr. Carter, could have been adduced under the circumstances; for, notwithstanding the "specific description" thus given of *A. princeps* at the commencement of his paper, at the close of that portion of it relating to *Amœba* we are distinctly informed that the villous appendage is "sometimes" altogether absent in *A. princeps,* and even the grand distinctive feature of the nucleus is inconstant; whilst, as if to add to the perplexity inseparable from the characters of *A. princeps,* as thus reconstructed, at the same time that, in Plate III. figs. 3 *d* & *f*, illustrating the paper on this form (Annals, July 1863), the absence of the pellucid ring around the nucleus is distinctly exhibited, in the same plate (figs. 2 *c* & *f*) the missing pellucid zone reappears in quite as marked a degree as in the figures of *A. radiosa* and *A. Gleichenii* appended to Mr. Carter's paper in the 'Annals' for 1856 (vol. xviii. pl. 5. figs. 4, 10, 17 & 18). So that the only characters left intact of those named in the introductory specific description are "the size of *A. princeps* when it is large, and the number of granules it contains" (Annals, July, p. 31). It need only be added on this head, that we are not left in doubt as to the size of the specimen depicted on the plate; for, instead of being under $\frac{1}{450}$th of an inch in length (see the next page), it is said in the explanatory references to be $\frac{1}{70}$th of an inch long, the nucleus itself (fig. 2 *c*) being $\frac{1}{700}$th of an inch in diameter, whilst in fig. 2 *f* it is as much as $\frac{1}{500}$th of an inch in diameter.

But I regret to say the difficulty of arriving at a clear view of the subject does not end here; for it seems doubtful whether the pellucid ring referred to as characteristic surrounds the nuclear cell-membrane, the nucleus within the membranous cell, or the nucleolus within the nucleus. This will appear on reference to the three subjoined passages:—

"It [the nucleus] is discoid in shape, of a faint yellow colour, and fixed on one side of a transparent capsule, which, being generally more or less large than the *nucleus* itself, causes the *latter* to appear as if surrounded by a narrow pellucid ring. In this state it is *invariably* present in *Amœba, Actinophrys, Spongilla,* &c." (Annals, ser. 2. (1856), vol. xviii. p. 221).

"While the distinguishing character of the nucleus [in *A. princeps*] to which I have above alluded, consists in the nucleolus being so much extended over the inner surface of the nuclear cell that it passes beyond the equatorial line of the latter, and thus causes the pellucid halo which is seen round the nucleus of other *Amœbæ* to be absent; that is, the nucleolus, being circular and of much less extent than the hemisphere of the nuclear *capsule,* in most *Amœbæ,* causes it to appear in them as if surrounded by a transparent area." (Annals for July, 1863, p. 31.)

"The nucleus in *A. princeps,* as before stated, differs in appearance from that of all other freshwater Rhizopods that I have examined in the absence of a pellucid area round the nucleolus." (Annals, July 1863, p. 39.)

Here we find the term *nucleus* at one time applied to the nuclear capsule, at another to the granular body lying within it; whilst, on the other hand, the whole of the granular body is at one time termed the nucleolus, at another the clear space within it receives that name. There can be no doubt that a vast deal of confusion has arisen here as elsewhere in referring to the *nucleolus* as if it were always a distinct portion of the nuclear structure, endowed with some distinct function. As referred to in my descriptions, the term nucleolus simply implies the central portion of the nuclear body, rendered more diaphanous than the marginal part by the partial or total absence of the granules, and the crowding of these bodies around the circumference.

Mr. Carter's views with reference to the feasibility of determining the appearances of so small an organ as the nucleus of *Amœba,* or tracing specific characters, where the specimen is small, are so diametrically opposed to all my experience that they demand careful examination. He says, "Whether" the nucleus, before the period at which the creature has attained the $\frac{1}{450}$th of an inch in length, "is circular and presents the usual pellucid area around it, or not, I do not pretend to determine, but I think it very likely; and then this state and the smallness of the *Amœba* would preclude all possibility of specific distinction; hence I do not think that there is any necessity for us to concern ourselves about the appearances. At this period the nucleus is not larger than a human blood-corpuscle, and the consistence of the nucleolus apparently homogeneous, that is, without granules, and composed of a fine delicate yellowish film of transparent plasma, in which state it continues, with the exception of increasing in bulk, up to the time when the *Amœba* has attained about one-tenth of the adult or maximum size, that is, about $\frac{1}{250}$th of an inch long."

Whatever difficulty Mr. Carter may have experienced in determining the minute characters of organisms not larger than a human blood-corpuscle, I repeat that I have, over and over again, observed the nucleus with its hyaline ring, the action of the contractile vesicle, granules, and the villous tuft in specimens of *A. villosa* not exceeding $\frac{1}{3330}$th of an inch in length, and $\frac{1}{10000}$th of an inch in breadth, the lens employed being a $\frac{1}{8}$th with an A eye-piece. I candidly confess, therefore, that it would have spared me no little pain had Mr. Carter abstained from making an observation so uncalled for, and at the same time so much at variance with his own experience.

In answer to Mr. Carter's statement respecting the impossibility of distinguishing the characters of an *Amœba* until it has attained the length of $\frac{1}{450}$th of an inch, it may suffice to mention that, out of the twenty-five so-called species of the genus, six are generally described as being under $\frac{1}{450}$th of an inch in length, even when full-grown; whilst a refutation of the view regarding the nucleus of such specimens will be found in some important observations (by Dr. W. Roberts of Manchester) on the minute structure of the human and other "blood-corpuscles," which appeared in the same Number of the 'Annals' (p. 60 of the present volume) as Mr. Carter's remarks on *Amœba princeps*.

But, irrespectively of the observations of others, those previously published by Mr. Carter himself contain abundant evidence that he has not always held the same opinion on this point; and it is only necessary to adduce one, out of several that might be brought forward, to show that the limits now assigned to the successful employment of the microscope have been considerably exceeded by him. Thus in his paper on the Infusoria of Bombay, published in the 'Annals' for 1856, we find a description and figures of *Euglypha alveolata*, exhibiting "ovules" with their capsules, both within and without the test—the nuclei of these clearly defined when $\frac{1}{4000}$th of an inch in diameter, an equally detailed representation being afforded of "the separation and development of granules into spermatozoids (?) *within the test*"—and, in one example (namely, *Astasia limpida*), a clearly defined view of the discoid ovules only $\frac{1}{6000}$th of an inch in diameter, but nevertheless "showing its capsuled character;" whilst in the 'Annals' for the succeeding year (vol. xx. p. 33), it is stated that certain bodies, $\frac{1}{5755}$th of an inch in diameter, "are polymorphic, and present the granule and contracting vesicles like the monociliated sponge-cell of the ampullaceous sac" [of *Spongilla*], and that "they also enclose particles of food." A figure is given of these bodies. Here, then, at all events, we have an Amœboid organism, with some of the very characters present which Mr. Carter has recently declared it to be impossible to trace with accuracy,—the *smallest* of my *Amœbæ*, as referred to, having been $\frac{1}{3330}$th of an inch in length, and these Amœbiform sponge-cells of Mr. Carter being $\frac{1}{5755}$th of an inch in diameter.

I may observe that few persons will be found to acquiesce in Mr. Carter's opinion (Annals, July, p. 39) as to there being no "necessity for us to concern ourselves about the appearance of the nucleus in *A. princeps* before it [the young *Amœba*] arrives at the size just mentioned," namely $\frac{1}{450}$th of an inch in length; for it will be admitted that we stand but a sorry chance of being able to trace out the development or reproductive process which results in the viviparous parturition recently described by me as occurring in *A. villosa,* and which forms a most important link in the chain of its vital phenomena, unless we do concern ourselves specially to investigate the configuration of the young animal even prior to its extrusion from its parent. The failure to do so will assuredly "preclude all possibility" of ascertaining the correctness or otherwise of those highly complicated reproductive phenomena which Mr. Carter has so zealously endeavoured to elucidate.

I would here mention having repeatedly observed, during the past month, young *Arcellæ,* varying in number from one to four, within the test of the parent. These young specimens were provided with a distinct test, the diameter of which was already so far in excess of that of the aperture of the parent test as to render their escape improbable otherwise than by its rupture. I have also seen what appeared to be full-grown *Arcellæ,* exhibiting every characteristic of the soft parts, but whose test was still soft and membranous, and surrounded the body somewhat loosely. Its surface, however, already presented traces of reticulation, but, instead of the usual inverted orifice, the margin of the aperture through which the pseudopodia protruded was corrugated externally, giving the structure the appearance of a medlar. Here, then, it would seem that viviparous parturition must necessarily be associated with the casting of the effete test of the parent and the development of a new one. In other respects, the occurrence of these young *Arcellæ* fully bears out Mr. Carter's detection of young individuals within the test of the closely allied *Euglyphæ* (Annals, 1856, ser. 2. vol. xviii.); whilst in both cases the phenomena may be regarded as analogous in their nature to the viviparous parturition described by me as observable in *Amœba villosa**.

* Perty records having "once seen two round motionless animals in *Arcella vulgaris,* each having a greater diameter than the mouth of the shell containing them." And he asks if these young *Arcellæ* are set free by the breaking up of the shell. Schultze also cites a similar example as occurring in *Gromia Dujardinii.* (See Pritchard's 'Infusoria,' London, 1861, p. 215.)

As also bearing directly on the characters of the Amœbina, I have to record an important fact which revealed itself during my examination of some of the material containing *A. villosa.* I allude to the detection in *Gromia oviformis* of a well-marked nucleus and nuclear vesicle. The contractile vesicle I failed to trace; but, in the presence of the manifest analogies between the *Gromidæ* and *Lagynidæ,* suggested by this discovery, it is extremely probable, I think, that this organ also may yet be detected. Should it be so, the transfer of *Gromia* from the lowest to the highest ordinal type of Rhizopod structure would be rendered necessary.

If the object now alluded to, in the paper on *A. princeps,* under the term "reproductive cells," be identical, as I suppose, with the "ovules" of Mr. Carter's former papers, these bodies must differ from the former in the very material point of not being nucleated. In the 'Annals' (ser. 2. vol. xviii. p. 223) the term "ovule is applied to a number of discoid or globular nucleated cells, which appear together in the sarcode of some of the Infusoria. At *an early stage,* in *Spongilla, Amœba,* &c., these bodies consist of a transparent capsule, lined with a faint yellow film of semitransparent matter, which, *subsequently becoming* more opake and yellowish, also becomes more marginated and distinct, and assumes a nucleolar form." That these bodies are the same seems certain, inasmuch as in Mr. Carter's recent paper they are spoken of as having been shown in *A. verrucosa,* under the first designation; whilst, on referring to the paper on that form and on *Spongilla* (Annals, vol. xx.), the general characters are identical with those of the bodies called "ovules" in the latter place.

But here, again, I am perfectly at a loss to reconcile the appearances and descriptions presented in one series of observations with those presented in the other. Above, it is stated that the ovules are "nucleated" (*loc. cit.*). In the 'Annals' for July 1863, p. 40, Mr. Carter affirms that he has "*on no occasion* been able to detect a nucleus in these cells, or anything like a germinal vesicle at *any* period of their existence—perhaps because it eluded" his "search." It is true he is now speaking of *Amœba princeps*; but, inasmuch as the *Amœba* with a villous appendage became known to him two years before he published his general characters of *Amœba,* in 1856, it is undeniable that marked and apparently exceptional characters must have been unnoticed by him. But, even as to the source whence these bodies primarily spring, it is impossible to arrive at a satisfactory conclusion regarding Mr. Carter's view; for, in opposition to the appearances presented by the ovules in their earliest state, as above cited from the paper of 1856, Mr. Carter now says, "At first they are delicate, and their capsules so undeveloped that they present the appearance of cells composed of nothing but a fine, delicate, semitransparent, homogeneous plasma; but as they grow older, this becomes granuliferous, and towards the adult state there is a distinct capsule," it being stated that they are the produce of the repeated binary division of the parent nucleus.

On the last-named head I cannot speak with certainty, but several reasons have led me provisionally to adopt a somewhat different view. Two of these may be mentioned more particularly. Mr. Carter says, "Of course, when present [viz. the ovules], there is no nucleus to be seen with them." (Annals, July 1863, p. 41.) Now, I can confidently assert that in specimens of *A. villosa*, charged with quite as large a number of these bodies as are described as having been counted by him in a specimen of *A. princeps*, the nucleus was present also; whilst in such as showed fewer sarcoblasts I constantly met with two, and now and then three, distinct nuclei, of almost equal size. And, again, in those individuals which contained sarcoblasts, the nuclei, whether single or multiple, were invariably less granular than those without them, the hyaline ring observable between the inner surface of the nuclear capsule and the nucleus itself of the latter specimens being more or less completely obliterated. But to this question I shall recur again presently.

From the description given of these bodies, now called "reproductive cells" by Mr. Carter, and which has appeared since my last paper was published, it is evident that I was in error when I stated my belief that the nucleated corpuscles of *Amœba villosa* (in contradistinction to the non-nucleated sarcoblasts) were probably identical with the "reproductive cells" of *A. princeps* (Carter). But inasmuch as I was ignorant, at the time my paper was written, that he had changed his view regarding the constitution of these bodies since the date of his previously published observations (1856 & 1857), it will be seen I had no alternative but to assume that, out of two kinds of corpuscles, differing from each other chiefly in the one being nucleated, the other devoid of nucleus, the kind presenting a nucleus corresponded with the "ovules" which up to that period stood described by him as possessing a similar feature.

I am glad to find, however, that the detection of this error, unavoidable as it was on my part, causes Mr. Carter's and my views regarding the reproductive office of his "reproductive cells" and my sarcoblasts to coincide in a great measure, although I am unable to confirm, by my own observation, the opinion entertained by him as to their being surrounded by a distinct membrane. But I cannot speak positively on the point until I have enjoyed further opportunities of studying the bodies in question.

On the mode of development of the nucleated corpuscles and sarcoblasts of *Amœba,* I have nothing to add to my previous observations; but I may avail myself of the opportunity to state that, in the earliest recognizable condition in which I have found Polycystina and Acanthometrina occurring as independent free-floating organisms at the surface of tropical seas, their rudimentary shell or framework* has invariably been enveloped in bodies precisely resembling the sarcoblasts of the mature forms. Since every gradation in size of these organisms has been met with by me, from that most minute condition in which they are scarcely larger than the large sarcoblasts found within the parent forms, to the fully-grown individuals,—and since the sarcoblasts of *Thalassicolla* have been met with by me in abundance, occurring both *within* and without the nuclear capsule, within and without the shell or spicular representatives of the shell in the form in which the latter are present, there can be no doubt, I think, that to this extent I have traced their share in the reproductive process. But whether any true reproductive act precedes their appearance or maturation, I have no evidence whatever to show; nor ought any evidence to be accepted as proof until the unbroken chain of attendant phenomena shall have been consecutively seen and described.

I may here mention that, as pointed out in *Amœba,* the nucleated corpuscles as well as the sarcoblasts have been detected by me in the Foraminifera, the Polycystina, the Acanthodesmidæ, Acanthometrina, Thalassicollidæ, and Dictyochidæ—all pelagic forms. In the Foraminifera the primordial segment is in reality the homologue of the omphalostype; and it seems by no means improbable that the coccospheres, already alluded to as constituting a phase in the development of some of the genera (as, for example, *Textularia*), may prove to be an advanced stage of their sarcoblasts. I have never seen a coccosphere within the chamber of a Foraminifer; but I may state that I possess numerous specimens of these bodies (from the single primordial chamber to the perfectly formed multiple segments of the shell) in which each chamber has retained the characters of the coccosphere to the last.

The first portion of the Amœban structure to which Mr. Carter draws attention he terms "the pellicula," stating that "*inference* leads us to the conclusion that there is a pellicle over the surface of *A. princeps,* however thin; and the fact that very frequently,

* As the earliest rudiment of the hard shell or framework of these organisms furnishes a most important character in their classification, I have applied to them the term *omphalostypes.*

on the application of iodine, the margin becomes of a deep violet colour, while all the other parts of the Rhizopod exhibit nothing but a more or less deep amber tint, seems to confirm it by chemical differentiation." Again, "Such a covering has been demonstrated by Auerbach in *A. bilimbosa*, and more satisfactorily, on account, probably, of the pellicula in this species being more rigid; but Auerbach does not show that it is coloured by iodine, although he figures starch-globules thus turned blue within it." .... "We must also infer that it is possessed of great elasticity and tenacity, so that it can yield a covering to the pseudopodia almost to any extent (as proved by the actinophorous rays of those Rhizopods which infest the cells of plants remaining after the sarcode has withdrawn itself into an interior or secondary cell); also that it admits of rupture (as in the introduction of food into the sarcode), and yet can heal over rapidly again. Thus it can undergo comparatively unlimited extension even to discontinuity, *but possesses no adhesiveness externally*, as evidenced by nothing adhering to it which is not seized and kept there by the instinct of the animal. Furthermore, in *A. princeps* the pellicula is allied to the cell-wall of plants by position, and, from chemical evidence (*i. e.* when treated with iodine), by an amylaceous composition." (Annals, July 1863, p. 32.)

In referring to the analogous organs of *Amœba* and *Serpicula verticillata*, Mr. Carter goes so far as to say, "The difference between cellulose and pellicula, and the absence of the vesicula, &c., are points which have so little [!] to do with the analogy in question when the latter is followed up through *Astasia, Euglena, Navicula, Closterium*, &c., into *Œdogonium* and *Nitella*, to *Serpicula*, that very little doubt will, I think, then remain of the offices of the nucleus in *Amœba* being similar to those of the nucleus of the plant-cell, whatever these may hereafter prove to be" (Annals, ser. 2. vol. xviii. p. 223), thus instituting a comparison between the plant-cell and a portion of the Amœban structure regarded by him as typical, but of which not a trace has ever yet been seen except in *A. bilimbosa* or the encysted state of other species, and then making this comparison a basis for assuming the identity in function of an organ which is present in the plant-cell as well as in *Amœba*.

It appears to me that an error of a serious nature is committed in associating the Rhizopods, whose bodies are polymorphous, with the Infusoria, whose bodies are monomorphous. Mr. Carter speaks of *Astasia* and *Euglena* as "freshwater Rhizopods" (Annals, ser. 2. vol. xviii. p. 227). But even here, I think, the distinction about to be drawn holds good, independently of differences in internal organization. In *Amœba villosa* we have a determinate indication, in a non-testaceous Rhizopod, of an anterior and posterior portion of the body, but nevertheless associated with a very high degree of true polymorphism. In *Astasia*, on the other hand, we have a definite shape of the body when at rest, but subject to variation when the creature is moving. *A. villosa* may be regarded, therefore, as a link, if need be. But the absence of a permanent aperture, either for inception or excretion of food, defines its position at the head of the Rhizopods; whilst the permanent "buccal tube" of *Astasia* marks that organism as belonging to a higher group.

With reference to the "diaphane" or ectosarc, Mr. Carter goes on to say, "This layer, as in other *Amœbæ*, lies immediately underneath the pellicula, and is distinguished from the sarcode or endosarc within by its greater degree of transparency and peculiar functions; for while the sarcode is clouded and presents a *rotatory motion*, the diaphane is clear and *distinctly endowed* with a locomotive and *prehensile* power. *Analogy* and actual observation would lead us to infer that, in certain if not in all instances, the ectosarc has the power of passing *through* (*sic*) the pellicula by rupture of the latter—a fact which becomes most evident when the pellicula is thick and resistant, as in *Amœba bilimbosa*, where it has been demonstrated by Auerbach, especially in his third figure of this species (Siebold und Kölliker's Zeitschr. vol. vii. p. 365, pl. 19. figs. 1–5, Dec. 1855)"*.

Before touching on the nature of the evidence on which the existence of the "pellicula" is based by Mr. Carter, I would direct attention to what appear to me to be contradictory characters assigned to that portion of the structure,—namely, elasticity so great as to enable it to yield a covering to the pseudopodia "almost to any extent," and yet such an amount of friability that "it admits of rupture (as in the introduction of food)"; for, since the pseudopodia are projected from the "diaphane" (ectosarc), and it is also the "diaphane" "which seizes the nutritious body, whether living or dead, animal or plant, surrounds it, and encloses it" (Annals, July 1863, p. 35), it is certainly difficult to conceive how the extreme elasticity insisted upon in the case of the pseudopodia should be completely cast aside in the case of the food-particles.

During my late survey of *A. villosa*, and after numerous carefully conducted examinations of the form usually known as *A. princeps* (from quite distinct localities, and kept separately from my specimens of *A. villosa*), I can only say I have never detected a trace of anything like a membranous outer investiture, except in the single individual referred to in the May Number of the 'Annals.' That specimen was in a state of nearly perfect quiescence, and apparently encysted; and consequently my experience

* Ann. Nat. Hist. July 1863, pp. 31, 32 & 33.

of these organisms leads me to the conclusion that nothing analogous to a pellicle exists, save during the period of encystation —for a similar reason that it would be unwarrantable to regard the capsule within which any of the other Protozoa are enclosed during their encysted condition as a true envelope belonging to the creature at all times. I may repeat that I have completely failed to render a membrane apparent even under the use of the customary chemical reagents. By employing iodine and sulphuric acid, I have coloured the external layer to some depth at times, and, as shown by Auerbach in his *A. bilimbosa,* have caused the granular and other contents to shrink towards the centre of the organism. But surely it demands much stronger evidence than is derivable from this experiment, to prove that the appearances so engendered are the exponents of a normal condition that previously existed, and not mere effects of chemical action on organic matter.

With due deference to M. Auerbach, I entertain the belief (based on appearances repeatedly seen by me in *A. villosa* when imperfectly defined under the microscope, coupled with those observed by me in the encysted specimen) that *A. bilimbosa* will prove to be either an encysted condition of another form, or one of the Protean phases of the typical form, namely *A. villosa.* The very striking character of the irregular portion of the surface shown in Auerbach's figure tends to confirm this view. This has been my opinion ever since the encysted specimen came under my notice; and I only hesitated to publish it in the hope of obtaining the encysted form of *A. villosa* in sufficient quantity, and with sufficient evidence of its being a transitional condition, to enable me to speak more confidently on the subject. Meanwhile I would simply direct attention to the fact, admitted by Mr. Carter, that the existence of the "pellicula" (except in those cases in which chemical reagents are employed) is wholly hypothetical,—and hence that the phenomena said to take place in it are equally so.

But my view with regard to *A. bilimbosa* is not an unsupported one; for, in order to put it to some degree of test, I have instituted the following experiments within the last two days.

Having killed some *Amœbæ* by holding a portion of the material containing them in a watch-glass over a spirit-lamp, I placed them under the microscope. The specimens were then motionless, and devoid of the usual contractile vesicle, but otherwise they scarcely differed in aspect from the living specimens. I now broke them up by carefully graduated pressure; and, by a slight displacement of the thin glass cover beneath which they were being examined, the detached masses were separated from each other. On dilute sulphuric acid and iodine being now applied, the result was similar to that produced in the case of living individuals,—with this exception, that the broken-up masses were not spherical, but irregular and ragged in their outline.

Here, then, the inference is legitimate, that, whilst vitality and contractility were destroyed by the heat so as to preclude the formation of ectosarc over the torn surfaces, the recession of the granular and other contents towards the centres of the masses yielded unmistakeable evidence that the action was purely chemical. But still nothing at all resembling membrane was evoked; and the tint imparted externally by the iodine was neither blue nor purple, but brownish; and, as in the case cited by Auerbach, some of the internally contained particles assumed a purple colour.

In *Amœba*, the true ectosarc appears to me to be nothing more than the outer layer of sarcode (for the time being) consolidated by contact with external influences, its depth (or, rather, thickness) being dependent on the length of time these influences continue to act upon it without intermission; whilst the consolidation referred to is greater at the immediate surface, and gradually diminishes in extent and finally fades away altogether from thence inwards. Leaving just now the question of reciprocal convertibility of ectosarc and endosarc, I would observe that this view is essentially similar to that propounded by Dujardin. It is corroborated, however, by a fact open to the observation of every one,—namely, that in the nearly quiescent condition of *Amœba*, when the outline becomes more or less spherical, the greater amount of consolidation of the exterior layer is shown by the hyaline margin becoming broader, and the whole of the contents being consequently made to recede towards the centre.

That an increased degree of consolidation does really exist in the outer layer of sarcode, and that the particles of which the entire body is composed are not held together only by the molecular cohesion of which we have examples in the formation of water-globules or oil-globules when placed in fluid media in which they are insoluble, I deduce from this fact, that whereas a foreign body, when of great size and resistent—as, for example, the large *Pinnulariæ* so frequently met with in the Hampstead *Amœba*, when fresh (Annals, April, pl. 8. fig. 4, and May, pl. 9. figs. 1–8, and in the *Actinophrys* figured in the number for June, pl. 10. fig. 4)—causes the outer layer to project almost to any extent without rupture (as in the last-named figure), the moment the body is torn asunder by pressure or other violence, such an object instantly slides completely out of the mass, and becomes liberated.

As to the power, spoken of by Mr. Carter, possessed by the ectosarc (*sic*) of passing through the pellicula, it will be seen, on reference to my paper in the 'Annals' for May (p. 370), that I distinctly point out this feature, and endeavour to prove by it, for reasons there assigned, that the ectosarc is gradually dissolved, as it were, when pierced by a newly projected mass of sarcode in the shape of a pseudopodium, in such a manner as to envelope a portion of the old ectosarc. Mr. Carter's figure (Annals for July, pl. 3. fig. 4) diagrammatically represents this condition, and, to my mind, clearly proves one of two things,—either that a new portion of ectosarc is instantaneously produced on the contact of the endosarc with the surrounding medium, or that, where such pseudopodia are projected, their characters must be of a different kind from the rest of the structure—an inference which is obviously not tenable for a moment. Lastly, I am unable to see that, by calling in to our aid any such process as *secretion* from the surface of the newly projected portion of sarcode, any more satisfactory explanation of the phenomenon is afforded; for it is obvious that, for every quota of ectosarc secreted, an equivalent quota would have to be re-absorbed, otherwise the whole body would rapidly be converted into ectosarc; whilst, assuming the process to be one of alternate secretion and absorption, the reciprocal convertibility of the ectosarc and endosarc for which I contend would be admitted *à priori* *. If not reciprocally convertible one into the other, as I have described, how is it that the contractile vesicle is sometimes single, sometimes multiple, in the same portion of the body—the multiple vesicles now performing their office separately and independently of each other, now coalescing with one another, so as to undergo their contraction in the shape of a single cavity? How is it that we constantly see a tentative double or multiple contractile vesicle—that is to say, two or more cavities separated from each other only by the most delicate films of protoplasmic substance which forms the partition-walls, these walls permitting the union of the contents on either side, not through a minute specialized aperture, but in a similar manner to the coalescence of two soap-bubbles? whilst on the next occurrence of distention at the same spot the contractile vesicle may appear in the shape of a single large cavity without supplementary ones. How is it that an *Amœba* may be lacerated so as to form two or more portions, each of which almost instantaneously presents, at every portion of the surface, the same appearances as existed prior to

* Mr. Carter speaks explicitly on this point. He says (Annals for July, p. 118), "That the diaphane, therefore, should pass into the pellicula, or the pellicula be secreted by the diaphane, seems untenable."

laceration, not necessarily by the folding together and union of the torn margins, but by the immediate development of ectosarc upon the torn surface? Let the process be called instantaneous cicatrization, or what else we will, the phenomenon remains the same.

Again, let me ask what prevents the food-vacuole * from collapsing suddenly when relieved of its contents by absorptive digestion, as often happens? Admitting that the watery contents prevent collapse from taking place, why do not all the vacuoles, when crowded together, as they frequently are, coalesce, instead of remaining for the most part distinct from one another? † And lastly, why do the globules of sarcode, when extruded under pressure by rupture of some part of the surface, and floating side by side (as described and figured by me in the 'Annals' for May, p. 370, pl. 9. fig. 8), show no tendency to coalesce, unless it be that the inner layer in the former case, and the outer layer in the latter, by which each globule is surrounded, instantaneously becomes converted into ectosarc by simple contact with the surrounding medium?

Chemical reagents, when applied to a mass of sarcode, prove nothing beyond their effects on that substance; that is to say, they do not demonstrate the primary presence of a membranous layer, even where they succeed in producing the semblance of one. And this is the case without reference to the well-established fact that certain chemical substances frequently render more distinct structures which are already imperfectly visible or demonstrable without their employment.

It is obvious that when a food-particle is incepted by an *Amœba*, the vacuolar cavity receiving it must either be formed of ectosarc or endosarc, or of both combined. If it be urged that it is composed of the former, it follows that, at every inception of food, so much ectosarc as is requisite to surround the object must be abstracted from the general surface of the body. Hence, when the quantity of ingesta is large, as frequently happens, the greater part, if not the whole, of the ectosarc must speedily be conveyed into the interior, leaving the viscid

* See my paper in the 'Annals' for June, p. 436.

† It will be recollected that I have endeavoured to prove, by the mode in which foreign bodies are incepted as food, that the food-vacuole is formed either of an intussuscepted portion of the ectosarc around the point of inception, or, supposing the food-particle to be forced through the ectosarc by the rupture of the latter, that the simultaneous admission of a portion of water at once converts the endosarc, of which the boundary of the cavity is formed, into ectosarc. It is by this means that the entire food-vacuole is sometimes extruded through an orifice in the villous region—a thing which could not take place were the food-vacuole formed of *endosarc*.

surface unprotected. Such a view is therefore untenable; and, as I have endeavoured to show, the appearances are only reconcilable with one or other of the following processes: that is to say, the food-particle, on being dragged to the surface, or surrounded, as the case may be, either penetrates the ectosarc and finds its way into a cavity extemporized in the endosarc, or, the cavity being formed partly by the inversion of a portion of the ectosarc, which is thrust in, as it were, before it, the sealing up of the food-vacuole is effected by a portion of endosarc. In the first case, the mere contact of the endosarc with the portion of water which is admitted along with the incepted object converts it into ectosarc. In the second, that part of the food-vacuole which does not already consist of ectosarc is converted into it by the same means. But under no circumstances have the appearances been such as to lead me to the inference that the food object passed into the interior in the same manner that a stone does when slowly dropped into water.

It might, at first sight, be imagined that the food-vacuole is a simple cavity produced within sarcode by the presence of a foreign body, after the fashion of a globule of oil in water, since the incepted masses at times present no appreciable vacuolar space around them; or that the endogenous vacuolation, to which reference has been made, negatives the above view. To the first of these objections I would answer that the vacuole, when present, undoubtedly contains watery fluid; and it appears almost certain that a distinct coagulative effect is produced in the endosarc by contact with it, from what takes place when effete matter is extruded through a tubule in the neighbourhood of the villous organ. We then perceive that, on reaching this region, the contractile power is so great as to cause the vacuole and its contents to move towards the margin, and the egress of the effete matter proceeds slowly till its largest diameter has passed outwards. When this has happened, the effete object slips out with a jerk, whilst the residue of the contractile effort causes the vacuolar spherule to assume a tubular and, very frequently, an infundibuliform shape, similar to that described and figured by me in the 'Annals' for May. But at this point the special contractile effort ceases, and hence the consolidated layer constituting the wall of the tubule requires a considerable period for its reconversion into endosarc, which proceeds from within outwards. In this case, it is very evident, I think, that, did no difference exist between the degree of consolidation of the tubular wall and the endosarc by which it was immediately surrounded, the reconversion spoken of, and the consequent obliteration of the excretory tubule and its external orifice, would be comparatively instantaneous, instead of occupying, as it generally does, a period varying with its size, from a few minutes to upwards of an hour.

Here, then, we have the strongest evidence that the degree of consolidation necessary to establish the differentiation of the ectosarc, so as to permit a tubule or excretory passage to be formed, the walls of which do not instantly coalesce as water does around any heavier object dropped into it, but close slowly and gradually from within outwards, is due to the mere contact of the fluid which is invariably present whenever such tubules or excretory orifices are observable; whereas, in those cases in which the watery matter has been removed by digestive absorption prior to the discharge of an effete mass, the latter passes out through the substance of the ectosarc, and without the production of any passage whatever. In this case, moreover, the ectosarc closes around the effete body almost as rapidly as that body can escape.

When foreign substances appear within the endosarc, unsurrounded by any appreciable vacuole, I have almost invariably found them to consist either of mineral particles or the effete remains of food objects. But this by no means proves that they obtained entrance into the interior without any accompanying water, but only that the latter has been absorbed; for, in view of the conditions and the manner in which a foreign body is invariably engulfed, it seems almost impossible to conceive the entrance to take place without the simultaneous entrance of a portion of the medium in which both the animal and the food-particle are sustained.

The reciprocal convertibility of endosarc and ectosarc, for which I would propose the term *amœbasis**, constitutes, as it appears to me, a very important and definite distinction between the animal and the vegetable protoplasm,—the permanent differentiation of the true cell-wall of the protophyte rendering necessary nutrition by endosmotic absorption, whereas in the Protozoan the continual interchange of parts enables the animal to incept organic matter for food. But, as I shall endeavour to show on a future occasion, this power of incepting solid organized substances does not present itself distinctly in the two lower orders into which I propose to divide the Rhizopods, but only in the third or highest order, in which the contractile vesicle makes its appearance for the first time; whilst, as already mentioned in my paper in the 'Annals' for June, p. 440, if a

* 'Αμοιβή (reciprocity). It is somewhat singular that the word from which the generic name of *Amœba* is derived, and which was selected with reference to the alternate expansion and retraction of the pseudopodia, should in reality express the precise action now referred to as being involved in the sarcode substance.

boundary line exists between the Rhizopods and the true Infusoria, it consists in there being, amongst the former, no permanent orifice either for the inception or extrusion of foreign or effete matter, and the phenomena of amœbasis are present; in the latter, whatever parts exist are permanent formations, and there is either a single or dual orifice for the inception and extrusion of substances used for food.

"Of the peculiar and particular function of the *sarcode*," says Mr. Carter (Annals, July 1863, p. 36), "*there can be no doubt*, viz. that of digestion." Now, without calling in question the function, I may be permitted to observe that Mr. Carter takes for granted a most important histological as well as physiological distinction between the ectosarc and endosarc, which has only been entertained by Cohn with regard to the Infusoria, as far as I am aware,—namely, that the ectosarc ("diaphane") is formed from the "sarcode" (or endosarc), and that, "since it has a distinct structure as well as office, having been produced, it is not reconvertible into any other organ by any process but that of digestive assimilation" (Annals, July 1863, p. 37).

So that having, in the first place, assumed a histological distinction between endosarc and ectosarc, the existence of a special function is likewise assumed in one, and its absence in the other, whilst an analogy is insisted on between a lower and a higher grade of organisms,—solely, as it would appear, on the ground that the microscope has failed, in both cases, to render visible specialities of structure for the existence of which there is not a vestige of evidence!

I am also compelled to avow that the theory put forward by Mr. Carter regarding the pellicula "possessing no adhesiveness, as evidenced by nothing adhering to it which is not seized and kept there by the instinct of the animal," is not reconcilable with a fact to which I drew attention in the 'Annals' for April (p. 288), or with his subsequent admission to the same effect, contained in his paper (July, p. 43), notwithstanding his previously expressed opinion (p. 32), namely, that the villi exercise a distinct prehensile faculty, and one which unquestionably resides in the *external* layer of which they are composed, and is quite independent of any grasping action, such as we witness in the rays of *Actinophrys*.

Before quitting the subject now under discussion, I may mention that a vast fund of light has recently been thrown on "the development of the organic cell" by Professor H. Karsten, in a paper to which I shall have occasion to refer more in detail at some future opportunity. At present I would merely state that we are indebted to him for having been the first to advance a definition of "cell"-structure conformable with the organization of the Rhizopods, at the same time that it proves they cannot be regarded as unicellular. For although my experience of Rhizopod structure compels me to deny the normal presence of such an investiture as might legitimately be termed either membranous, capsular, or vesicular—whatever may be the true state of the case as regards *A. bilimbosa,* or the encysted condition of any other form, I regard the exterior of *Amœba* as falling strictly within the definition of a cell-"*wall,*" as propounded by Professor Karsten, the outer layer or ectosarc for the time being, however indefinite, constituting the homologue of the cell-membrane of the higher Protozoa and Protophyta; whilst the facts connected with the truly cellular nature of the sometimes single, sometimes multiple nucleus demonstrate the truth of the concluding sentence of that author's paper. His views are summarily embodied as follows:—

"The primitive form which matter capable of organization assumes is that of the vesicle—the cell, inseparably composed of membrane (wall) and contents. Each of these two constituents of the elementary organ, constantly exerting the most intimate influences upon each other, is capable of advancing further in its development by the aid of the *physico-chemical forces to which it is indebted for its existence.*" And again, "Owing to the complicated structure of the tissue-cells which enter into the composition of developed organisms, it is erroneous to speak of unicellular plants and animals. With as little reason can we imagine cells without membranes; such bodies, in my opinion, should be designated drops or granules" *—thereby confirming the opinion I guardedly expressed when speaking of the true significance of a membranous nuclear cell in *Amœba villosa* (Annals, June, p. 438).

The basal sarcode in *Amœba,* and probably in all the lower animals, is generally regarded as a homogeneous, colourless or nearly colourless, hyaline mucus, within which a number of extremely minute granules are suspended. This granularity, coupled with a high refractive power, serves at once to distinguish sarcode from water, and hence enables me to affirm that the clear space surrounding the nuclear mass of *A. villosa* is composed of this substance.

It will be observed that there is a discrepancy between Mr. Carter's and my estimate of the size of the crystalloids, his measurement of the largest met with being recorded as $\frac{1}{2000}$th of an inch in length, whereas my largest is only $\frac{1}{4500}$th of an inch in length. But inasmuch as Mr. Carter states that the

* Translated by Dr. Arlidge from a separate impression from Poggendorff's 'Annalen' (vol. cxviii., Berlin, 1863), and published in the 'Annals' for July 1863.

specimen he alludes to "was composed of an irregular crystalline *aggregate,* based *apparently* upon an octahedral form," the two measurements of the single crystalloid are probably nearly identical.

Contrary to the opinion expressed by Mr. Carter, I found that the crystalloids of *A. villosa* are of the hexahedral series*, and occur as such even in the smaller specimens. Whether the crystalline state be the primary one or not, I am at present unable positively to say, although it seems highly probable; for the association with them of rounded granules, of nearly similar size, in some but by no means in all specimens, although perhaps indicative of the latter being a rudimentary condition of the former, cannot be accepted as a proof of the fact, any more than that in the oldest specimens, which sometimes present both the granules and the crystalloids, the former necessarily constitute a disintegrated stage of the latter. In my Streatham specimens of *A. villosa,* when first procured, the roundish granules were almost entirely absent. Now (July 3) they are nearly as plentiful as the crystalloids. On this head I have only to express my obligation to Mr. Carter for calling to my recollection that I had inadvertently omitted to allude to Auerbach's discovery of crystalloids in *A. bilimbosa,* although fully alive to the fact when I penned my paper—more particularly as Auerbach regards the crystalloids as hexahedral, which is the view I adopt with regard to those of *A. villosa* and the other forms in which those bodies have been detected by me (Annals, June, pl. 10. fig. 7).

Mr. Carter says that he observed the villous appendage in 1854; but it would appear that he failed to recognize its nature or office; for, writing in the 'Annals' in 1856 (vol. xviii. p. 116), the following passage occurs:—"Finally, when all activity ceases and the *Amœba* becomes stationary (by fixing itself to some neighbouring object through a pedicular prolongation of the *pellicula*†), a new layer of the latter is formed below the old one, and thus a capsule is formed, and the pellicula replaced on the body of the *Amœba,* until the latter becomes firmly encysted. To what part of the body of the *Amœba* the pedicular process corresponds I am ignorant; but it is interesting to see that in *Euglena,* where a similar process takes place, it is the *anterior* extremity which is next the pedicle." This is precisely the *reverse* of the position of the prehensile portion in *A. villosa,* unless, indeed, Mr. Carter means to convey that the villous region

* I have succeeded in mounting these crystalloids in balsam, by which their true shape is very distinctly brought out under a $\frac{1}{8}$th or $\frac{1}{12}$th objective.

† Proving that at this period he entertained a different view with regard to its adhesive quality.

is not invested, as he supposes the rest of the body to be, with the "pellicula," which I imagine is not the case, from what he says in the 'Annals' for July 1863. In that paper, at page 31, he says the "pseudopodia proceed from a *posterior* end which is normally capped with a tuft of villous prolongations." It will be seen that this expression admits of two diametrically opposite interpretations; that is to say, it may either mean that the pseudopodia are projected *from* (in the sense of the opposite direction to) the villous appendage, or that they are actually projected from the midst of the villi themselves. If we accept the first interpretation, it is evident that Mr. Carter, when describing the characters of *Amœba* generally, in 1856, must have been unaware of the true significance of the villous appendage; for he referred to *Amœba Gleichenii*, and not *A. princeps*, in order to exemplify the prehensile organ of the genus. In doing so, moreover, he says, "To what portion of the body of the *Amœba* the pedicular *process* corresponds I am ignorant. But it is interesting to see that, in *Euglena, where a similar process* takes place, it is the *anterior* extremity which is next the pedicle"—that is to say, the opposite extremity to that in which it occurs in *A. villosa* or *A. princeps*.

On the other hand, if we accept the second interpretation, as already pointed out, it is altogether irreconcilable with the appearances presented, which may be seen at a glance on examination of *every* form exhibiting the villous appendage.

I have seen no reason to call in question the generally received opinion that, after each contraction, the contractile vesicle reappears at the point of obliteration, or in immediate contact with that point. Alluding to this fact, Mr. Carter (in the 'Annals' for 1856, vol. xviii. p. 128) says, "We may perhaps *infer* that the situation of the vesicula in *Amœba* and *Actinophrys also* is fixed, though, from their incessant polymorphism, it appears to be continually varying in position." In the case of *Amœba villosa*, however, the polymorphism does not interfere with observation; and hence it becomes manifest, at a glance, that the contractile vesicle reappears as above stated—the villous organ, in the midst, or at the margin, of which the contraction invariably takes place, affording a fixed point for comparison. In *Actinophrys Eichhornii*, again, when examined on a slide under a thin glass cover, there is no difficulty in obtaining a tangential position of the contractile vesicle at the same time that the body of the creature is kept immoveable; and we thus obtain a perfect view of the alternating action. But in the latter species I have never detected anything like supplementary vesicles given off from the primary one, or any appearance indicating that the contractile vesicle is in direct communication with the vacuolated sarcode around.

Owing, doubtless, to an unintentional alteration of my description of the contractile vesicle of *A. villosa*, Mr. Carter makes it appear, however, that I assume the possibility of its formation as in the case of spontaneously formed vacuoles, at any portion of the body. Thus (Annals, July 1863, p. 39) it is stated that I regard "all these dilatations as extemporized vacuoles;" whereas I draw a marked distinction (Annals, June 1863, p. 439) between the contractile vesicle, to which I refer as "a *specialized* vacuolar cavity," the "food-vacuole, which is invariably formed at the surface," and those endogenous vacuoles which appear and disappear spontaneously within the substance of the organism (*loc. cit.* p. 436). The grounds for these distinctions will become manifest as I proceed. Meanwhile I would direct particular attention to the definition of the contractile vesicle given by Dr. Carpenter ('Introduction to the Study of the Foraminifera,' p. 14), namely, "*a vacuole with a definite wall*," inasmuch as I shall hereafter endeavour to prove that to this extent only can it, with propriety, be regarded as a distinct structure.

In allusion to my remarks in the 'Annals' for June (p. 439), Mr. Carter says he is glad to find that I support him in the opinion that the contractile vesicle of *Amœba* discharges itself externally. As stated in the 'Annals' for June (p. 441), it will be seen that I had also satisfied myself of the fact with regard to an Infusorial animalcule. It is right, however, to mention that, so long ago as 1849, Dr. O. Schmidt asserted that the contractile vesicle in *Actinophrys* opens externally—although Dr. Lachmann, from whose writings I obtain this piece of information, is of a contrary opinion*. But Mr. Carter inadvertently omits to state that the determinate portion of the body in *Amœba* at which the discharge of the contractile vesicle takes place was pointed out, for the first time, as observed in *A. villosa*; for when I quoted his very graphic description of the action of this organ as occurring in *Amœba* and *Actinophrys* (Annals, 1856, vol. xviii. p. 126), I was certainly under the impression, from what was advanced in the same place (see next paragraph), that, in indicating a definite spot at which the discharge takes place in *Amœba*, my opinion was at direct variance with his. Thus, although Mr. Carter, in his recent paper (Annals, July 1863, pp. 38 & 39), says, "It is a remarkable fact, that although the vesicula is borne round the interior of *A. princeps*

* Dr. C. F. J. Lachmann on the Organization of the Infusoria (Ann. Nat. Hist. 1857, ser. 2. vol. xix. p. 227).

with the sarcode to which it belongs, it only discharges itself in the neighbourhood of the villous or posterior end; and such is the case also with the egesta of the digestive spaces; so that one might also *infer* that there was a particular aperture through the diaphane and *pellicula* at this part of the *Amœba* for this special purpose, as we see in most of the other Protozoa, where the vesicula is stationary, and frequently fixed close to the anal aperture,"—in his observations on the contractile vesicle, published in 1857 (Annals, ser. 2. vol. xvii. pp. 356 & 357), he writes as follows:—"All the internal organs are imbedded in it [the sarcode], part of which are fixed, and part moveable; it is also the receptacle for food, which, in the *Amœba*, passes *into and out of it*, directly through the diaphane, *as they have no special apertures of external communication* for this purpose;" and, as already stated, the latter view remained unaltered in any of his published papers, up to the date of his recent notice on *A. princeps*.

Having thus far shown the grounds on which Mr. Carter now infers the existence of a permanent excretory aperture through the diaphane and pellicula, which, according to the above admission, invest the sarcode-substance at the villous region, I would adduce the evidence upon which I have arrived at an opposite conclusion, and accordingly consider the excretory orifice as being neither a permanent portion of the structure of the contractile vesicle nor of the ectosarc of the villous organ.

Premising that the following details have chiefly been gathered from *Amœba villosa* and its protean varieties, I have to observe that, in its collapsed quiescent state, the contractile vesicle presents the appearance of a minute villous tuft suspended freely within the endosarc. When the specimen is tolerably free from foreign objects, the structure of the contractile vesicle can readily be made out whilst it remains quiescent near the villous organ, and then the identity in the intimate structure of the two parts becomes at once manifest. This is a material point, since it lends strong confirmation to the view, that whatever the mode in which the excretory orifice is produced in the one organ, it is in like manner produced in the other. But to this subject I shall more fully revert hereafter.

During the complete contraction of the contractile vesicle no internal space is discernible. This is probably owing to the consolidation of the ectosarc of which the minute villi are composed engendering a slight degree of opacity. The external surface of the contractile vesicle, however, can readily be distinguished as being composed of a number of minute papilliform villi, closely appressed, and imparting so rough an outline to the organ that it is somewhat difficult to believe that it can be identical with the hyaline and brilliant globule presented to view when observed in its state of greatest distention. The transition, however, is gradual, and leaves no room for doubt on this head. Sometimes the diastole* is altogether confined to the main cavity of the organ. When this happens, the central diaphanous space which shortly presents itself increases slowly in dimensions, whilst *pari passu* the boundary-wall becomes thinner, the villi grow shorter†, and the opacity is exchanged for an almost crystalline transparence. In this condition, the remains of the little villi can be faintly detected, under a sufficient magnifying power, as minute spots, distributed sparsely and unequally over the surface of the vesicle. But no trace of a double outline is visible, even under the highest power of the microscope; nor does its boundary wall approach more closely to the appearance of distinct membrane than the boundary wall of an oil-globule. Indeed, but for the scattered papillæ on its periphery, it would be absolutely hyaline throughout, and barely distinguishable from a solid globule of sarcode. In this, its fully distended state, no supplementary vesicles are evolved from any portion of its surface. During the systole, the appearances are reversed in their order, and take place in a much shorter period—the hyaline clearness becoming first destroyed, and the faint spots growing, as it were, into a crowd of villi, until finally the whole mass resumes its pristine aspect. But now and then the systole seems to be checked before completion, and the diastole recommences without entire obliteration of the cavity. Again, instead of the diastole originating at a single point, sometimes from two to twenty minute globules start into existence around or near that point, and cover a space considerably in excess of that occupied by the collapsed primary contractile vesicle. These globules are cavities formed within the villi, which thus become temporarily converted into cæca, admitting of distention to a certain point, and then either bursting into each other or into the primary cavity, as the case may be; whilst at other times one or two, but very rarely more, of the supplementary vesicles thus formed become altogether detached, after the fashion of a soap-bubble given off from a pipe‡, and circulate amongst the rest of the particles within the endosarc of the *Amœba*. When this occurs, I have

* Although the organ in question bears no analogy to the heart of the higher animals, as it contracts and expands rhythmically, the terms diastole and systole may be employed without impropriety, in order to distinguish the action more clearly from that of the ordinary vacuoles.

† An analogous effect is produced when a caoutchouc capsule, the wall of which is tuberculated and opaque in its unexpanded state, is inflated until the entire surface assumes a homogeneous and semidiaphanous appearance.

‡ Mr. Carter suggests this simile in describing the disengagement of

now and then distinctly seen the tubular isthmus which connects the supplementary with the primary cavity contract, become by degrees attenuated to a mere filament, and finally part in the middle, its conical-shaped ends gradually melting into the boundary-wall of the primary contractile vesicle on the one hand, and the supplementary vesicle on the other.

Both seem now to be wholly independent of each other*. The primary vesicle may either go on performing its diastole and systole without moving from the villous margin, or may take part in the pseudocyclosis. The supplementary one, again, may move away to the opposite or anterior extremity of the *Amœba,* changing its relative position to the villous organ and the primary contractile vesicle in every possible manner, and apparently for an indefinite period, and may ultimately return to discharge its contents independently at some portion of the villous region distinct from that occupied by the primary vesicle, or may actually find its way to the parent from which it sprang, and coalesce with it, reappearing, or otherwise, on the next diastole of the primary organ, as the case may be. These supplementary contractile vesicles rarely present papillæ on their surfaces; when they do so, these are very few in number; so that it is almost impossible to determine whether the object we are looking at be an ordinary empty vacuole or a contractile vesicle, unless we continue our observations over a period sufficiently protracted to embrace the next systolic action.

Lastly, it is deserving of special notice, that whenever the identification of one or more supplementary contractile vesicles

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"digestive spaces" at the inner extremity of the "buccal tube" of *Paramecium,* &c. (Annals, 2nd ser. vol. xvii. p. 357).

* In Dr. Carpenter's 'Introduction to the Study of the Foraminifera,' it is stated, on the authority of MM. Claparède and Lachmann, that in a species of *Amœba* allied to *A. princeps,* after the contraction of the contractile vesicle, from four to eight vacuoles were seen to spring up at different parts of the body, often at a considerable distance from the contractile vesicle, and that these seemed to move towards the latter when they had attained a certain size, and discharge their contents into it. In a note, Dr. Carpenter states his belief that distensible vacuoles have been mistaken, by some observers, for multiple contractile vesicles, but that they have not the well-defined boundary of that organ, and they do not present the rhythmical contractions.

According to my experience, no vesicle, unless it be a true contractile vesicle, under any circumstances bursts into the primary one.

According to my experience, contractile vesicles or supplementary contractile vesicles, when detached, may burst into each other, but never into vacuoles, or *vice versâ;* I cannot help thinking, therefore, that the "vacuoles" which are here spoken of as seeming to burst into the contractile vesicle must have been supplementary vesicles, not evolved spontaneously in the substance of the endosarc, but disengaged and moved to a distance from the primary one before the observation commenced.

has been rendered possible, owing to their having been continuously watched from the moment of their evolution, neither they nor the primary contractile vesicle from which they were evolved coalesce with the *vacuoles* or with the nuclear capsule, even when powerfully appressed against each other. They coalesce, however, with each other when they happen to come in juxtaposition during their movements to and fro, even at a distance from the villous region. But they neither perform their systole singly nor when so coalesced, until they once more reach the posterior or villous margin.

Now, assuming, for the sake of argument, that the primary contractile vesicle is furnished with a fixed and determinate orifice for the discharge of its contents, and that a corresponding orifice occurs at some spot on the villous surface, it is quite obvious that the coincidence of the two apertures can only be maintained, in an organism of so polymorphous a nature, as long as the contractile vesicle and the villous appendage maintain an undeviating relation to each other. But it has been shown that this is not the case in *Amœba villosa*; for the location of the vesicle at the spot where it discharges is only temporary, and its movements, when detached from that spot, conclusively prove that all union whatever between the wall of the vesicle and the villous region, apart from that provided by the general protoplasmic substance constituting the interior of the body, is destroyed. Besides this, I am inclined to believe, from the appearances (although I cannot speak positively to it as a fact), that the discharging orifice is not always in the same spot of the villous surface, but that its position, although restricted to that portion of the animal's body, varies with the polymorphic character of the villous organ itself and the situation it assumes relatively to the nucleus or other contents when resting in the vicinity. In the case of the supplementary vesicles formed each in one of the minute villous cæca, the isolation from the primary vesicle and from the villous appendage is quite as certain; for, owing to their being generally of smaller diameter, these supplementary vesicles move about with greater freedom, passing in every direction round or along the different aspects of the primary vesicle when at rest or when it also happens to be roaming about the centre of the body, and, for the time being, constituting as distinct organs as if they had been derived from separate sources. This being the case, it seems, as already urged, almost impossible to conceive that any permanent bonds of union, such as sinuses, or any determinate apertures, should exist either in the primary or supplementary vesicles. With regard to the non-existence of a determinate and constant excretory orifice at the villous surface, the evidence is quite as conclusive.

In the first place, no such permanent orifice can be detected even with the aid of the highest powers of the microscope and every essential accessory in manipulation. I am aware that this may be regarded as inconclusive by some persons; but, whilst I am quite as ready as Mr. Carter to believe that our optical appliances frequently fail, even under the most favourable circumstances, to resolve extreme subtleties of organic structure, I conceive that, in the example under notice, this evidence is not of the purely negative character that it would be were no trace discernible of the process whereby the contents of the contractile organ, or the effete matter within the food-vacuoles, are extruded at the surface.

The excretory aperture is extemporized, and its closure takes place from within outwards, solely because the indefinite consolidation of the sarcode, to which the name of ectosarc has been very appropriately given by Dr. T. Strethill Wright, being at its maximum at the immediate surface in contact with the medium around, and decreasing in degree from the surface inwards, the same cause that prevents the coalescence of the pseudopodia of *Amœba* under ordinary circumstances, in the first place increases the resistance to the passage of the object about to be extruded as the surface is approached, and, in the second, causes the coalescence to take place from within outwards, and its rate to depend upon the degree of consolidation attained by the ectosarc (see p. 132). Hence (and this is a most important fact), whilst the viscidity of the endosarc, when an *Amœba* is suddenly torn across, enables foreign bodies to slip out as they do from a globule of oil (that is to say, without driving a layer of the substance before them as they escape, or leaving a depression on the surface behind them), the comparative rigidity of the ectosarc causes a generally infundibuliform tubule* or pit to be formed, which tubule or pit coalesces from its inner pointed extremity in the direction of the exterior, and, finally, becomes altogether obliterated. In the least active condition of *Amœba villosa,* when several villi frequently combine to form single larger ones, the latter are often so hyaline as to render the detection of anything like a canal inevitable, did it exist; and it is in these that the mode of formation of the excretory tubule and its closure can be so clearly made out as to leave no doubt on the subject; for as the point of the tubule slowly advances outwards it leaves behind it a perfectly hyaline tract, the appearance presented during the process of closure being precisely similar to that observable in a thermometer-stem

* See my observation on the infundibuliform tubule in the 'Annals' for May 1863, pp. 366, 367.

where the capillary channel has been somewhat extended and sealed up at one end under the action of the blowpipe.

In a former communication ('Annals,' May, p. 367) attention was drawn by me to the occasional occurrence of a funnel-shaped tubule which opened out in the midst of the villous organ; and it was stated that when this took place, no contractile vesicle was observable. It was also stated that I had seen effete particles, and, on three occasions, bodies which resembled vacuoles, extruded through similar orifices. More recent observations, however, have satisfied me that the failure to detect the contractile vesicle during periods which I then considered sufficient to ensure the occurrence of the diastole or systole may have been due to the insufficiency of those periods, and hence that this organ may have been present notwithstanding its having escaped notice. The guarded manner in which I stated what took place was the result of a doubt as to whether the tubule was formed by the contractile vesicle, or by a vacuole, or was in reality an extemporized channel. The opinion I now hold—one based on actual observation—is, that whereas in some cases a food-vacuole may be reabsorbed into the substance of the body after the effete matter it contained has escaped, and in this way be converted into an infundibuliform tubule, in others the vacuole may be discharged along with the effete matter which it encloses, and the tubule may be produced in the substance of the body at the point of extrusion,—the first of these appearances presenting itself when the effete mass is of a shape admitting of easy discharge as soon as the margin is reached, the second when the mass is so irregular in outline as to entangle its own vacuole and carry it along with it.

According to my experience of *A. villosa*, it seems almost certain that, normally, the contractile vesicle is single, and that the evolution of supplementary vesicles from the primary one, in the manner already described, may take place without reference to approaching fission. For, did the evolution invariably precede that process, we should, in all probability, detect a plurality of nuclei also, which is not always the case. And, unless we regard fission in these lower organisms as an accidental phenomenon, the supplementary vesicles, when once detached in such cases, would not coalesce again with the primary one. On the other hand, there is every reason to believe that, when fission takes place normally, each segment is provided with its own nucleus and contractile vesicle. I say normally, because examples have been observed by me, from the commencement to the end of the process, in which sometimes the nucleus, and sometimes the contractile vesicle was absent in one of the newly formed segments. But I must mention that, whenever the former has been absent, the segment remained comparatively torpid and motionless, whilst the segment provided with this organ moved away energetically as soon as the separation was complete*. Under these circumstances it has yet to be determined whether the contractile vesicle at any time originates spontaneously, or is invariably an integral part of the organism. Judging from its presence in full activity in the minute viviparously produced *Amœbæ*, the latter conclusion seems to me most probable. But, I need hardly say, the point is one that demands a great deal of careful investigation before it can be regarded as settled.

Mr. Carter ('Annals,' 2nd series, vol. xviii. p. 129) observes, in allusion to the occasional plurality of the contractile vesicles in *Chilodon cucullulus* and the Rhizopoda generally (*loc. cit.* p. 130), that "the synuses of this system the sarcode of *Amœba* not only seem to burst into each other and into the vesicula, but, when the latter has contracted, another sinus, partially dilated and situated near the border, may be seen to swell out and contract after the same fashion before the reappearance of the vesicula,"—a figure (plate 7. fig. 81 *a a*) being appended in which two contractile vesicles, in a partially distended state, are represented on *opposite margins* of the body of *A. quadrilineata*, and described in the explanatory text (p. 248) as being "about to discharge themselves independently of the large, apparently normal one," which is centrally placed between them at a considerable distance from the true posterior extremity of the body.

In describing the contractile vesicle of *A. villosa* in the 'Annals' for April last (p. 289), I mentioned that it sometimes presented a reticulated appearance. I have repeatedly seen the same appearances since then, and have no doubt now that each contractile vesicle is able to project from its wall supplementary vesicles at points answering to the reticulations or, as I now regard them, villi. But, whilst it is quite possible to conceive that the contractility of the wall of the supplementary vesicles is sufficient to enable their orifices of communication with a principal one to remain closed until their complete expansion takes place, or even to expand and collapse independently during the apparent obliteration of the principal vesicle, it appears to me that the view expressed by Mr. Carter in the 'Annals' for 1856 (vol. xviii. p. 129), namely, that "the sinuses

* From the extreme difficulty of determining whether we are looking at a contractile vesicle or a mere passive vacuole, I am unprepared to speak positively as to the behaviour of a detached segment when *apparently* devoid of the former of these organs—the diastolic condition being sometimes maintained without interruption for upwards of an hour.

of this system in the sarcode of *Amœba* not only seem to burst into *each other* and into the vesicula," is not only altogether irreconcilable with the facts advanced regarding the "complete isolation of the contractile vesicle and its supplementary cavities from the body and from each other," but irreconcilable with any other view than that the orifices of discharge are extemporized, and not permanent portions of the structure.

But we have some clue to the process by which the discharge of the contractile vesicle is supposed to be effected, according to Mr. Carter, from an observation made by him in the 'Annals' for 1856 (vol. xviii. p. 131), namely, that "in *Amœba* it [the contractile vesicle] is attached to the pellicula, and therefore no sarcode exists immediately opposite this point." Here, again, we find no mention of what is now described as taking place in *A. princeps*; for the remark is illustrated, not by any reference to that form, but to *A. radiosa*—no allusion being made to any fixed point of discharge or, indeed, any determinate aspects of the body, but it being simply stated that the figure appended "presents a mammilliform projection preparatory to discharging its contents."

Reverting now to the number of contractile vesicles, it will be seen that Mr. Carter expresses himself with perplexing ambiguity, as the subjoined extracts testify :—

"In *Amœba* and *Actinophrys* the vesicula is generally single; sometimes there are two, and not unfrequently in larger *Amœbæ* a greater number" ('Annals,' 2nd ser. vol. xviii. p. 128).

"There is no knowing how many vesiculæ there may be in *Amœba*; while *Actinophrys Sol* (Ehr.) is surrounded by a peripheral layer of vesicles, which, when fully dilated, appear to be all of the same size, to have the power of communicating with each other, and *each individually* to contract and discharge its contents externally as occasion may require; though, generally, one only appears and disappears in the same place" (*loc. cit.*, succeeding page).

"In *A. princeps* the normal number is one; but there are many smaller ones which *act* as sinuses around it, and one of these occasionally becomes so enlarged as to look like a second vesicula, yet it also ultimately discharges its contents into the main one. Where the vesicula discharges itself, it again recommences to appear; and there, also, the accessory sinuses may be best *seen* as they successively become dilated and discharge their contents into the vesicula" ('Annals,' July 1863, p. 38).

The condition of abnormal vacuolation referred to by me (in the 'Annals' for June, p. 436) as presaging disruption and death, is probably the same as that described by Mr. Carter as "an intense vacuolar state of the sarcode, which makes it look like an areolar tissue composed of vesicles, diminishing to a smallness that cannot be determined by the microscope." But he adds, "whether this state be a part of the vesicular system, or not, I am unable to decide." And it would appear that a similar opinion was held by him in 1856, from the subjoined statement extracted from the 'Annals,' vol. xvii. p. 358. "In *Amœba*, sometimes, the sarcode appears to be filled with such vesicles *, which not only now and then *burst* into the large one or *vesicula*, but, when the latter has discharged itself, frequently burst of themselves externally."

Without dwelling on the perplexing modifications of opinion, regarding the number of the contractile vesicles in *Amœba* and *Actinophrys*, which are embodied in the above extracts, I may observe that I regard the origin of the abnormal vacuolation as totally distinct from that of the multiple or supplementary contractile vesicles; and, bearing in mind that in *Amœba* it is connected with an exhausted condition of the organism, it appears explicable on the supposition that the effete watery particles, being unable to obtain a discharge through the ordinary endosmotic transference to the true excretory organ (namely the contractile vesicle, which now acts very sluggishly), are poured out, and produce vacuoles at any portion of the endosarc where a rudiment exists (see *antè*, p. 146). Should this view be correct, it would appear that the endogenously formed vacuoles constitute a rudimentary water-respiratory system †; whilst the contractile vesicle serves to throw off such portions of the watery particles as are effete; and the food-vacuoles (which are invariably formed at the surface) *ipso facto* constitute digestive cavities, whose assimilative function is called into action by the stimulus of organic objects capable of solution by them. In this sense I fully acquiesce in Mr. Carter's opinion that a digestive power is essentially inherent in sarcode *generally*, although I can no more admit the conversion of ectosarc and endosarc to be the result of a digestive process, as urged by him ('Annals,' July, p. 37), than that the absorption of a morbid growth, or the constant decay and renewal of parts, in the case of the higher animals is similarly brought about.

The conversion of endosarc into ectosarc I regard as analogous in its character, if not identical, with coagulation, the effect being produced by the mere contact of sarcode with the medium in which it resides; whilst the converse process constitutes an inherent vital function of the animal protoplasm. Should this view be admissible, we have presented to us a phenomenon bearing, in the most important manner, on the general question of development, and one which, I venture to affirm, is far more

* The context shows that the supplementary contractile vesicles are here referred to.

† The Diatomaceæ and Desmidiaceæ, when becoming languid and unhealthy, present this inordinate vacuolation.

largely engaged in the production of specific type, not only amongst the lower, but also the higher orders of being, than we have heretofore been inclined to allow. I allude to the reciprocal action of physical and vital forces.

Keeping in view, then, the proofs that have been adduced by me to show, 1st, that no permanent or determinate aperture exists either in the contractile vesicle, the supplementary vesicles, or in the outer layer (by whatever name called) of the villous appendage of *Amœba*; 2ndly, that, whilst the ectosarc is but a more consolidated condition of the endosarc, both endosarc and ectosarc are reciprocally convertible one into the other; 3rdly, that no appreciable difference is traceable between the ectosarc of the organism and the wall of the contractile vesicle when seen in its distended state; 4thly, that the coalescence of two distinct contractile vesicles takes place without reference to the special aspects in which they come into contact; 5thly, that no vestige of a permanent system of sinuses is discoverable, and that the facts actually observed militate in a direct manner against the possibility of its existence; 6thly, that the non-coalescence of a contractile vesicle with an ordinary vacuole, when coupled with what has been advanced under heads 2 and 3, and the fact that the obliteration of the extemporized aperture of the contractile vesicle takes place only when it comes into immediate contact with the ectosarc of the villous region, renders it extremely probable, if not certain, that the constitution of the wall of the one is identical with the investing layer of the other,—it appears to me to have been conclusively established that no determinate or permanent orifice occurs either in the villous region or the wall of the contractile organ *.

If, then, no permanent orifice exists at any portion of the wall of the contractile vesicle, and yet, notwithstanding, two or more of these organs have the faculty of coalescing, so as to constitute one vesicle, even after being so far removed from each other, and so subjected to change of relative position as to preclude the possibility of any bond of union such as a sinus being present,—it is manifest that we can only regard the coalescence of two or more vesicles as due to the gradual attenuation and ultimate disruption of the wall that intervenes between them. The appearances are those that would ensue from this process, and not such as would be likely to follow on an interchange of the con-

* On reference to the 'Annals' for June 1863, p. 441, it will be seen that I allude to the illusory appearance of an aperture in the contractile vesicle, engendered by an imperfect systole of that organ. I am still of opinion that this appearance is illusory, and shall reserve my views on the precise mode in which the discharge of the contents of the vesicle is brought about for a future occasion.

tents of two or more vesicles through a minute duct or aperture. In short, the process is identical with that observable on the coalescence of two adjacent soap-bubbles.

But it has been shown, I think, satisfactorily, both on evidence adduced in the preceding pages and from the opinion expressed by Dr. Carpenter (p. 138, *antè*)—namely, that "the contractile vesicle may be regarded as a vacuole with a defined wall,"—that the said wall is not identical in its degree of differentiation with the wall of the ordinary vacuolar cavities. The fact, already alluded to, of the contractile organ never coalescing with the true vacuoles would seem at once to establish this differentiation. Now it is not membranous in the usual acceptation of the term; but the appearance presented by its margin, its behaviour when isolated from the body altogether, as spoken of by Mr. Carter ('Annals,' July 1863, p. 39), and, since the publication of Mr. Carter's paper, verified by myself (with the exception of the iodine test), clearly prove that the differentiation in question is identical both in degree and character with that of the ectosarc generally. It is true that Mr. Carter (*loc. cit.*) refers to "the presence of condensed sarcode round the point of contraction manifested under the effect of iodine;" but this condensation is quite manifest without the iodine; and were it not so, I am inclined to think, as already urged, that the appearances presented *after* amorphous structure (such as that under notice) has been subjected to the action of a powerful chemical reagent are no guarantee that those appearances existed normally and prior to its employment. The condensed layer, moreover, may be seen whilst the contractile vesicle is still within the parent endosarc; and should it be isolated whilst in a state of contraction, the true villous character of the condensed layer becomes so palpable, that, but for the previous knowledge of its origin, it might readily be mistaken for a fragment of the villous appendage itself.

Mr. Carter's remarks on this head have such a material bearing on the view I put forward, that it is necessary for me to quote them in detail:—"Towards death, the vesicula, growing weak, is not easily refilled, nor do the small sinuses which surround it readily discharge their contents into it; so that by a little pressure, when the group is at the margin, they may be made to pass out into the water without bursting; and, at this time, if iodine be applied, each may be seen to retain its cell-form, puckered and tinted yellow by the iodine, *although they may be all quite isolated and separated from the rest of the sarcode and from each other*" (see figures, *loc. cit.*). Mr. Carter then asks, "If the vesicula be distinct, why not the sinuses?" (p. 39 *ut suprà*).

So far from admitting that Mr. Carter's view as to the permanent nature of the channel of communication between two or more supplementary vesicles (the analogues of the sinus-system of *Paramecium*, &c., according to that author), between the supplementary vesicles and the primary contractile vesicle, or between the principal one and the exterior, are borne out by the facts he thus describes and their illustrative figures, it appears to me that no facts could more directly negative the conclusions at which he has arrived,—in the first place, from the circumstance of "the small sinuses which surround" the primary vesicle being at all capable of isolation "from the rest of the sarcode and from each other;" and in the second, because the effect of iodine being to cause sarcode to contract and become consolidated, unless it can be shown that, besides mere reduction in bulk, such an increase of contractile power is secured as would prevent a determinate orifice from yielding under the tension to which the wall of the vesicle is subject, the retention of the cell-form, at the same time that the connecting sinuses are destroyed, is only reconcilable with one supposition, namely, that every portion of the vesicular wall is of uniform and unbroken composition. For I must repeat that since the changes of position usually undergone by every detached supplementary vesicle are as fortuitous as the shape of the body or the size of the pseudopodia, the difficulty of conceiving that these vesicles should revert to the precise point at which the excretory aperture is assumed to exist, so as to ensure that exact coincidence between the latter and their own excretory orifices which is essential to the stability of Mr. Carter's theory, must be regarded as insuperable.

I must also call attention to the difficulty of comprehending in what manner the prehensile power of the villi is effected, if the pellicula, which Mr. Carter declares to have no prehensile power ('Annals,' July 1863, p. 32), save when exercised under the "instinct" of the creature, invests the villous organ. It is clear that Mr. Carter assumes that it does so; otherwise he would not have made use of the expression, that there is an "aperture through the diaphane and pellicula" at that particular portion of the body.

Lastly, without offering any opinion on the question of "instinct," as here introduced, I have no hesitation in saying that the prehensile action observable in the villi of *Amœba villosa* is not of a grasping kind, as if they were minute pseudopodia, but distinctly adhesive and residing at the immediate surface. As stated by me ('Annals,' April, p. 288), so powerful is the prehensile action, that at times the villi become stretched beyond their endurance when the animal is moving. When this takes place to an inordinate degree, they are rent asunder, the torn extremity next the body starting back, at the instant of rupture, as if resilient.

Taking into consideration, then, the various facts that have been adduced on the subject in the present and preceding papers—that the characters of *A. princeps,* as assigned to it by Ehrenberg and Dujardin, have been universally accepted by writers on the Rhizopods up to the period at which my observations on *A. villosa* were published—the strong evidence afforded that *A. princeps* (Carter) is not a distinct form, but, together with other varieties to which separate specific names have heretofore been assigned, referable to *A. villosa*—that the characters of *A. villosa* are such as to elevate the genus to which it belongs considerably beyond the position it formerly occupied—and, lastly, that no descriptive notice or figures of any of the characters brought to notice in *A. villosa* had previously appeared in any printed work whatever,—I think it will be admitted that *A. princeps* (Ehr.), if still recognized at all as a species, should be retained under the definition originally assigned by its founder, whilst *A. villosa* should henceforth constitute the true type of *Amœban* structure.

I would state, in conclusion, that the length to which my observations have unavoidably extended, coupled with the absolute necessity for verbatim extracts, have precluded me from referring, in many cases, to the works of Ehrenberg, Dujardin, Schultze, J. Müller, Cohn, Lachmann, Claparède, Reichert, and others, and likewise from touching on numerous minor points bearing on the questions at issue. These omissions I hope hereafter to rectify. Meanwhile let me claim the reader's indulgence if I have been somewhat prolix in my treatment of a very important and imperfectly understood subject. In sustaining the accuracy of the opinions and statements published in my preceding papers, I had two distinct objects in view, namely, to advance science, and perform an act of justice to myself: for a very cursory perusal of Mr. Carter's notice on *Amœba princeps* will suffice to show that, directly or indirectly, nearly every opinion and statement of mine has been therein assailed.

Under these circumstances, should I have appeared somewhat tenacious of the little fame attaching to good service, I trust it may be taken into consideration that such service is not heaven-born, but the fruit of long and assiduous study, and that, however widely my friend Mr. Carter's views and mine may differ on certain points, we assuredly have no sympathy with those intellectual eagles who, whilst they affect to see everything at a glance, deny all credit to others, and would have the world believe that their aims are purely unselfish.

Kensington,
July 15, 1863.

XIV.—*Description of a new Species of* Lycosa *living in the Island of Madeira; with some Remarks on* Lycosa tarentuloides maderiana, *Walckenaer.* By James Yate Johnson, Corr. Mem. Zool. Soc.

Lycosa Blackwallii, n. sp.

The *legs* are long, robust, thickly clothed with hair, and furnished with sessile spines; they are brownish grey, with broad rings of dark brown. The metatarsus and tarsus of the two anterior pairs of legs are black, and the undersides of the other joints are black, or very dark brown. At the distal extremities and on the upper sides of the femur and genua of the first two pairs of legs, as well as at the extremities of some of the joints of the two posterior pairs of legs, there is a patch of orange hairs. Each tarsus is terminated by two curved pectinated claws and a minute simple claw. The fourth legs are the longest; and then come the first, second, and third, the last being the shortest.

The *palpi* are rather short, and each is terminated by a curved pectinated claw. The last joint is black or dark brown, and the uppersides of the penultimate and antepenultimate joints are orange.

The *falcès* are powerful, conical, vertical, and armed with a strong curved fang at the extremity, and five or six teeth on the inner surface. The orifice of the poison-duct is conspicuous.

The *maxillæ* are straight, and have rounded extremities, which are enlarged and obliquely truncated on the inner side. The lip has the middle broader than either its base or apex, and the latter is truncated and hollowed.

The *sternum* is oval, polished, and hairy. All these parts are of a deep brown hue, sometimes almost black.

The *cephalothorax* is compressed at its anterior part, and rounded at the sides; it is convex, has a slight longitudinal furrow in the median line, and is densely clothed with short hair of a brownish-grey colour. At each side is a series of brownish-grey suboval spots surrounded by black; these are more apparent in the male than the female. On the median line in the posterior half of the cephalothorax there is a delicate Y-shaped black mark, the fork being directed forwards, and the extremities of the tines being dilated. Posteriorly there are two broad longitudinal black bands or blotches, one at each side of the median line; and these bands are continued upon the anterior part of the abdomen, where they have between them a patch of long orange hairs.

The four anterior *eyes* are equal in size, and form a straight transverse row near the frontal margin of the cephalothorax.

The *abdomen* is oviform, a little broader posteriorly than in front, where it projects slightly over the end of the cephalothorax; it is convex above, and thickly covered both above and below with short hair, of a brownish-grey colour, plentifully marked with small black spots. About the middle of the upperside is a pair of closely approximated black spots, having the shape of right-angled triangles, and so disposed that the vertical side of each is next the median line. Behind these, on the median line, is a series of triangular black spots, which have their apices pointing forwards, and their posterior angles more and more produced laterally as they approach the hinder extremity of the abdomen. The first of these spots is the largest, and its apex is truncated. The apical portion of the hinder ones becomes gradually less. At each side of this median series are some groups of black spots, forming blotches of irregular shape. Along the middle of the underside is a broad longitudinal black band, which narrows behind. The spinnerets and sexual organs are black or deep brown.

The male resembles the female, except that it is smaller, the abdomen shorter, the legs of the third pair proportionally longer, and the colours more decided. The following are the dimensions of an adult male and female in parts of an inch :—

	♂	♀
Length	$\frac{15}{20}$	$\frac{22}{20}$
Length of cephalothorax	$\frac{3}{10}$	$\frac{4}{10}$
Width ,, ,, ...	$\frac{7}{30}$	$\frac{9}{30}$
Width of the abdomen	$\frac{5}{20}$	$\frac{6}{20}$
Length of a leg of the 4th pair..	$1\frac{1}{20}$	$1\frac{10}{20}$
Length of a leg of the 3rd pair..	$\frac{16}{20}$	$\frac{21}{20}$

This handsome spider may be at once distinguished from the great *Lycosa* of Deserta Grande (*L. ingens*, Blackw.) and from that of Porto Santo (*L. tarentuloides maderiana*, Walck.) by the Y-shaped mark on the cephalothorax, and by the black triangular spots on the upperside of the abdomen. From the former it may be further distinguished by the orange marks on the palpi and legs, and from the latter by the black and grey annuli on the legs, and by the eyes of the first row being nearly equal in size, whereas in the Porto-Santan spider those forming the middle pair of that row are decidedly larger than the other two.

Examples were first obtained by me three or four years ago, from holes in a rock in the lower part of the ravine of S. Jorge, on the north side of the island of Madeira. Others have been lately obtained by Frederick Pollock, Esq., from banks of earth covered with moss, in two localities upwards of 2000 feet above Funchal, on the south side of the island; and my description has been drawn up from living specimens which he kindly presented to me.

This spider feeds eagerly in captivity on large "blue-bottle" flies. The only web which has been observed was a small circular one fabricated by an individual whilst in captivity. This web was of close texture, open above at the middle, and less than a shilling in size. It was apparently the foundation of a nest, in which, however, no eggs had been deposited.

It is remarkable that Madeira, Porto Santo, and the Desertas should each have their own peculiar large species of *Lycosa*—a fact that goes to confirm the testimony already given by the land-shells and beetles, as to the distinctness of the aboriginal fauna in the different parts of this insular group.

This new species of *Lycosa* is dedicated to that able arachnologist, John Blackwall, Esq., the author of a Monograph of British Spiders, the first part of which has been recently published by the Ray Society. In the 'Annals and Magazine of Natural History' for October 1859 will be found descriptions by Mr. Blackwall of a collection of Madeiran Spiders made by me in the preceding year, and in the same publication for May 1862 descriptions of another collection from the same island.

A remarkably fine female individual of *Lycosa tarentuloides maderiana*, Walck., having been lately presented to me by the Baron do Castello de Paiva, I will take this opportunity of making a few remarks upon it, chiefly with reference to the colours of the living spider. The example, which was found on the uninhabited islet of Ferro, near Porto Santo, had the following dimensions:—

	inch.
Length	$1\frac{9}{20}$
Length of cephalothorax	$\frac{6}{10}$
Breadth " "	$\frac{9}{20}$
Breadth of abdomen (nearly)	$\frac{6}{10}$
Height " "	$\frac{5}{10}$
Length of a leg of the 4th pair	$1\frac{9}{10}$
" " " 3rd pair	$1\frac{4}{10}$

The cephalothorax has a dark greyish-brown hue, and there is a yellowish-grey band along each side, and another along the middle, the latter having some small orange dashes at its posterior part. The abdomen is of a brownish (or rusty) black colour. On the upperside two obscure dark longitudinal lines enclose an elongated fusiform or lanceolate space. These lines approximate very gently posteriorly, and their termination is behind the middle of the abdomen. At each side of the median line, where the fusiform space is broadest, there is a small rounded pit just outside that space; and immediately behind each, there is a still smaller pit. Near the middle of the length of the abdomen is another pair of pits, which are further apart than the anterior pair. All of these pits have a chestnut-brown colour. At each side of the anterior end of the fusiform space is a black blotch, and between them is a small patch of yellowish brown. On the underside of the abdomen there is a longitudinal brownish band at each side of, but at some distance from, the median line. These bands are furthest apart at the middle; they approximate, but do not meet, as they approach the spinnerets. As to the legs and palpi, the uppersides of the five distal joints of the former and of the three distal joints of the latter are orange, which is very intense on the palpi and the two anterior legs. The undersides of the legs and palpi are black, and of this colour are also the falces, maxillæ, labrum, and sternum.

BIBLIOGRAPHICAL NOTICE.

English Botany; or, Coloured Figures of British Plants. Third Edition. Enlarged, rearranged according to the Natural Orders, and entirely revised; with Descriptions of all the Species. 8vo. London: R. Hardwicke. 1863.

We have waited for the completion of the first volume of this great work before taking any notice of it. Now that seven monthly numbers have been issued and a volume completed, the proper time has arrived for a few remarks. It is quite unnecessary to say anything concerning the original 'English Botany,' projected and the plates executed by James Sowerby and accompanied by descriptions (each limited to one small page) from the pen of Sir J. E. Smith. It was, and even now continues to be, the most complete illustration of the flora of any country which has appeared. But, having been commenced in the year 1790 and concluded in 1814, the descriptive part has long been somewhat obsolete, and interesting chiefly for the many curious historical facts to be learned from it. Its technical accounts of the plants were meagre, even when published, and are now very far from furnishing the information expected by botanists. Also the plates are not always such as we now desire: the dissected parts are not magnified to a proper extent, and many things required in the present state of science are altogether wanting. It also appears, from an examination of the original drawings from which the plates were engraved, that alterations were often made by Smith, which have sometimes been very unwise. He has occasionally altered Sowerby's drawing to correspond tolerably with the plant known to him, whereas an examination of the original sketch shows that the artist and the author had different plants in view. Again, the want of any scientific arrangement of the plates, which was impossible under the plan of publication necessarily adopted, renders the reference to them inconvenient. A second edition was commenced in 1830, and carried on for many years to completion. In it Smith's part is left out, and new letterpress, of no very high order of merit, is given. The plates were, we believe, untouched, and are therefore a mere reissue of the original set, but arranged according to the Linnæan system, and coloured in a less finished manner. Imperfect as it was, this seems to have been a successful undertaking, as it is now apparently nearly, if not quite, out of print. It is therefore with much satisfaction that we see something more than a reissue of this national work successfully commenced.

In the present edition, which is arranged according to the natural orders, the original plates have been carefully examined by Mr. Syme, the author of the descriptive part, altered in many cases, in accordance with his directions, by Mr. J. E. Sowerby, transferred to stone, and printed from thence. In general, this is done in a satisfactory manner; but we fear that the artist has not always fully carried out Mr. Syme's intentions; and the colouring is certainly far inferior to that of the original work in many cases. It is manifest that the mantle of James Sowerby has not fully fallen upon his grandson. We have spoken of the author of the text, and are justified in doing so when referring solely to the scientific portion of the work; but, in fact, there are two authors, and two quite distinct parts of the book. Mr. J. T. B. Syme writes the scientific part and superintends the revision of the plates; and Mrs. Lankester adds "popular descriptions," for which she is solely responsible.

We do not purpose to enter upon a minutely critical examination of either of these three parts, but will make a few remarks upon each of them. To begin with the plates:—Plate 23 professes to illustrate *Ranunculus confusus* (Godr.); but we very much doubt its correctness. Neither the leaves nor the head of carpels are those of *R. confusus*, but rather belong to *R. Baudotii*. If this is the only *R. confusus* known to the editor, we can account for his joining that plant to *R. Baudotii*. Plate 30 represents the true *R. reptans* (Linn.), and is the first figure of that plant which has appeared in this country, except the vignette on the title-page of Lightfoot's 'Flora Scotica,' published in 1776. Mr. Syme does not seem to have found the plant in any place except the shore of Loch Leven, near Kinross—the very spot from whence Sibthorp obtained it. Most British botanists have mistaken the creeping form of *R. Flammula* for this much rarer plant. Plate 72 (*Fumaria Boræi*) retains nearly all the faults (and they are many) of the original plate. We think it a very poor representation of the plant. The new plate of *F. pallidiflora* is very far superior; that also of *F. muralis* is deserving of praise; but on neither of them is the lower part of the fruit well shown. The artist has mistaken the fleshy mass forming the base of the somewhat drupaceous fruit for a carpophore: no such marked separation between that base and the rest of the fruit exists in nature; it is altogether an invention of the artist.

Plate 153 (*Lepidium latifolium*) is a bad copy of the original plate, which is not itself good. But, as we have said, on the whole the plates are satisfactory.

Let us now turn to the text. Mr. Syme furnishes a description of each genus and species, and has performed his task thus far in a very creditable manner. We do not like his mode of arranging the plants as species and subspecies, neither can we see the use of it. It also leads to a very inconvenient introduction of new names, and especially to that of the prefix "eu," as *Thalictrum eu-minus* for the true *T. minus* of botanists. The author's theory leads him to take for granted that in this case the term *T. minus* "properly belongs to the whole" of his "collective" species (and similarly in many other cases), whereas it seems to us to be clearly the property of his "subspecies *T. eu-minus*." He thinks that this nomenclature will tend to prevent confusion; and, indeed, such might be the case if people could be persuaded universally to adopt his mixture of Greek and Latin and his ideas of sub- and super-species exactly as he holds them. But as this is exceedingly unlikely, we shall suffer under the difficulty of not knowing to what an author refers when using such a term as *T. minus*, until we have discovered the class of "splitters" or "lumpers" to which he himself belongs; and those who, fortunately or unfortunately, belong to neither of these classes must necessarily run the risk of being placed in one of them, probably very much against their will. The author himself is just in that position. We have known him stigmatized as an extreme subdivider of species, and have seen the remark in print that Mr. Syme "will soon exhaust the patience of both publisher and buyers" by the plan adopted. We do not admit the justice of this remark. It is highly desirable for all botanists to see what is really intended by authors who extensively divide plants, whether they agree with their views or not; and probably Mr. Syme might have wisely introduced plates of some other recognized forms. On the other hand, his adoption of this system has led others to class him with the very men from one of whom the recently quoted remark is derived. We believe that he is endeavouring to follow Nature wherever she may lead him, without caring for the theories of either extreme class; and therefore amongst those botanists who are unfortunately swayed (perhaps unknowingly) by party he has no friends. He seems to be a "searcher after truth," such as would have pleased the late Edward Forbes, who certainly did not belong to either of those classes. We may not agree with Mr. Syme in some of his views, but still think most highly of him as an honest, learned, and painstaking botanist—just the man to edit 'English Botany.' It would be well if he had a little more absolute power over his coadjutors, and especially over the artist.

Our remarks have extended to such a length that we must dismiss the popular part of the book in a very few words. Mrs. Lankester's remarks are clever and interesting; but they are sometimes too long, and not always absolutely correct.

Although we have found it necessary to make a few adverse remarks, we can safely add that this edition of 'English Botany' is really deserving of support, and should be obtained by all botanists to whom five shillings a month (a very cheap rate of charge) is not too much cost.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Nov. 25, 1862.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

Notice of a New Species of Dogania from Asia. By Dr. J. E. Gray, F.R.S., etc.

We have received for the Museum a dried and varnished specimen of a *Dogania*, unfortunately without any special habitat, which appears to be distinct from *Dogania subplana*. It is scarcely two-thirds the size of the specimen which we received from General Hardwicke, which agrees with the type specimen of Geoffroy, on which the species was originally described; yet the dorsal shield is more ossified, the ribs more expanded, and the surface of the bone of the back and chest more granulated. This leads me to believe that it must be of a distinct species; I shall therefore give diagnoses of the two kinds.

Dogania subplana.

The first odd transverse bone of the dorsal shield smooth, with a narrow band of granules on the middle of the hinder edge. The first, fifth, sixth, and seventh ribs narrow, the last being the narrowest and shortest; the second, third, and fourth ribs broader, dilated at the outer end, the width being about one-third of the length. The sternum smooth, with a small, narrow, oblong, longitudinal granular patch on the hinder edge of the transverse bone.

Hab. India, Singapore?

The dorsal disk of this species is well figured by Cuvier, Oss. Fos. iii. t. 13. f. 5.

Mr. Swinhoe informs me that this animal is common in the rivers of China and Formosa; that it is known to the Europeans there by the name of "Terapan," most likely a corruption of the American word "Terrapin," and is esteemed a great delicacy by the Chinese, and fetches a good price in the market to make soup.

The head of the older specimen is not so large compared with the body. The animal has the power of drawing its head within the skin of the neck.

Dogania Guentheri.

The odd transverse bone in front of the dorsal shield entirely covered with granulations, like the ribs. The ribs all nearly similar in width (nearly four times as long as wide), and very slightly and gradually dilated at the outer end; the last rib the smallest, narrow and short compared with the others. The hinder sternal bones broad, with a large oblong patch of granulations at the inner hinder end. The labral bones with a large indeterminate group of tubercles near the suture that divides them.

Hab. India, ——?

I have named this species after my friend Dr. Albert Günther, one of my colleagues in the Museum, who has prepared such admirable catalogues of the Snakes and Fishes in the Museum Collection. He first drew my attention to the specimen, and considers it as indicating a very distinct and interesting species. It is to be regretted that the head is so dried and covered with varnish that it is impossible to see the distribution of the colours with any certainty; for I have found that the distribution of the colours on the head and exposed parts of the body affords one of the best and most prominent characters for the distinction of the species of this family, and one, unlike the form of the bones, that is not at all, or but slightly, altered by the age of the specimens.

On the Breeding of a West-Indian Tortoise in this Country. By William Williams (of Tregullow).

A female Land-Tortoise, brought from the West Indies and given to Mrs. Williams's mother upwards of fifty years ago, was then about the size of a watch. It has now been in the garden at Tregullow about thirty-two years. Four years ago another Tortoise was obtained, which turned out to be a male; they were allowed to roam in the garden at their will. In 1860 some eggs were found, but, from insufficient heat, they were not hatched.

About the 25th of July last, the gardener, on passing a south border, observed the female Tortoise making a pit with her hind legs in a very peculiar manner. On watching her, he found she had made a hole some four inches deep, quite flat at the bottom. On returning, in about five minutes, he found she had deposited six eggs, and was in the act of covering them with earth. He immediately removed them, in a flowerpot-stand about two inches deep, filled with white sand, to a pine-pit, and placed them on a tan-bed. On the 19th of October last he observed two of the eggs had been hatched; and on looking around he found, much to his astonishment, two young live Tortoises. The eggs were about the size of those of a pigeon, and much the same in appearance.

The young ones are kept in a wooden box (in a pine-pit) with some earth and moss, under which they nestle. They are fond of lettuces and strawberries, but do not eat much. They appear quite well and lively, moving about briskly; they are now a little larger than half-crowns.

The eggs were not disturbed while in the pine-pit, the temperature of which during the time they were there was from 85° to 90° by day, and from 65° to 70° by night.

The female measures 12 inches long, by $12\frac{1}{4}$ inches wide over the back; the male 8 inches long, by $8\frac{1}{2}$ inches wide over the back.

Descriptions of Sixteen New Species of Birds from the Island of Formosa, collected by Robert Swinhoe, Esq., Her Majesty's Vice-Consul at Formosa. By John Gould, Esq., F.R.S., etc.

Parus castaneoventris, Gould.

A bar across the forehead and cheeks white; crown of the head, back of the neck, throat, and chest jet-black; on the nape a spot of pure white, bounded below by a slight mark of chestnut; mantle, back, shoulders, upper surface, wings, and thighs very deep blue-grey; abdomen and under tail-coverts rich chestnut; bill bluish black.

Total length, 4 inches; bill, $\frac{1}{2}$; wing, $2\frac{1}{2}$; tail, $1\frac{5}{8}$; tarsi, $\frac{5}{8}$.

Remark.—This species is very similar in colour to the *Parus varius* of Japan; but differs in having a much smaller amount of chestnut on the back, and in its smaller size.

Alcippe brunnea, Gould.

Feathers of the crown and upper surface deep reddish brown, those of the crown slightly fringed with a darker tint, giving that part a scaled appearance; a longitudinal black stripe commences above the eye and passes down towards the nape, separating the brown colouring of the crown from the grey of the sides of the face and ear-coverts; throat and under surface brownish grey; flanks wood-brown; primaries and tail-feathers uniform chestnut-brown; thighs reddish brown; bill horn-colour; legs and toes flesh-white.

Total length, $4\frac{3}{4}$ inches; bill, $\frac{9}{16}$; wing, $2\frac{3}{8}$; tail, 2; tarsi, $\frac{3}{4}$.

Remark.—A small brown bird, rather less in size than *Accentor modularis.*

Myiophoneus insularis, Gould.

Lores jet black; forehead crossed by a narrow band of shining deep blue; crown of the head, throat, back of the neck, all the upper surface and the tail obscure blackish blue; shoulders very bright metallic blue; primaries and greater wing-coverts margined externally with bright blue; feathers of the chest and upper part of the abdomen black, with shining blue tips; lower part of the abdomen, thighs, under tail-coverts, and the under side of the tail-feathers dull black; bill and legs black.

Total length, $11\frac{1}{4}$ inches; bill, $1\frac{3}{8}$; wing, $6\frac{5}{8}$; tail, $5\frac{1}{8}$; tarsi, $2\frac{1}{8}$.

Remark.—This is a much larger bird than the *Myiophoneus cæruleus* of China; it also differs in the finer blue of the breast, and in the total absence of the spangled spots of shining blue which occur on the back of that species.

Garrulax ruficeps, Gould.

Lores and chin black; forehead and crown, down to the nape, light orange-red; ear-coverts orange-brown; mantle, back, rump, sides of the chest, flanks, thighs, and two middle tail-feathers light brown; primaries blackish brown, margined externally with light olive-brown;

lateral tail-feathers light brown at their bases, and largely tipped with white; throat, centre of the chest, and abdomen white; bill blackish brown; legs, toes, and claws light flesh-brown.

Total length, $10\frac{1}{2}$ inches; bill, $1\frac{1}{8}$; wing, 5; tail, $5\frac{1}{4}$; tarsi, $1\frac{3}{4}$.

Remark.—This species is allied to *Garrulax albogularis* and *G. cæruleatus*; but differs from both in the uniform orange-red colouring of the crown.

Garrulax pœcilorhyncha, Gould.

Crown of the head, nape, back, rump, throat, and chest deep rusty brown; many of the feathers of the crown slightly fringed at their tips with black, a hue which is also observable on the tips of the ear-coverts; primaries and secondaries reddish brown on their inner webs; the external edges of the former light grey, and of the latter deep rusty chestnut; tail deep rusty chestnut, particularly the six central feathers, the remainder being darker and having less of the chestnut hue, these lateral feathers also become lighter and of a reddish fawn-colour towards their tips; abdomen and thighs deep blue-grey, tinged on the latter with rufous; under tail-coverts fawn-colour; legs and toes yellowish olive.

Total length, $9\frac{1}{4}$ inches; bill, $1\frac{1}{4}$; wing, $4\frac{3}{8}$; tail, $4\frac{1}{2}$; tarsi, $1\frac{1}{2}$.

Remark.—This species differs so much in colour from all other known species of the form, that it cannot be confounded with any of them.

Pomatorhinus erythrocnemis, Gould.

A narrow bar across the forehead, knees, and under tail-coverts rusty red; lores and ear-coverts grey; crown of the head and back of the neck brownish grey, passing into the deep rusty chestnut of the back, shoulders, and external margins of the wing-feathers; inner margins of the wing-feathers blackish brown; tail blackish brown, with rusty margins; a streak of black, commencing at the base of the under mandible, passes downward to the chest, which is conspicuously spotted or rather blotched with black; throat and centre of the abdomen white; flanks and upper part of the thighs rusty olive-brown; bill much curved, and of a purplish brown.

Total length, $8\frac{1}{4}$ inches; bill, $1\frac{3}{8}$; wing, $3\frac{3}{4}$; tail, $3\frac{3}{4}$; tarsi, $1\frac{1}{2}$.

Remark.—This species differs conspicuously from every other known species of the genus. It is about the size of the common Thrush (*Turdus musicus*).

Hypsipetes nigerrima, Gould.

Entire plumage black, with the exception of the edges of the primaries and tail-feathers, which are pure grey, a tint which is also observable, but in a minor degree, on the margins of the greater and lesser wing-coverts, and on the feathers of the flanks and the back, on the latter, however, it is rather of a greenish cast than pure grey; bill blood-red; legs red.

Total length, $8\frac{1}{2}$ inches; bill, $1\frac{1}{8}$; wing, 5; tail, 4; tarsi, $\frac{3}{4}$.

Remark.—This species is somewhat allied to, but is a smaller bird than, the well-known *Hypsipetes psaroïdes* of India.

PERICROCOTUS GRISEOGULARIS, Gould.

Male: forehead, crown of the head, back of the neck, back, shoulders, and two central tail-feathers sooty black; wings black, with an oblique bar of scarlet across the primaries and secondaries, near their bases; throat and ear-coverts light grey; chest, abdomen, flanks, under tail-coverts, and rump rich scarlet; lateral tail-feathers black at their bases, and scarlet for the remainder of their length; thighs blackish brown; bill and legs black.

Total length, $6\frac{3}{4}$ inches; bill, $\frac{5}{8}$; wing, $3\frac{1}{2}$; tail, $3\frac{3}{4}$; tarsi, $\frac{3}{4}$.

Female: throat light grey, as in the male; crown, ear-coverts, back, and shoulders deep leaden grey; rump sulphur-yellow; chest, abdomen, under tail-coverts, the oblique band across the wing, and the tips of the outer tail-feathers rich Indian yellow; bill and legs black.

Remark.—This species is somewhat allied to *Pericrocotus saularis*, but differs from that bird in its clearly defined throat-mark and other characters.

GARRULUS TAÏVANUS, Gould.

Feathers covering the nostrils, a narrow bar on the forehead, and a longitudinal mark down the cheeks black; crown of the head, nape, back, and all the under surface vinous brown, tinged with grey on the centre of the back; rump and under tail-coverts white; primaries black, fringed on their outer margins with greyish white; the secondaries have the usual speculum of blue disposed in broad bars on their outer webs, and a patch of chestnut on the inner margin of the two shortest feathers, as in most of the true Jays; shoulders and spurious wing alternately barred with fine lines of blue and black; tail black; bill black; tarsi and toes flesh-colour.

Total length, $10\frac{1}{2}$ inches; bill, $1\frac{1}{8}$; wing, $6\frac{1}{8}$; tail, $5\frac{1}{2}$; tarsi, $1\frac{3}{8}$.

Remark.—This very distinct species, the smallest of the genus I have yet seen, has the same general colouring as the *Garrulus bispecularis* of the Himalayas and the *G. sinensis* of China, but differs from both in its smaller size and in the black colouring of the feathers covering the nostrils.

UROCISSA CÆRULEA, Gould.

Crown of the head, nape, cheeks, throat, and chest jet-black; body, both above and below, and the thighs blue, of a cobalt tint in certain lights; all the primaries and secondaries fringed with white at their tips; upper tail-coverts light cobalt-blue, with a broad bar of black at their tips; two centre tail-feathers cobalt-blue, broadly tipped with white; the lateral feathers blue at their bases, to which succeeds a broad band of black, beyond which they are snow-white; bill and legs blood-red.

Total length, 21 inches; bill, $1\frac{5}{8}$; wing, $7\frac{1}{2}$; tail, $14\frac{1}{4}$; tarsi, $1\frac{5}{8}$.

Remark.—In size this fine new species is about equal to the *Urocissa sinensis*, but it differs from that and every other member of the genus in its stouter bill and in the blue colouring of the entire body.

MEGALÆMA NUCHALIS, Gould.

Forehead dull olive; immediately before the eye a small patch of red; throat sulphur-yellow; remainder of the cheeks, the ear-coverts, back of the neck, and a band across the lower part of the throat pale greenish blue, to which succeeds a band of red, separating the sulphur-yellow of the throat from the yellowish green of the under surface; upper surface and tail green, with an obscure patch of red on the mantle; primaries blackish brown, externally margined with green; bill blackish horn-colour, except the base of the under mandible, which is sulphur-yellow; legs olive-black.

Total length, $7\frac{1}{2}$ in.; bill, $1\frac{1}{4}$; wing, $4\frac{1}{8}$; tail, $2\frac{3}{4}$; tarsi, 1.

Remark.—This very distinctly marked species is about the size of *Megalæma asiatica.*

PICUS INSULARIS, Gould.

Male: forehead crossed by a narrow band of buff; crown of the head scarlet; lores, cheeks, sides of the neck, and throat white; a black line, commencing at the base of the lower mandible, passes down between the ear-coverts and the throat, on to the sides of the chest, where it forms a broad patch; flanks buffy white, strongly striated with black; lower part of the abdomen and under tail-coverts rosy scarlet; mantle, shoulders, upper tail-coverts, and four middle tail-feathers black; centre of the back white, crossed with irregular rays of black, as in *Picus leuconotus*; wings black, spotted with white on both webs of the feathers, as in that species; outer tail-feathers alternately barred with black and white; bill bluish horn-colour; tarsi and feet lead-colour.

Total length, $9\frac{1}{4}$ inches; bill, $1\frac{1}{2}$; wing, $5\frac{3}{8}$; tail, $3\frac{1}{2}$; tarsi, $\frac{5}{8}$.

Female like the male in every respect, except in having a black instead of a red crown.

Remark.—This species is nearly allied to the *Picus leuconotus*, but is very distinct from that and every other member of the *Picidæ* I have yet seen; and it is certainly not included in the great work on this family of birds just completed by M. Malherbe.

GECINUS TANCOLO, Gould.

Lores, a narrow band across the forehead, back part of the head, nape, and a stripe down the cheeks black; centre of the forehead blood-red; back dull green, passing into greenish yellow on the rump; shoulders and upper part of the wings dull wax-yellow; primaries olive-brown, with small elongated marks of buff on their external margins; internal webs of the greater coverts and primaries crossed with distinct bars of greyish white; throat and cheeks grey; under parts of the shoulders and axillaries alternately barred with greenish white and blackish brown; chest and under surface sordid green.

Total length, $10\frac{1}{4}$ inches; bill, $1\frac{5}{8}$; wing, $1\frac{5}{8}$; tail, $5\frac{1}{4}$; tarsi, $\frac{5}{8}$.

Remark.—The species to which this bird is most nearly allied is the *Gecinus occipitalis* of the Himalayas, from which however it is conspicuously different. I have adopted its Chinese name for a specific appellation.

Euplocamus Swinhoii, Gould.

Male: forehead black, gradually blending into the snowy-white lanceolate plumes which form a slight crest, and continue in a narrow line down the nape of the neck; back snowy white, offering a strong contrast to the narrow black line with which it is bounded on each side, and the rich fiery chestnut of the scapularies; lower part of the back, rump, and upper tail-coverts intense velvety black, broadly margined with shining steel or bluish black, these scale-like feathers gradually becoming of a larger size and of a more uniform black as they approach the tail-feathers; wings blackish brown; the greater and lesser coverts fringed with green; two centre tail-feathers snow-white, the remainder black; the somewhat elongated feathers of the chest and flanks black, with shining blue reflexions; thighs and under tail-coverts dull black; legs and spurs blood-red, except the tips of the latter, which are brown; sides of the face mottled to an extent seldom seen even among Gallinaceous birds; in front this appearance extends to the nostrils, while posteriorly it terminates in a point near the occiput; a large lappet hangs down over each cheek, and a more pointed one rises, in the form of a horn, high above the crown, the whole being of the finest red, and covered with papillæ, as in the *Gennæus nychthemerus*; bill light horn-colour.

Total length, 28 inches; bill, $1\frac{1}{2}$; wing, 9; tail, 17; tarsi, 4.

Female: this sex offers a strong contrast to the male, from there being no appearance of a crest in any specimen I have seen, and in the entire plumage being reddish or orange-brown, particularly the under surface; when examined in detail, however, many different but harmonizing tints are seen on the various parts of the body: on the back of the neck, mantle, scapularies, and lesser wing-coverts, the freckled brown feathers have lanceolate or spearhead-shaped markings surrounded with black down their centres, while the rump and upper tail-coverts are more uniformly and more finely freckled with orange and dark brown; primaries alternately barred on both surfaces with chestnut and dark brown; secondaries dark brown, conspicuously barred with ochre-yellow; throat brownish grey; chest orange-brown, each feather with two crescentic markings of dark brown centre of the abdomen and thighs orange-brown, slightly freckled with darker brown; two centre tail-feathers dark brown, obscurely barred with buff; lateral tail-feathers nearly uniform deep chestnut; bill horn-colour; space surrounding the eye and the legs red.

Total length, 18 inches; bill, $1\frac{1}{4}$; wing, $8\frac{1}{2}$; tail, 8; tarsi, 3.

Remark.—This exceedingly beautiful species is one of the most remarkable novelties I have had the good fortune to describe; in size it is somewhat smaller than the *Gennæus nychthemerus*, which it resembles in its red wattles and in the form of its tail, while in its strong legs, the scaly stiff feathers of the lower part of its back, the red-and-white colouring of the anterior portion of its upper surface, and in its steel-blue crest it more closely assimilates, in my opinion, to the members of the genus *Euplocamus*; and with that group, the Fire-backs, I have accordingly associated it.

In dedicating this fine bird to Mr. Swinhoe, I feel that I am only paying a just compliment to a gentleman who must ever rank among the foremost of those travellers who have enriched ornithology by their numerous Eastern discoveries.

Genus Bambusicola, Gould.

Generic characters.—Bill moderately long, and very similar in form to that of *Perdix*; nostrils covered by an operculum; wings moderately long, round, and concave, the fifth primary the longest; tail somewhat more lengthened than in *Perdix*, rounded or inclined to a wedge-shape; tarsi rather long, and armed with a well-defined but blunt spur; toes longer than in *Perdix*, the two lateral ones equal in length, and united at their base by a membrane; hind toe rather long and free.

Sexes alike, as in *Caccabis*, but the female destitute of a spur.

This is a very distinct form among the *Gallinaceæ*, the species of which, so far as we yet know, are only two in number, namely, the present bird and the *Galloperdix sphenurus* of China. Both evince a predilection for forests of bamboo, which circumstance has suggested the generic appellation. In point of affinity they equally approach the members of the genera *Perdix* and *Caccabis*.

Bambusicola sonorivox, Gould.

Male: crown of the head rusty brown, each feather obscurely barred and freckled with blackish brown; lores, ear-coverts, chest, back of the neck, and chest grey, each feather minutely freckled with blackish brown; back and rump olive, each feather minutely freckled with blackish brown; those of the back, nearest the mantle, largely blotched with deep chestnut; these chestnut marks also extend over the shoulders, near the tips of which is a lanceolate spot of white; a similar but more obscure mark also occupies the sides of the wing-coverts, but, instead of being white, it is pale fawn-colour; greater wing-coverts chestnut in the centre, then black, fringed with deep buff; primaries blackish brown externally, margined with reddish chestnut; two middle tail-feathers freckled brown, buff, and black; the remainder deep chestnut-brown; abdomen rich cinnamon, with a bar of rich chestnut near the tip of all the feathers of the flanks; thighs cinnamon-brown; bill and legs blackish brown.

Total length, $9\frac{1}{2}$ inches; bill, 1; wing, $5\frac{1}{8}$; tail, 4; tarsi, $1\frac{3}{4}$.

Female similarly coloured.

The young, at about a month old, have acquired much of the colouring of the adults, but the centre feathers of the back and shoulders are darker, with lighter edges, giving this part of the plumage a very sparkling appearance.

Numenius rufescens, Gould.

Head, neck, upper and under surface reddish fawn-colour, deepest and most conspicuous on the rump and tail-feathers; down the centre of each of the feathers is a streak of blackish brown, broadest and most conspicuous on the back, rump, and upper tail-coverts; primaries blackish brown, strongly toothed on their inner margins with greyish white; tail-feathers irregularly crossed with blackish brown; thighs light buff.

Total length, 23 inches; bill, 7; wing, $12\frac{1}{2}$; tail, $3\frac{3}{4}$; tarsi, 5.

This is a very fine species, about the size of *Numenius arcuatus* and *N. australis,* from the former of which it differs in the absence of the white rump, and from the latter in its rufous colouring.

MISCELLANEOUS.

"*Do Diatoms live on the Sea-Bottom at Great Depths?*" *
By G. C. Wallich, M.D.

The following are some of my reasons for believing this question may with certainty be answered in the negative.

Although the soft parts are retained in specimens obtained from extreme depths, they differ materially both in aspect and qualities from those of Diatoms known to be living. Broken frustules are met with, which retain the whole or a portion of the soft parts, in a condition identical with that of unbroken specimens. Diatoms, when obtained from extreme depths, never present a trace of motion—a very important fact, inasmuch as it is difficult to conceive that the mere transit from the bottom should destroy the power of locomotion, which is so tenaciously retained by Diatoms under all other circumstances. The *Coscinodisci* (which, as Dr. Stimpson very justly observes) constitute the largest proportion of the Diatoms found in the deep-sea deposits, are essentially inhabitants of shoal water—that is to say, from one to fifty fathoms—being either independent free-floating organisms, epiphytes on floating Algæ, or epiphytes on the immediate surface layer of the sea-bed down to that depth. They do not live imbedded in mud. On the other hand, the upper waters of the ocean actually teem with their frustules, both in our own and in tropical latitudes, although only visible at the surface during calms. In the mud brought up from great depths, the Diatoms are distributed equally throughout the mass of the soundings—a fact which, with all deference to Dr. Stimpson's views, I am inclined to regard as directly contraindicative of their vitality. And, lastly, there appears to me to be no satisfactory evidence that Diatoms, whether living or merely preserved from decay, constitute the food of the deep-sea Rhizopods.

On the questions of light, aëration, &c., I have already written in detail elsewhere, the above facts being merely offered for the guidance of those who are pursuing this line of research.

Description of a New Coral (Lithoprimnoa arctica), *and Remarks upon its Systematic Position.* By E. Grube.

The new Coral (*Lithoprimnoa arctica*) described by Grube was obtained on the Norwegian coast, in 70° N. lat. It presents several

* See a short paper on this subject, extracted from 'Silliman's Journal' for May 1863, and published at p. 79 of the 'Annals and Magazine of Natural History' for July 1863.

very interesting peculiarities. Its axis is formed by a hard polypary, resembling *Corallium rubrum* in appearance, except that its colour is a greyish white. A transverse section of this polypary shows that it is not calcareous throughout, but formed of regularly alternating concentric layers of white calcareous matter, and a black substance, analogous to the horny matter (*corneine*) which forms the axis of the *Gorgoniæ*. The polypes are eight-armed. Their cœnenchyma is covered with calcareous scales, and their mouth is surrounded by eight valvules, which are likewise calcareous. These characters approximate it to the *Primnoæ* (*P. lepadifera*), which alone among the octactinian polypes are furnished with a hard covering of this kind. The genus *Primnoa* belongs to the *Gorgonidæ*. This family, according to Milne-Edwards, shares with that of the *Isidinæ* in the character of possessing a sclerobasic axis wholly or partially soft, of a horny or corklike texture, in opposition to the *Corallinidæ*, in which the common axis is entirely stony. Milne-Edwards adds that in the *Gorgonidæ* a little carbonate of lime is sometimes united with the corneine, but that this salt never predominates in such a manner as to give the axis a stony consistence, like that of coral. *Lithoprimnoa*, however, forms an exception to this rule, and the characters of the family must therefore be modified. It will also be necessary to give up the subdivision of the *Gorgonidæ* into *Gorgonaceæ* and *Gorgonellaceæ*. The former of these groups was characterized by the horny consistence of the sclerobasic axis, whilst in the second this axis should be cerato-calcareous. The author shows that the quantity of carbonate of lime is too variable to admit of such a distinction.

M. Grube remarks, in passing, that a great part of the chemical characters ascribed to corneine by Valenciennes are inexact, or not generally applicable. Valenciennes states, for example, that corneine is insoluble in caustic potash with the aid of heat. M. Lothar Meyer has found it to be constantly soluble in that agent.—*Bibl. Univ.* March 1863, *Bull. Sci.* p. 240.

On the Crustacea which live in Species of Ascidians. By T. Thorell.

We have hitherto known only a small number of Crustacea parasitic on the Molluscoida. Düben was the first to describe a *Lernæa* living on a compound Ascidian of the Norwegian coast. Subsequently Claus found a *Sapphirina* inhabiting the respiratory cavity of *Salpæ*; and Allman described, under the generic name of *Notodelphys*, a new type of parasites from the respiratory cavity of the simple Ascidians; lastly, Leuckart found a Crustacean of the genus *Notopterophorus* of Costa in the respiratory cavity of a *Phallusia*. Incited by these observations, Thorell has studied the Ascidians of the shores of Bohuslaen in regard to their Crustacean parasites. Of these he has found twenty species, nineteen of which are new. By far the greater part belong to the two families *Notodelphyidæ* (13 species) and *Sapphirinidæ* (4 species).

The family *Notodelphyidæ* thus gains greatly in importance. The first species of this family (*Notodelphys ascidicola*) discovered by Allman was regarded by that naturalist as closely allied in its organization to the free Copepoda, although its mode of life and some modifications in the buccal and natatory appendages seemed to approximate it to the parasitic Crustacea (Siphonostoma). He regarded it as a free Copepod living in the respiratory cavity of an Ascidian, as the *Pinnotheres* are true Brachyurous Decapods residing in the cavity of the mantle of the *Pinnæ*. This view is now confirmed by Thorell, who detects a nearly perfect identity between the appendicular organs of the *Notodelphyidæ* and those of the free Copepoda.

These little Entomostraca are found clinging to the inner wall of the respiratory sac of the Ascidians by means of the antennæ of the second pair. Only one species (*Botachus cylindricus*, Thor.) resides between the two lamellæ of this sac. Notwithstanding this parasitic mode of life, they possess buccal appendages adapted for mastication. They appear, therefore, to derive their nourishment, not from the fluids of the Ascidian, but from the Infusoria and organic particles which float in the circumambient water. The most remarkable peculiarity of structure presented by these animals is that which gave occasion to the name of *Notodelphys*, given to them by Allman. It consists in the presence, in the females, of a pouch situated beneath the integuments of the back, and destined for the reception of the ova on their emission from the ovary. This pouch therefore replaces the external ovigerous sacs of the other Copepoda.

The present memoir contains a new classification of the Copepoda, which, according to the author, include the Siphonostoma. In this he concurs with Steenstrup and Lütken. He divides these Crustacea into three series—Gnathostoma, Pœcilostoma, and Siphonostoma. The second of these, establishing the passage between the masticatory (Gnathostoma) and the sucking Copepoda (Siphonostoma) is of new formation. It includes the *Corycæidæ*, *Ergasilidæ*, *Sapphirinidæ*, *Miracidæ*, and some other small families. It is distinguished from the Siphonostoma by the want of the sucker, and from the Gnathostoma by the absence of mandibles.—*Kongl. Vetensk. Akad. Handl.* iii. No. 8; *Bibl. Univ.* March 1863, p. 235.

Characters of a new Species of Sedge-Warbler (Calamoherpe Newtoni) *from Madagascar.* By Dr. G. Hartlaub.

♂. *Supra obscurius olivacea, subunicolor, subtus multo pallidior, medio subflavicans; mento gulaque albidis; jugulo maculis longitudinalibus fuscis conspicue notato; subularibus flavo-albidis; subcaudalibus obscuris; maxilla fusca, mandibula obscure aurantiaco-rubente; ore interno læte aurantiaco; iride helvola; ala brevi; cauda longa, rotundata, rectricibus angustatis, apice rotundato-attenuatis.*

Long. $6\frac{1}{3}''$; rostr. a fr. $6\frac{1}{4}'''$; rostr. a rict. $9'''$; al. $2''\ 7'''$; caud. $3''$; tars. $11'''$.

Two male specimens of this unquestionably new species were collected by Mr. Edw. Newton near Soamandrikazay, in the island of Madagascar.—*Proc. Zool. Soc.* May 12, 1863.

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XV.—*On the Impregnation in Orchids as a Proof of the two different Effects of the Pollen.* By Dr. F. Hildebrand, of Bonn.

Of late years most of the investigations on impregnation in plants have been directed to the pollen-tubes acting on the ovules to form the embryo. That there are a great many other interesting and important points respecting the fecundation of plants, everybody will admit who has directed attention to the two celebrated works of Darwin, 'On the Origin of Species' and 'On the Fertilization of Orchids,' bearing in mind at the same time the inquiries of Koelreuter, Sprengel, Gaertner, Herbert, &c.

Looking at some tropical Orchids cultivated in the Botanical Garden of Bonn, I found no ovules in the ovarium of the expanded flower; nevertheless I saw the enlargement of the ovarium after having applied the pollen to the stigma. This curious circumstance seemed deserving of further examination, especially as the numerous writers on the impregnation in Orchids* have made out this point imperfectly; and even Robert Brown, in his paper on the Fecundation in Asclepiadeæ and Orchideæ†, has merely alluded to it.

As my investigations are to be published at greater length in Mohl and Schlechtendal's 'Botanische Zeitung,' I shall describe only the experiments and observations made on one species, and then give the results of these and all the other experiments. The ovarium of *Dendrobium nobile* has a diameter of about

* Brongniart in Ann. des Sc. Nat. 1831, p. 117; Amici, Flora, 1847, p. 255; Mohl, Bot. Zeitung, 1847, p. 465; Hoffmeister, Entw. d. Embryo der Phanerog. p. 5; Schacht, Ann. des Sc. Nat. 1851, p. 83; Henfrey, Trans. Linn. Soc. xxi. p. 7.

† Trans. Linn. Soc. 1833.

$2–2\frac{1}{2}$ millim., and a length of 10–15 millim.; its cavity is a very narrow channel, on the walls of which are to be seen three ridges, of an irregularly undulated appearance; these ridges are the placentæ that are not yet fully developed; there are no incipient ovules upon them. The stigma of the expanded flower is covered with numerous utriculi separated by a copious viscid substance. If the pollen is applied to this viscid surface of the stigma, very soon, at least after two days, the labellum of the flower folds up round the column, and the petals and sepals incline over it, and, withering in about nine days, do not fall off, but are to be found at last on the top of the ripe fruit. If the pollen is not applied to the stigma, the flower remains unchanged for a long time; in from twenty to thirty days it begins to wither, and falls off: during this time the placentæ have not grown in any way.

After the application of the pollen to the stigma, the petals and sepals soon begin to wither, as stated above; at the same time the column begins to swell hemispherically, and the pollen-tubes, forming a cord, pass through the channel of the column. On reaching the cavity of the ovarium, they divide into three parts, and each of these parts divides again into two, running down on each side of the placentæ. Soon after the application of the pollen to the stigma, the ovarium began to enlarge both in length and in diameter; in eleven days, the placentæ were more deeply undulated, and in twenty days they were distinctly divided into two parts, each part being fringed irregularly; no ovules were yet to be seen. Now I thought that the enlargement of the ovaria which had no ovules on their placentæ was only abnormal, and that no ovules ever would be formed. Therefore I did not examine a fruit before the 3rd of March: this fruit had originated from a flower impregnated on the 5th of January. I found the placentæ quite covered with ovules showing very different degrees of development: there were some incurved, the outer and inner coats enclosing the nucleus; some where the nucleus was still protruding; and some that appeared only as a papilla a little incurved, and surrounded at its base by the incipient coats. The cords of the pollen-tubes were in an unchanged state on both sides of the placentæ. At this time the fruit had a diameter of 20 millim., and a length of 60 millim.; it had become green and succulent, and there were some stomata on its surface; its much enlarged cavity was not yet filled up with the ovules. Next a fruit that had originated on the 10th of January was examined on the 13th of April, and all the ovules were found in a perfect state, filling up the entire cavity of the ovarium; the embryo-sac was to be seen distinctly, but no pollen-tube had reached it. On the 22nd of April, the germinal corpuscles were distinctly evident, but the cords of the pollen-tubes were unchanged as before. Finally, on the 12th of May, when the diameter of the fruit was 25 millim., and its length 80 millim., the first two or three cells of the embryo were formed, one of the germinal corpuscles had disappeared, and the pollen-tubes were seen in a decaying state between the ovules.

Thus we see that a space of four months (January 10 to May 12) was required in order that, after the application of pollen to the stigma of a flower (the ovarium of which contained no ovules), the ovules might attain perfection, and the formation of the embryo begin.

Having thus described the observations made on *Dendrobium nobile*, I pass over the experiments on other species, and proceed at once to give the general results of my observations.

The experiments and observations were made on thirty different species of Orchids, of which nine were tropical and twenty-one indigenous; therefore we may safely extend the results to the whole Orchidaceous family as follows:—

1. In the recently expanded flowers of Orchids the ovules are never fully developed. The degrees of development are very different: there are some species (for instance, *Listera ovata* and *Neottia nidus-avis*) that have almost perfect ovules, which are incurved and have both of the coats, but the outer is as yet shorter than the inner, and the embryo-sac is not yet to be seen in the nucleus; in other species (for instance, in *Dendrobium nobile*) the formation of the ovules has not yet commenced, even the placentæ are not yet fully developed, but appear only as three narrow undulated stripes running down the walls of the cavity of the ovarium, and the bifurcation of every placenta is only slightly indicated. Between these extremes of development there are different degrees of perfection of the ovules.

2. After the application of the pollen to the stigma, the enlargement of the ovarium begins; at the same time the ovules become more and more perfect, or if there were only the placentæ, the ovules begin to appear after a certain time as minute papillæ projecting from the surface of the placenta. The enlargement of the ovarium begins before the pollen-tubes reach the placentæ or the ovules; in the same manner the ovules begin to grow without being touched by the pollen-tubes. From this it is clearly evident that the tubes of the pollen have no direct influence on the original development of the ovules, but that these tubes first act on the enlargement of the ovarium only, and by this enlargement indirectly on the ovules. Flowers that have no pollen applied to their stigmata do not wither so

soon as those that are impregnated; their ovules show in most cases no further development; they sometimes become a little more perfect, but are always decomposed before the ovarium has withered and the flower has fallen off. After the stigmata of the flower are impregnated with pollen, in most cases the sepals and petals soon wither, but do not fall off, and are still to be found in a dry state at the top of the ripe fruit; sometimes they fall off in a few days. One curious case occurred in *Listera ovata*, where they change very little after impregnation, and were still found in a fresh and succulent state on the top of the ripe dehiscing capsule.

3. The time that elapses between the application of the pollen to the stigma and the full development of the ovules and the formation of the embryo depends on the degree of development of the ovules in the recently expanded flower. This fact might have been suspected, but it will appear to be made out sufficiently after looking at the following summary (in which *ii* means the integumentum internum, the inner coat; *ie*, the outer; *n*, the nucleus):—

Time from the application of Pollen to the Stigma to the incipient formation of the Embryo.	*Degree of Development of the Ovules in the expanded Flower.*
Neottia nidus-avis, May 24 to June 2; 8–9 days.	Ovules inverted, *ii* overlapping *n*, *ie* not yet overlapping *ii*.
Listera ovata, May 8 to 17; 9 days.	The same.
Orchis pyramidalis, June 22 to July 1; 8–9 days.	Inverted, acorn-like, *ii* and *ie* not yet overlapping *n*.
Orchis coriophora, June 14 to 23; 9 days.	The same.
Gymnadenia conopsea, June 8 to 23; about 2 weeks.	Inverted, *ii* beginning to appear.
Orchis Morio, May 9 to 22; about 2 weeks.	The same.
Orchis maculata, June 8 to 25; 2½ weeks.	The same.
Orchis hircina, May 24 to June 13; 3 weeks.	Inverted, *ii* and *ie* beginning to appear.
Orchis latifolia, May 17 to June 3; 2½ weeks.	Inverted, *ii* beginning to appear.
Ophrys myodes, May 24 to June 13; 3 weeks.	The same.
Orchis mascula, April 22 to May 22; 4 weeks.	Straight papillæ, seldom a little incurved, with the beginning of *ii*.
Orchis mascula, May 3 to 24 (?); 3 weeks	The same.
Platanthera chlorantha, May 24 to June 17; 3½ weeks.	Straight papillæ, seldom a little incurved, without the beginning of *ii*.
Orchis militaris, May 15 to June 16; more than 4½ weeks.	The same.
Cypripedium laticolus, May 16 to June 20; 5 weeks.	Papillæ a little incurved; beginning of *ii* very small.

Time from the Application of Pollen to the Stigma to the incipient formation of the Embryo.	*Degree of Development of the Ovules in the expanded Flower.*
Cephalanthera grandiflora, end of May to beginning of July; 5–6 weeks.	Papillæ a little incurved; beginning of *ii* very small.
Eria stellata, Feb. 13 to April 15; 2 months.	Placentæ irregularly fringed, with very small wartlike projections.
Bletia Tankervilliæ, Jan. 26 to end of March; more than 2 months.	The same.
Dendrobium nobile, Jan. 10 to May 12; 4 months.	Placentæ undulated, not fringed.
Cymbidium sinense, Dec. 9 to beginning of June (?); 6 months (?).	The same.

It appears that those ovules which were most developed in the expanded flower (for instance, in *Listera ovata* and *Neottia nidus-avis*) wanted only nine days to attain perfection and to be impregnated by the pollen-tubes; while, on the other hand, in those cases where even the placentæ were not as yet developed (*i. e.* in *Dendrobium nobile*) an interval of four (in one case perhaps of six) months elapsed before the embryo began to be formed. Respecting the differences of temperature in the different years, it will scarcely be necessary to add that the above-mentioned intervals of time will not be quite the same every year.

Soon after the commencement of the formation of the embryo, the six cords of the pollen-tubes disappear. R. Brown says (*l. c.* p. 707) that they are to be met with even in the ripe capsule; but I could not find them anywhere. I saw them very often in a decaying state, some time after the impregnation of the ovules.

4. From these observations it follows that, in the formation of the fruit in Orchids, the pollen acts in two different ways: on the one hand, it effects the enlargement of the ovarium and the development of the imperfect ovules without the pollen-tubes directly touching the ovules; on the other hand, it impregnates the ovules, directly touching the embryo-sac, and determining the development of one germinal corpuscle into an embryo. It is not necessary to allude further to the observations on this last point, as they only confirm known facts.

Having given the results of a long series of observations and experiments made on Orchidaceous plants, I may be allowed to add a few words on the impregnating action of pollen in general. It is a question, often spoken of among botanists, whether the pollen acts only in impregnating the ovules, or whether, independent of this power, it has yet another, and what this other power might be, and in which way it might act. Professor

Treviranus, in a treatise recently published *, inclines to answer the last question in the affirmative, but he says that he cannot give any positive proof. I am therefore the more pleased to have made the foregoing observations, which seem to give such a proof in an incontestable manner. The pollen applied to the stigma of an ovarium containing no ovules, making this ovarium swell, proves that the pollen may act on the ovarium independently of the ovules; and if this is the case in Orchids, why should it not be the same in all other phanerogamous plants? If we admit that the ovules are enclosed more or less in a dark cavity, that of the ovarium, and therefore have not the power of preparing the nutritive substances themselves, but must receive them from the exterior green parts of the ovarium, we can easily imagine how the pollen, besides the direct action of its tubes on the formation of the embryo within the ovules, effects in the same direct manner the enlargement of the ovarium. We even see that, in Orchids, this last-mentioned action on the ovarium is primary—that not until this action has taken place do the ovules attain perfection and become suited for the other, embryo-forming power of the pollen-tubes. If the first power has not acted, the second cannot act. Whether the same may be the case in all other phanerogamous plants, we must leave to further but rather difficult observations.

Finally, it may be repeated that, at least in Orchids, if not in all plants, the pollen acts in two different ways: it effects the enlargement of the ovarium, and impregnates the ovules.

I close these short notices with the very just remarks of Robert Brown which are to be found at the end of his treatise on the fecundation of Orchideæ and Asclepiadeæ:—"I even venture to add that, in investigating the obscure subject of generation, additional light is perhaps more likely to be derived from a further minute and patient examination of the structure and action of the sexual organs in Asclepiadeæ and Orchideæ than from that of any other department either of the vegetable or animal kingdom."

XVI.—*On the European Species of the Genus* Labrax. By Dr. A. Günther.

M. Barboza du Bocage, Director of the Museum at Lisbon, has directed my attention to a remarkable difference in the dentition of the vomer, by which he was enabled to distinguish two forms of *Labrax* inhabiting the sea at Lisbon, viz. the true *Labrax Lupus* and a second, spotted species. Fortunately

* Verhandl. d. naturhist. Ver. für Rheinland u. Westph. 1862, p. 299.

the British Museum has received several examples collected at Gibraltar by Dr. Sclater, in two of which I have recognized the spotted form; whilst examples received from Alexandria, through Consul Petherick, cannot be referred to either of those two species, but evidently belong to a third. These three species, although readily distinguished by their vomerine teeth, are externally very similar to one another, so that it is not necessary to give a detailed description of them.

1. We retain the name of *Labrax Lupus* for the species which is the most common on the European coasts. The vomerine teeth form a simple subcrescentic transverse band . D. 9 | $\frac{1}{12-13}$. A. $\frac{3}{11-12}$. L. lat. 66–74. The body is almost always immaculate, and I have seen only one young specimen with small black spots on the back. British specimens have the scales on the hind part of the tail rather larger than those from more southern coasts; but this does not appear to me to be of specific value. The following synonyms ought to be referred to this species:—

Centropomus Lupus, Lacép. iv. p. 267.
Sciæna Labrax, Bloch, taf. 301.
—— *diacantha*, Bloch, taf. 302.
Perca elongata, Geoffr., Descr. Egypte, Poiss. pl. 19. fig. 1.
—— *sinuosa*, Geoffr. *l. c.* pl. 20. fig. 3.

2. The second species, observed by M. Bocage at Lisbon, of which we have two specimens from Gibraltar, is *Labrax punctatus*; it has the vomerine teeth arranged in an anchor-shaped band , extending backwards to the end of the vomer. D. 9 | $\frac{1}{13}$. A. $\frac{3}{12}$. L. lat. 62. The upper parts of the body are constantly marked with small black spots. This is *Sciæna punctata*, Bloch, taf. 305.

3. The third species has the posterior process of the vomerine band very short . D. 9 | $\frac{1}{13}$. A. $\frac{3}{11-12}$. L. lat. 57. The upper parts of the body are black-spotted, as in the preceding species. Two specimens sent by Consul Petherick from Alexandria are perfectly alike. This is probably the species figured by Geoffroy St. Hilaire in the 'Description de l'Egypte,' Poiss. pl. 20. fig. 2, as *Perca punctata*—a name which cannot be retained, as it belongs to the preceding species, and instead of which we propose that of *Labrax orientalis*.

XVII.—*Notes on American* Emydidæ, *and Professor Agassiz's Observations on my Catalogue of them.* By Dr. J. E. Gray, F.R.S. &c.

Professor Agassiz, in the appendix and errata to his "Essay on the North-American Tortoises," in the 'Contributions to the Natural History of the United States of America,' published in 1857, observes:—

"*Ptychemys concinna* is mentioned under four different names by Dr. Gray—as *Emys ornata, E. floridana, E. annulifera,* and *Pseudemys concinna. Ptychemys mobilensis* appears twice—as *E. mobilensis* and *E. ventricosa. Ptychemys rugosa* also appears twice—as *E. rivulata* and *Pseudemys serrata.* These facts are sufficient to show that Gray's genus *Pseudemys* is not well founded, as the two species which he himself had an opportunity of examining are only varieties of other species which he refers to the old genus *Emys*. I am unable to refer his *Emys callirostris* with certainty, as his figure, though well drawn, does not exhibit the generic characters. I believe it, however, to be one of the many varieties of *Ptychemys concinna.* The same remark applies to *Emys venusta*" (vol. ii. p. 641).

These observations are only founded on an examination of the figures, and not on the specimens themselves, and, as I suspect, on but a cursory study of the descriptions,—which may be an excuse for their inaccuracy; but that is a reason why they ought not to have been made. It is very true that the figures of the entire animal do not and cannot "exhibit the generic characters" used by Professor Agassiz, which are founded on the ridges on the roof of the palate, and can only be seen in a figure of the skull. The observation that these species appear under more than one name is either a disingenuous statement or one that neither Professor Agassiz nor any one else, from the imperfection of the specimens, can confirm or contradict with certainty: consequently any careful zoologist would be very averse to giving an opinion on such a subject, unless he could examine the specimens on which the species are established.

I am satisfied that if Professor Agassiz had examined the specimens of *Emys ornata,* he would himself allow that it not only is not a variety of *Pseudemys concinna,* but that it does not belong to the same genus. *Pseudemys concinna* belongs to his genus *Ptychemys,* and *Emys ornata* to his genus *Trachemys,* according to his characters. I only know *Emys floridana,* as stated in the Catalogue, from Holbrook's figure, and quote it as such; but I am still not satisfied that it is the same as *E. concinna.* As to *E. annulifera,* that is only founded on a very young specimen, which differs in the pattern of its colouring from all the many young of *E. ornata* I have seen; and, like that species, it is a *Trachemys*, and not a *Ptychemys* of Agassiz. Both *E. venusta* and *E. callirostris*, which the Professor believes to be only varieties of his *Ptychemys concinna*, are also species (and, I believe, most distinct ones) of his genus *Trachemys*.

As to *Emys mobilensis* and *E. ventricosa* being the same, this is only a repetition of the statement I have made in the Catalogue; but this is the case with many other observations which he puts forward as his own, rather than copies of my own corrections. But, as I only knew one species from a shell without any animal, and the other from the figure in Dr. Holbrook's work, I considered it better to let them remain for further examination. Here, again, Professor Agassiz has never seen the original specimen on which *E. ventricosa* is founded.

The same observation is applicable to the proposed union of *E. rivulata* and *Pseudemys serrata*. The former is described from a shell without an animal; and it is so very unlike any specimen of *Pseudemys serrata* that I have seen, that I think it is very unsafe to unite them without further evidence.

This analysis will show how fallacious is the argument that the genus "*Pseudemys* is not well founded, as the two species which he himself had the opportunity of examining are only varieties of other species which he refers to the old genus *Emys*." I may first observe that the genus *Pseudemys* is separated from *Emys* by the form of the lower jaw and beak, and the scales and size of the web of the feet—characters only to be seen on the animal (so that my referring *Emys ventricosa* and *E. rivulata* to species described from shells alone, without any part of the animal attached to them, is no proof as cited); secondly, that *E. ornata, E. venusta, E. callirostris*, and *E. annulifera*, which are founded on perfect specimens, have proved, on examination, not to belong to my genus *Pseudemys* or M. Agassiz's genus *Ptychemys*; and thirdly, that *E. floridana* and *E. mobilensis* are only placed in the Catalogue on the authority of the figures and description of Dr. Holbrook,—all proving that the Professor's observations are not well founded. I might as well say that his genera *Ptychemys* and *Trachemys* are not well founded; for he regards *E. ornata, E. venusta, E. callirostris*, and *E. annulifera*, from the examination of the figures or descriptions alone, as varieties of *Ptychemys concinna*, when they are, in fact, species of his genus *Trachemys*, which would, according to his argument, prove that these genera are not distinct!

But further, I have no doubt that Professor Agassiz will admit that *Pseudemys* is well founded, when he finds that it and his genus *Ptychemys* are synonyms of one another, founded on nearly the same characters and on the same species, my characters being taken from the external part of the beak, and his from the ridges on the palate; but then *Pseudemys* has the priority, which may be a grievance.

Now it is quite evident, from these observations, that Prof. Agassiz has never seen these species, and he must have formed these opinions solely on the sight of the plates and descriptions; and I think that he must have read the latter very cursorily, or else he has not understood the importance of some of the characters there given, or I feel convinced that he could never have committed such a mistake; for certainly his practice, as proved by the paper in which these observations are contained, is not to "lump" species together, but rather the contrary, as is proved by his previous work on Fossil Fish, on Echinida, and even by the work here quoted; for I must say, after examining a large series of specimens, from different parts of the United States and of different ages, that I cannot agree with him in separating the specimens of *Chrysemys*, of *Cistudo*, &c., into several species, as he has done; and several of the new species indicated (for he promises to describe them in some future work) appear to be separated on very slight characters; while the species here proposed to be combined not only are most distinct, but belong to different genera, according to the characters which he himself used in the family Emydidæ for the separation of genera.

I am much surprised that such an experienced zoologist should have been led to give such a crude opinion, *ex cathedrâ*, without first examining the type specimens on which the species were founded, or at least specimens obtained from the same locality, which agreed with the description and figures.

My experience as a student of Tortoises does not agree with the opinion expressed by Professor Agassiz "that there are genera among our Emydoids in which neither the tint nor the pattern of coloration affords any specific characters" (vol. i. p. 432, foot-note). It is no doubt true that the tint of colouring is not only liable to vary with age, but is also influenced by the peculiarities of the locality, as the purity and clearness, or muddiness, the stillness or current of the water in which they happen to be located; but as regards the pattern, it is far otherwise. And I cannot think that Professor Agassiz would have made such an observation if he had studied the subject with sufficient care, or even had worked out the observations which I have made on this subject in the Catalogue that he was criticising; for he would there have seen that some of the groups which he has called genera are separated and characterized by the pattern of the colour.

The pattern, to be understood, should be studied in the young animals, and traced up through all the stages until they are full-grown; for in the full-grown and more adult or aged specimens the colour is apt to become suffused, and the distinctive character of the pattern more or less obscured, or rendered more difficult to analyze; and I am satisfied that the best specific characters of the species are to be derived from such a study.

But not only does the pattern afford good specific characters, but, as far as I have been able to examine them, they seem to give some of the best characters to separate the species into natural groups, either genera or subgenera, as the student may be inclined to regard them. Thus the best character for the group of which *E. ornata* may be considered as the type is furnished by the fact that there is one eye spot under each shield; and an excellent character to separate the species is the position which this spot occupies on the shield in the young and the older specimens, as marked in my Catalogue above cited (p. 24).

As examples of the assistance which the distribution of the colouring-matter, or the pattern, affords in the distinction of the genera, I may observe:—The underside of the margin of most coloured American Emydoids has a series of eye spots. In *Graptemys* the centre of this spot is on the hinder margin of each of the marginal shields; in all the other genera it is on the suture between two neighbouring marginal shields, the spot being on the middle of each of the marginal bones, and the suture of the horny shields alternating with the suture of the bones. The genera *Chrysemys* and *Deirochelys* have a distinct continued vertebral line, not found in any of the other genera, *Chrysemys* being peculiar for having a very distinct well-marked pale edge to the dorsal shields, while *Deirochelys* has a dark spot surrounded by reticulated lines on each shield.

The variegated species of the genus *Trachemys* (if the genus ought not to be restricted to those species) and *Pseudemys* (*Ptychemys*, Agassiz) have several eye spots, which are often more or less confluent and separated by pale or bright-coloured lines under each dorsal shield, the former genus having a convex horny lower beak, and the latter a flattened lower jaw with a small thin lower beak and broadly webbed toes.

The genera *Callichelys* (of which *Emys ornata* may be considered the type) and *Malaclemys* have a single eye spot, surrounded by regular concentric rings, under each dorsal shield. The *Callichelyes* have a hard thin skin on the head, and the centre of the rings approaches the hinder edge of the shield as the shields enlarge. Some specimens of this genus have a pale streak down the centre of the nuchal plates. The *Malaclemyes* have a soft fleshy skin on the head, the centre of the spot remains in the middle of the shields, and the feet of the latter are largely webbed.

The genera *Deirochelys* and *Graptemys* have a single eye spot under each dorsal shield, which is surrounded with narrow polygonal rings, sending out anastomosing cross lines to the margin. *Deirochelys* has a central continued narrow vertebral streak, not found in *Graptemys,* which is peculiar in having a nodulose vertebral keel invested with oblong rings.

The genus *Chrysemys* is at once known by the pale margin to the dorsal shields, and the continued vertebral streak.

Even the coloured lines on the fore legs seem to be characteristic of genera. In *Trachemys,* for example, the upper streak is continued on to the second toe; and in *Pseudemys* it is bent and continued on to the third or middle toe.

The *Nicotees,* or West-Indian Emydoids, have a nearly uniform-coloured back of the shell, with dark spots on the margin of the shields. In the Catalogue (p. 31) I pointed out the difference in the form of the head and skull of the two species, *E. decussata* and *E. rugosa.* Professor Agassiz refers the first to the genus *Ptychemys,* and the latter to *Trachemys.* They appear to be rather aberrant species of these genera, without colour, at least in the adult state. I have never seen young specimens of either. Do they in that state show the pattern which is typical of these genera? for it is the younger animals that have the colours most distinctly marked, and on which the disposition is best studied. It is therefore more remarkable that Professor Agassiz should make the statement that is here quoted, as he has studied these animals in their young state, and figured the newly hatched specimens of most of the North-American species; but the pattern, in some of the figures, is not so distinct as it might be, or as it is in the specimens, even when they have been preserved in spirits.

In the Catalogue will be found several additional observations showing the coloration of the species of these genera.

The following are the genera and synonyma of the North-American Emydoids:—

DEIROCHELYS, Agassiz, Contrib. i. 414 (1857).

D. reticularia, Agassiz, 414, t. 1. f. 44; 16, t. 2. f. 1–3 (young). *Emys reticularia,* Gray, Cat. 27.

GRAPTEMYS, Agassiz, Contrib. i. 436 (1857). = *Emys,* Sect. **§§ Gray, Cat. Shield Rept. 29 (1855).

1. *G. geographica,* Agassiz, Contrib. 436, t. 2. f. 7, 9. *E. geographica,* Gray, Cat. *l. c.* 29.
2. *G. pseudogeographica.* *Emys pseudogeographica,* Gray, *l. c.* 29; Holbrook, t. 15. *G. Lesueurii,* Agassiz, Cont. p. 436, t. 2. f. 10, 12.

Callichelys, n. g. = *Emys*, Sect. *§ Gray, Cat. Shield Rept. 24 (1855).

1. *C. ornata* = *E. ornata*, Gray, Cat. Shield Rept. p. 24, t. 12.
2. *C. venusta* = *E. venusta*, Gray, *l. c.* 24, t. 12 *a*.
3. *C. callirostris* = *E. callirostris*, Gray, *l. c.* 25, t. 12 *b*.
4. *C.? pulcherrimus* = *E. pulcherrimus*, Gray, *l. c.* 25, t. 25. f. 1, 2.

Trachemys, Agassiz, Contrib. 434 (1857). = *Emys*, Sect. *§§ Gray, Cat. Shield Rept. 25 (1855).

1. *T. Holbrookii. E. Holbrookii*, Gray, Cat. *l. c.* 25, t. 15. f. 1. *E. cumberlandensis*, Holbrook, t. 18. *E. sanguinolenta*, Gray, Cat. *l. c.* t. 15. f. 1. *T. elegans*, Agassiz, Contrib. i. 435, t. 3. f. 9–11. *E. elegans*, Neuwied.
2. *T. scripta*, Gray, *l. c.* 26. *E. serrata*, Holbrook, t. 5. *T. scaber*, Agassiz, Contrib. i. 434, t. 2. f. 13–15 (young).
3. *T. Troostii*, Agassiz, Contrib. 435. *Emys Troostii*, Gray, *l. c.* 28; Holbrook, 1, t. 20.
4. *T. rugosa*, Agassiz, Contrib. 436. *Emys rugosa*, Gray, Cat. 31; Shaw, Zool. iii. t. 4. Var. ? *vermiculata*, Gray, Cat. t. 12 *d*.

Chrysemys, Gray, Cat. Tort. 27 (1844); Agassiz, Contrib. i. 438 (1857).

1. *C. picta*, Gray, Cat. *l. c.* 33; Agassiz, Contrib. i. 438, t. 1. f. 1–5, t. 3. f. 4, t. 9. f. 22, 23.
   C. Bellii, Gray, *l. c.* 33; Agassiz, Contrib. i. 439, t. 6. f. 8, 9 (very young).
   C. Orbigniensis, Agassiz, Contrib. 444, t. 3. f. 1, 3 (young) = *C. Nuttallii*, Agassiz, Contrib. ii. 642.
   C. marginata, Agassiz, Contrib. 439, t. 1. f. 6, t. 5. f. 1.
   C. dorsalis, Agassiz, Contrib. 440.

I do not say these local varieties are not distinct, but they are not characterized; and the series in the Museum shows that the species is very variable, and seems to include some of them.

I formerly separated *C. Bellii*, which, when I had only a single specimen, I thought probably might be distinct.

Malaclemys, Gray, Cat. Tort. Brit. Mus. 28 (1844). *Emys*, §** Gray, 1828. *Malacoclemys*, Agassiz, Contrib. i. 437. *Euchyloclemys*, Sclater, Ann. & Mag. Nat. Hist. i. 292 (1858).

M. concentrica, Gray, Cat. *l. c.* 37. *Malacoclemys palustris*, Agassiz, Contrib. i. 437, t. 1. f. 10–12 (young).

Professor Agassiz truly observes, "this species varies most remarkably in its colour and sculpture, as well as in the size of the head,"—all characters used to separate other species of Terrapins.

E. areolata, Dum. (Arch. Mus. vi. 223, t. 14), is also regarded as a variety from Central America.

PSEUDEMYS, Gray, Proc. Zool. Soc. 1855, 197; Cat. Shield Rept. 35 (1855). = *Ptychemys,* Agassiz, Contrib. i. 431 (1857). *Nectemys,* Agassiz, Contrib. ii. 642 (1857).

1. *P. concinna,* Gray, Cat. *l. c.* 34. *Ptychemys concinna,* Agass. Contrib. i. 432, t. 1. f. 13, t. 2. f. 4–6 (adult). *Emys floridana,* Holbrook, t. 8 (*vide* Agassiz).
2. *P. hieroglyphica,* Gray, *l. c.* 34. *Emys h.,* Holbrook, t. 17.
3. *P. mobilensis. Ptychemys mobilensis,* Agassiz, Contrib. 433, t. 3. f. 14, 16. *E. mobilensis,* Holbrook, t. 9. *E. ventricosa,* Gray, Cat. *l. c.* 28?
4. *P. serrata,* Gray, *l. c.* 34. *Ptychemys rugosa,* Agassiz, Contrib. 431, t. 26. f. 1, 11, t. 27. f. 1–3. *E. rubriventris,* Holbrook, t. 6. *E. rivulata,* Gray, Cat. t. 11 (*vide* Agassiz).
5. *Pseudemys decussata. Emys decussata,* Bell, Test. t. 1; Gray, Cat. *l. c.* 20. *Ptychemys decussata,* Agassiz, Contrib. i. 431.
6. *Pseudemys? Berardi. Emys Berardi,* Dum. & Bibr. *Emys D'Orbignyii,* Dum. & Bibr. Erp. Gén.; D'Orb. Voy. Amér. Mérid. Rept. t. 1, from Buenos Ayres. Probably belonging to this genus, from the distribution of the colour; but it is peculiar for having a pale margin to the dark sternum, like *Rhinoclemys.*

I am by no means satisfied that these species are well determined, that the extent of the notching and dentation of the beak is a character of the importance that is attached to it, or that when the pattern of the coloration and the changes that each presents have been more carefully studied, they will not afford better characters than those now used. The nuchal shield, as in *Calliclemys,* is often marked with a central streak.

RHINOCLEMYS, Fitzinger, = *Emys* †††, Gray, Cat. Shield Rept. 31 (1855), of Tropical America. Peculiar for being of a dark, nearly uniform colour, with a pale ring round the circumference of the dark sternum.

Some species have the keel of the shell of the same colour as the back; and the head is dark, with a streak on each side of the nose and temple. The toes are very short, with a short web.

1. *Rhinoclemys scabra. Emys scabra,* Gray, Cat. *l. c.* 31, and

E. scabra, No. 2, Gray, Cat. *l. c.* 78. *Testudo punctularia*, Daudin ?

With a spot on each side of the nose, and a band on each side of the crown, from the forehead, across the orbit, to the edge of the temple, and a spot on each side of the occiput. The underside of the margin of the young shell variegated. Throat black, streaked on the sides.

Hab. East coast of tropical America. Guiana; Brit. Mus.

I only know this species in the young state; but they all have the band on the side of the face interrupted by the orbit.

2. *Rhinoclemys Bellii.* *Testudo scabra*, Bell, Test. t. 1, 2 (adult).

Head with a spot on each side of the nose and of the occiput, and with a sinuous urn-shaped band on the crown, over the orbit and temples.

Hab. Tropical America.

The figure differs from any species we have by the superciliary bands being united by a short transverse band in front between the eyes.

3. *Rhinoclemys melanosterna.* *Geoclemmys melanosterna*, Gray, Proc. Zool. Soc. 1861, p. 205. *Emys scabra*, No. 1, Gray, Cat. *l. c.* p. 78. *E. dorsalis*, Gray, Cat. *l. c.* 32, t. 14 *a* (not Spix).

The side of the head with a continued band on each side, from the nose to the temple. Neck with four broad black streaks on the sides; fore legs pale, with some black stripes.

One of the bands on the neck arises from the streak on the face under the eyes, and the upper one from the dark upper margin of the streak on the sides of the head.

Hab. East coast of Tropical America. New Granada, River Buonventura; J. O. Goodridge, Esq. Gulf of Darien.

Emys dorsalis of Spix, Bras. T. II. t. 9. f. 1, 2, which is described and figured from a young specimen, seems to be different from those here described.

One species has the dorsal keel pale, and the head and neck with several pale bands or streaks. The toes are short, conical, without any web; the second and third hinder toes are the least, and nearly equal. I propose to call this group *Callopsis*.

4. *Rhinoclemys annulata.* *Geoclemmys annulata*, Gray, Proc. Zool. Soc. 1860, 231, t.

Hab. West coast of America. Esmaraldas, in Ecuador; Frazer. Gulf of Darien; Salvin.

XVIII.—*Descriptions of* Cremnobates Syhadrensis *and* Lithotis rupicola, *two new Generic Forms of Mollusca inhabiting Cliffs in the Western Ghats of India.* By William T. Blanford, A.R.S.M., F.G.S.

[Plate IV.]

Family **Littorinidæ**.

Cremnobates, nov. gen.

Testa perforata, turbinato-globosa, costulata. Apertura mediocris, subovata; peristomatis margine dextro simplici, columellari vix calloso.

Operculum testaceum, subovatum, paucispirale; nucleo sinistro; margine membranaceo.

Animal (pulmoniferum?) parvum; tentaculis duobus brevibus subulatis, oculos in lobis tumidis ad basin gerentibus præditum. Pes brevis, rotundatus. Proboscis brevis.

C. Syhadrensis, n. sp.

C. testa subobtecte perforata, globoso-turbinata, costulis elevatis crenulatis circumdata, inter costulas liris minoribus spiralibus lineisque obliquis decussantibus incrementi ornata, periomphalo haud costulato concentrice decussato-striato albida, ad apicem rubella, epidermide viridi-fusca induta; spira brevis, conoidea, sutura impressa, apice acuto, plerumque erosulo; anfractibus 3, rapide accrescentibus, convexis, ultimo rotundato, circa perforationem angulato; apertura diagonalis, ovata, lineis longitudinalibus fusco-purpureis prope suturam et versus basin marginis dextri, spatio interveniente, interne signata, interdum omnino colorata; peristoma simplex, marginibus callo junctis, dextro recto, basali expansulo, columellari reflexo, appresso, perforationem partim tegente. Operculum normale.

Alt. 7, diam. 7 mill.; apertura 5 mill. longa, 4 lata.

Hab. in montibus "Syhadri" seu "Western Ghats," Indiæ orientalis, ad scopulos basalticos pendentes adhærens.

This very remarkable and interesting form appears to be one of the links connecting the Littorinidæ with operculated Pulmonifera. It occurs abundantly on the precipitous bare rocks of the Western Ghats of India, in the neighbourhood of Bombay. These mountains, which are entirely composed of basaltic lava-flows, rise suddenly from the low ground of the Concan, or country bordering the sea, to a height of 2000 feet, their scarp being extremely abrupt, and in many parts forming an almost precipitous inland cliff. In consequence of the neighbourhood of the sea, and the sudden change in the elevation of the ground, the rainfall is very heavy during the south-west monsoon, from June till October, and the surface of the rocks must be almost continually wet. In December the only specimens of *Cremno-*

bates which I found in motion were living on the wet rock in a place where a small stream trickled down the surface of a steep rocky ledge; everywhere else the shells were firmly attached to the rock in crevices and hollows. I am therefore, I think, justified in considering this form as rather an amphibious than a true land-shell; and this view is confirmed by the circumstance that when placed in a glass of water, the animals sometimes crawl out and creep about the glass, but quite as frequently remain beneath the water or just at its surface. Many Indian species of the genus *Littorina* itself are equally amphibious in their habits, always keeping at the limit of the advancing tide as long as possible, and, in some cases, inhabiting rocks far above the extent of the spray in ordinary tides and fair weather. I have thus met with *L. Malaccana*, Phil., in crevices of rocks several feet above high-water mark of ordinary tides, on the coast of Burma, in a place where they must frequently have remained many days, if not weeks, without being wetted by the sea.

I have carefully examined several individuals of *Cremnobates* without being able to detect any trace of gills, while the large vascular sac at the back of the neck exactly resembles that in the operculated land-shells*. The mantle-margin is free, and the sexes distinct. The lingual ribbon is very long; one from a large specimen measured $\frac{2}{3}$ inch (17 mill.); the teeth are 7-ranked, but differ in form from those of Cyclostomaceous genera. The amphibious habits of the animal, the short foot, and the olive-green epidermis, so characteristic of fresh-water shells, induce me to place it in the vicinity of *Lithoglyphus*. *Cremnobates* is well distinguished from that genus by its perforation, sculpture, and testaceous operculum, resembling in the two former characters the genus *Fossar*, species of which abound on parts of the Indian coast. One of the common Indian species of *Littorina* also, *L. ventricosa*, Phil., bears a considerable general resemblance to the form now described, and has a somewhat similar though less strongly marked sculpture. Young specimens of *Cremnobates* are frequently imperforate, the umbilicus being entirely covered by the columellar margin of the peristome.

Should my opinion as to the pulmoniferous character of this genus be confirmed, its place amongst the families of operculated land-shells will be difficult to determine. Its subulate tentacles and undivided foot distinguish it from *Cyclostoma*, its paucispiral and excentrically nucleated operculum from *Cyclopho-*

* My own experience in Molluscan anatomy is too small for me to state positively that no gills exist, until my observations have been confirmed by a better observer.

rus and its allies; it wants the long proboscis of *Truncatella*, and differs in both operculum and tentacles from the minute Indian shells ascribed to *Hydrocena**, which otherwise resemble it both in the form of the shell and in their rocky habitat. Every character of shell, operculum, and animal, with the one exception of the pulmoniferous sac, admits of the position I have assigned to it amongst the *Littorinidæ*, in the neighbourhood of *Fossar* and *Lithoglyphus*. If delegated to the Pulmonifera, a new family must be founded for it; and it will certainly add to the doubts of many naturalists as to the correctness of the retention of two groups, so distinct in many of their characters as are the *Helicea* and the *Cyclostomacea*, in the same "subclass" on account of the identity of one particular organ.

No question can exist as to the Western Ghats having formed a marine cliff in comparatively recent geological times. Whether *Cremnobates* be a lineal descendant of the Littorinas or Fossars then inhabiting the coast may perhaps not be an unfair subject for speculation.

Fam. **Helicidæ.**

Sub-family *Succininæ.*

Genus *Succinea.*

LITHOTIS, subg. nov.

Testa auricularis, ovata, tenuis, carina longitudinali externa, sulco interno correspondente prope suturam munita; apertura permagna, continua; spira minima.

Animal tentaculis carentibus (?), oculis magnis in summis pedunculis duobus retractilibus, brevibus, versus basin tumidis, positis: pes brevis, pyriformis.

L. rupicola, sp. nov.

Testa ovata, pertenuis, succinea, curvate costulato-striata; spira plana, sutura vix depressa; anfractibus $1\frac{1}{4}$, ultimo prope aperturam descendente; carina ex apice oriens, spiralis, peristomatis ad marginem dextrum, 2 mm. a sutura, desinens; apertura permagna, ovata, continua, intus politissima, nitida; peristoma tenue, rectum, margine columellari callose appresso.

Diam. maj. 7 mill., min. 5, alt. $2\frac{1}{2}$.

Hab. in montibus Syhadri cum *Cremnobate Syhadrensi.*

The above are the dimensions of the largest specimen I possess. This species appears to be very nearly as remarkable a link as that last described; for it combines the characters of *Camptonyx*

* *H. sorrita*, Bens., *H. pyxis*, B., *H. frustillum*, B., &c. The operculum has no spiral structure, being simply excentrically striated, as in *Helicina*; the tentacles are lobate. I propose to separate these species under the generic name of *Georissa*.

and *Otina*, belonging to the *Auriculea*, with those of *Succinea* and its allies. From the shell alone, which has the form of *Otina*, with the substance, texture, and peculiar external ridge and internal furrow of *Camptonyx*, I should have supposed the present species to belong to the last-named genus; but the retractile eye-bearing peduncles prove its place to be in the neighbourhood of *Succinea*, from which genus the internal furrow for a siphon distinguishes it as a well-marked subgenus. Tentacles are extremely small and rudimentary in several of the subgenera of *Succinea*, and, in the present case, appear to be wanting; if present, they are certainly very inconspicuous. The animal of *Helisiga*, Less., as represented in Adams's Gen. Rec. Moll., pl. 73, closely resembles that of *Lithotis*, but has a larger foot, while the shell only differs in the absence of the siphonal furrow.

Lithotis abounds adhering to the precipitous basaltic rocks of the Western Ghats, like *Cremnobates*, but apparently in rather more exposed situations, being perhaps more purely an air-breather, and requiring less moisture than its congener. Both probably feed upon the confervoid vegetation covering the surface of the rock to which they adhere.

I am indebted to the kindness of Mr. A. B. Mynne for the accompanying drawings of the shells above described.

EXPLANATION OF PLATE IV.

Figs. 1, 2. *Cremnobates Syhadrensis*, natural size.
Fig. 3. The same, enlarged 2 diameters.
Figs. 4, 5. The same; operculum enlarged 2 diameters.
Figs. 6, 7. Animal of the same.
Figs. 8, 9, 10. *Lithotis rupicola*, natural size.
Fig. 11. The same, enlarged 2 diameters.
Fig. 12. The same; animal from below.

XIX.—*On Cephalization, and on Megasthenes and Microsthenes in Classification (being in continuation of an Article on the Higher Subdivisions in the Classification of Mammals).* By James D. Dana*.

In the paper on the "Classification of Mammals," published by the writer in Silliman's Journal (vol. xxxv. p. 65)†, and also in his earlier paper on Crustaceans, the principle of cephalization is shown to be exhibited among animals in the following ways:—

1. By a transfer of members from the *locomotive* to the *cephalic* series.

* Communicated by the Author. From the 'American Journal of Science and Arts,' vol. xxxvi. (July 1863).

† See Ann. and Mag. Nat. Hist. March 1863, p. 207.

2. By the anterior of the locomotive organs participating to some extent in cephalic functions.

3. By increased abbreviation, concentration, compactness, and perfection of structure, in the parts and organs of the anterior portion of the body.

4. By increased abbreviation, condensation, and perfection of structure, in the posterior, or gastric and caudal, portion of the body: as, in the greater compactness and larger number of segments combined in the sacrum of the *higher Megasthenes* than in that of *Cetaceans* or *Edentates*; the less posterior elongation of the vertebral column and body in the *higher Megasthenes* than in *Cetaceans,* or in the *tailless Batrachians* than in the *tailed* species of the group, &c.

5. By an upward rise in the cephalic end of the nervous system. This rise reaches its extreme limit in Man. Birds thus show their superiority to Reptiles, but not to Mammals; for the Bird-type, like the Reptilian, is relatively diminutive in life-system (*infrà,* p. 196); its relation to the Reptilian type is much like that of Insects to the Crustacean (p. 193).

A decline in the grade of cephalization is shown by the reverse of these conditions: as (1) by a transfer of members from the cephalic to the locomotive series; (2) by the posterior cephalic organs participating in locomotive functions; (3, 4) by increased laxness, length and breadth, or spacing, among the parts of either the anterior or posterior portion of the body, or, further, a resolution, more or less complete, of the system of structure into its equal normal elements or elementary parts; (5) by increased proneness in the position of the nervous system: also—

6. By an adaptation of the organs of the senses to locomotive or prehensile purposes,—as in the case of the proboscis of the Elephant, which is a perverted nose; also the prehensile terminations of the second antennæ of many inferior Crustaceans.

7. By an abnormal multiplication of the parts in the anterior portion of the body,—as in the excessive number of teeth in some *Cetaceans* and *Edentates.*

8. By an abnormal multiplication of the parts in the posterior portion of the body,—as in the abnormal multiplication of members and segments in *Phyllopod Crustaceans, Myriapods,* &c.

9. By a further degradation of the structure before and behind, or a degeneration or obsolescence of the parts or organs,—as in the absence of teeth in some *Cetaceans* and *Edentates*; the degradation of feet into fins, as in *Whales,* or their total absence; the absence of a series of abdominal members in *Entomostracans*; the absence of antennæ in Articulates, *provided* the senses corresponding to these organs are absent or comparatively imperfect;

the coalescence of the head and thorax, or of these with the abdomen; the extension of the gastric viscera towards, or into, the head.

10. By excessive size of body through mere vegetative enlargement,—as in the *Megatherium*, the *female Bopyrus*, *Limulus*, &c.

Degradation, or a decline *below the normal* level, may hence be—

I. *Multiplicative.* Methods 7, 8, above.

II. *Degenerative.* Methods 3, 4, 9.

III. *Vegetative.* Method 10. Also IV. *Phytoid* (or *plant-like*), when animals (as *Polyps*) have (11) the power of budding, or (12) a radiate structure, or (13) attachment below; and in such cases the decephalization is often almost as complete as in plants*.

Examples of *cephalization* by the first method, or by a transfer of members from the locomotive to the cephalic series (or of *decephalization* by the reverse), occur in the two highest subkingdoms, those of *Vertebrates* and *Articulates*. They fail in the two lower subkingdoms, those of *Mollusks* and *Radiates*, because of the absence of the necessary structure for showing it.

The examples under *Vertebrates* and *Articulates*, and the relations of the orders among *Mollusks*, may be briefly considered.

I. *Vertebrates.*—Only a single example in the class of Mammals, or even in the whole subkingdom of Vertebrates, is possible, owing to the fixed nature and simplicity of the head, and also the limited number of feet, two pairs being the maximum.

This one example has already been pointed out and shown to be the basis of the grand distinction between Man and other Mammals. In passing downward from the exalted position which Man holds, there is a transfer of the fore limbs to the locomotive series: the structure of the head in Vertebrates, even

* The methods of decephalization in Crustaceans are embraced under *two* heads, by the writer, in his paper on the Classification of Crustaceans (Silliman's Journ. ser. 2. vol. xxii. p. 28, and Expl. Exp. Rep. on Crustacea, p. 1412), as follows:—

"1. A diminution of centralization, leading to an enlargement of the circumference or sphere of growth at the expense of concentration, as in the elongation of the antennæ and a transfer of the maxillipeds to the foot-series, the elongation of the abdomen and abdominal appendages, &c.

"2. A diminution of force as compared with the size of the structure, leading to an abbreviation or obsolescence of some circumferential organs, as the posterior thoracic legs or anterior antennæ, or the abdominal appendages (where such appendages exist in the secondary type embracing the species).

"These circumstances, moreover, are independent of a degradation of intelligence by an extension of the sphere of growth beyond the proper limits of the sphere of activity."

to the lowest Fishes, admits of no other case of analogous transfer*. In the *Walrus* the tusks have some locomotive functions, as they serve to rest the fore part of the animal, or its head, on the ice while the body is in the water; but this is an example under the *second* method. The feet are wholly absent in *Snakes*, and the ribs aid in locomotion; but this is only a degradation of the Vertebrate type, and not decephalization by the first method. In most *Fishes*, and in *Whales*, the locomotive function is transferred mainly to the elongated vertebrated posterior extremity of the body—a case of *degenerative* degradation similar to the last, and analogous also to the *multiplicative*.

It is of sufficient interest in this connexion to be repeated here, that among Mammals the four orders of Megasthenes exhibit in their *fore limbs* four distinct grades of cephalization: in the *Quadrumanes* these organs serve for carrying their young, supplying the mouth with food, taking their prey, and for locomotion; in the *Carnivores*, for taking their prey and for locomotion; in the *Herbivores*, for locomotion only; in *Mutilates*, for fish-like locomotion, the members having the degraded form of fins.

II. *Articulates.*—In the subkingdom of Articulates, the three classes are *Insecteans*, *Crustaceans*, and *Worms*: the first includes Air-breathing species (*Insects*, *Spiders*, and *Myriapods*), and the second and third the Water-articulates. Examples of cephalization by the *first* method occur in the first two of these classes. They cannot in the third, because Worms have no proper feet, and are not a type with *closed* limits, but one admitting of indefinite multiplication of parts behind, and therefore *open* posteriorly.

1. *Insects*, the highest of the three orders of Insecteans, have three pairs of mouth-organs and three pairs of legs. As the wings belong to the same segments of the body with two of the pairs of feet, they are not to be counted; for the transfer noted is, in fact, a transfer of *segments* of the body along with their appendages.

Passing down from Insects to *Spiders*, the mouth loses one

* To the *zoological* characteristics of Man, mentioned in the writer's article on Mammals (that is, the extreme cephalization of his system, and the erect form connected therewith) should be added the following,—that, while in the Quadrumanes the feet are clasping or prehensile feet, in Man they are simply organs of support and locomotion. The former fit the Apes for their climbing habits, the latter empower Man for human duty. The discussion, now in progress, whether the hind limbs of the Gorilla terminate in hands or in true feet ("in no sense hands," in the words of Prof. Huxley) is of small importance in this connexion.

The writer's view of the characteristics of Man depending on his *spiritual* nature are given in Silliman's Journal, vol. xxxv. p. 452.

pair of organs (the posterior), and the feet gain one pair, there being *four* pairs of feet in Spiders; that is, there is a transfer of *one* pair from the cephalic to the locomotive series. The absence of antennæ in Spiders is no mark of degradation, since the *senses* exist in good perfection.

Descending lower, to the *Myriapods*, the Articulate type passes below the range of normal variation into a degradational form, and one which, like that of *Worms*, admits of indefinite posterior elongation or multiplication of segments (by the *eighth* method of decephalization), and hence it has no *closed* or fixed limits, like that of Spiders or Insects. Under this loose and multiplicative condition of the system, there is no regular transfer backward of another pair of mouth-organs: the type is distinguished, instead, by the degradational character just mentioned.

2. The facts among *Crustaceans* have already been pointed out—that, descending from *Decapods* (Crabs and Lobsters), which have *six* pairs of mouth-organs and *five* of feet, to *Tetradecapods*, two pairs of the mouth-organs are transferred to the locomotive series, making the number of pairs of feet *seven*, and of mouth-organs four.

Descending further, to *Entomostracans*, or the third order, the mouth-organs lose one or more of the remaining pairs, and sometimes (as in *Limulus*, or the Horse-shoe Crab, as it is called) *all*, for the mouth-organs in this species are all true feet. The Entomostracans exemplify decephalization by degeneration (*ninth* method)—as in the absence of one or two pairs of antennæ, the absence of one or two or more posterior pairs of thoracic feet, the absence of the series of abdominal members, and sometimes (as in *Limulus*) by the reduction of the abdomen to a mere spine. They are *degradational* forms as well as the Myriapods; and hence the apparent difference of grade, which might be supposed to be marked by the number of pairs of mouth-organs transferred backward, cannot serve to subdivide the order. The distinction of the Entomostracans from the higher Crustaceans consists rather in their degradational characters than in any peculiarities of the mouth. In the tribe of Ostracoids (*Cypris*, &c.) alone, one genus has *two* pairs of mouth-organs, the rest being legs, another *three*, and another *four*, the Tetradecapod number.

III. *Mollusks.*—It has been remarked that the subkingdom of Mollusks cannot, from its nature, exemplify the *first* method of cephalization. The methods exemplified are the *third, fourth, ninth*, and *tenth*. In the transition from the order of *Cephalopods*, the *first*, to that of *Cephalates* (*Gasteropods*), the *second*, there is a loss of the feet or arms, and a diminished perfection of the senses, and activity is reduced to sluggishness. Descending to the *third* order, or *Acephals*, the antennæ fail, the eyes become imperfect or obsolete, locomotion becomes very imperfect, and in some fails altogether. Among *Bryozoans*, a still inferior order, all the organs of the senses fail, and there is the radiate structure of vegetation as well as its sessile character.

The difference in cephalization between an oyster and a clam is very strongly marked,—the oyster, when placed in its normal position, having its body nearly all posterior to the beak, being merely a large gastric mass; and the clam having one-third of the body anterior to the beak, and really exhibiting something stately in mien compared with the oyster.

Other illustrations of the subject might be given; but they are not necessary to explain the general principle in view.

The *number of pairs of feet* in the subkingdoms of Vertebrates and Articulates, under those types which afford examples of the first method of cephalization, is as follows:—

I. Vertebrates.

1 in Man; 2 in all other Vertebrates.

II. Articulates.

1. *Under Insecteans.* 3 in Insects; 4 in Spiders.
2. *Under Crustaceans.* 5 in Decapods; 7 in Tetradecapods.

The number of pairs of feet in the different groups are then 1, 2, 3, 4, 5, 7. Only *one* case of typical transfer occurs in each of the three classes illustrating the subject—Mammals, Insecteans, and Crustaceans; and these cases occur uniformly between the *two highest orders* of the class.

Man's title to the place assigned him in our former paper appears therefore to be unquestionable.

The types of Vertebrates and Articulates do not admit of any homological comparisons.

The types of Insecteans and Crustaceans are modifications of a common type; yet the two are so widely different, that it is far from true that the *five* pairs in the highest Crustaceans correspond to the *four* in Spiders *plus* a preceding pair of mouth-organs. The head and locomotive part of the thorax in the Land-Articulates appear to correspond unitedly, as stated by Latreille, to the cephalic portion of the Crab,—that is, to *nine* anterior segments out of the *fourteen* cephalothoracic. In other words, this part of the body of an Insect is an extreme concentration of the anterior portion of a Crustacean—an example of extreme cephalization; while a Crustacean is a diluted

Insect, being much larger, and more numerous in segments and members*.

The *Lobster* (or any ordinary Macrural Decapod Crustacean) has an elongate body, and an abdomen well developed and furnished below with a full series of members. In the male *Crab*, also a Decapod, the body is very short, and the abdomen is without its members, besides being so small that it folds into a groove in the under shell of the body: this diminution of size and increased compactness are a consequence of the higher cephalization of the species (Method 4). Passing from Crabs to the still higher Articulates, *Insects*, there is an example of this cephalization carried to its maximum,—it appearing in the extreme diminution of size of body and members, in the very small distinct head (comprising, normally, *a third* of the segments of the body, though so small), and in the thorax freed from the viscera and devoted mainly to locomotion. By this method an animal is made of the highest instincts under the Articulate type.

From these examples it is evident that, where there is a compacting of the body connected with rise in grade, it is not merely a *general* compacting of the different parts alike, or a general concentration and perfecting of the system, but a true *cephalization* of the system,—the compacting and perfecting showing itself primarily in a greater concentration, predominance, and domination of the cephalic extremity.

Among Articulates having feet, an *Insect* and a *Limulus* stand at the opposite poles of cephalization. The mouth-organs and feet in both correspond to those of the head (or the mouth-

* There appears to be no reason to doubt that in all types, *not degradational*, each pair of members (wings excluded) corresponds to a separate normal segment of the body. Audouin and Edwards are sustained in their views on this point by the fact that, in a *Squilla*, three anterior cephalic segments (those of the eyes and two pairs of antennæ) and four posterior thoracic are actually distinct; and in an *Erichthus*, other segments, anterior to these four, are faintly indicated. (See the author's Expl. Exped. Report on Crustacea, pl. 41.)

Assuming the number of normal segments anterior to the mouth in an Articulate from that (three) in the head of a Crustacean, the complete number in an Insect is *eighteen*, and in a Crustacean *twenty-one, three abdominal* being present which are obsolete in an Insect. In the former, *half* (or *nine*) pertain to the head and thorax (only three to the thorax); in the latter, *two-thirds* (or *fourteen*), the rest being abdominal. In an Insect, the viscera are *abdominal*; in a Crustacean (excepting some degradational forms), *thoracic*. The separation of the viscera from the thorax in an Insect leaves this part to higher purposes. It is to be noted that the tenth to the fourteenth segments, inclusive, are *visceral segments in both Insects and Crabs*,—being the first part of the abdomen in an Insect, and the last (and large-foot-bearing) part of the cephalothorax in Crabs.

organs) of a Crab. But in *Limulus* there is extreme of degradation, all the members being large and stout feet, only the basal joints of the feet serving as jaws,—the body being enormously enlarged by mere vegetative growth,—the antennæ wanting, or reduced to a pair of pincers, and the animal sluggish, a sport of the waves on the beach; while in Insects there is extreme of cephalization, the pairs of feet only *three* and those small and slender, and the body minute in comparison—the antennæ well developed, and serving as delicate organs of sense—the animal active, and wonderful in its instinctive habits and knowledge.

The parallelism above shown between Insecteans and Crustaceans proves that *Insects, Spiders,* and *Myriapods* are orders in a single class, and not separate classes*. Moreover the orders under the classes of Insecteans and Crustaceans constitute parallel series, the first two of each being *closed* types, within the range of normal variation, and the last one of each (*Myriapods* and *Entomostracans*) being a degradational type, though different one from the other in kind of degradation. The parallelism between the series would be well exhibited if the orders were thus named:—

Those of Insecteans, (1) *Hexapods,* (2) *Octapods,* (3) *Myriapods.*

Those of Crustaceans (1) *Decapods,* (2) *Tetradecapods,* (3) *Colopods,* this last term (from κόλος and ποῦς) signifying *defective feet* or *members,* which is the prominent characteristic of the order.

The parallelism extends even further than has been mentioned. The Tetradecapods are not an intermediate type between Decapods and Entomostracans; on the contrary, they lie quite out of the range of either. The Decapods, in their degradational species, pass almost into Entomostracan forms, and not into Tetradecapod forms. So among Insecteans, the Spiders have the same isolated position and defined limits. Insects, in

* The grand distinction of the subdivision of *Insects* consists in their having three pairs of mouth-organs and three pairs of feet; of *Spiders,* in having two pairs of mouth-organs and four pairs of feet; of *Myriapods,* in having, through degradation, an indefinite number of segments and feet. Hence, to include *Spiders, Myriapods,* and the Hexapod group of *Pulices, Lepismæ, Pediculi,* and the like, in one division called *Aptera,* as is done by some naturalists who adopt the general division of Insecteans, is a violation of all true affinities.

Professor Agassiz recognizes the same three classes of Articulates as above by the writer, and the same subdivisions, or orders, of Insecteans, but "from embryological data." The writer has not felt ready to deprive Spiders and Myriapods of their place in separate classes, co-ordinate with those of Insects, Crustaceans, and Worms (a common method among zoologists), until recently, when the special application to these Articulates of the principle above explained occurred to him.

their degradation, approximate to Myriapods, not to Spiders. In fact, Spiders stand more nearly between Insects and Crustaceans than between Insects and Myriapods.

There is here a cross affinity between Insecteans and Crustaceans which is of great interest. The relation of common *Spiders* to *Brachyural Decapods* or *Crabs* is seen (1) in the general form or habit of body (some Crabs are called sea-spiders), and (2) in the coalescence of the thoracic and abdominal nervous ganglions into a single central thoracic ganglion. At the same time, the division of *Scorpions*, among Spiders, is correspondingly related to that of the *Macrural Decapods*, (1) in the body consisting of a series of segments; and (2) in the nervous ganglions being distinct, one to each abdominal segment. Moreover the maxillipeds are long and chelate, like the outer pair in some inferior Macrurans.

Again, the *Myriapods* are distantly related to the *Tetradecapods*, they being similar in their annulated structure, each segment having its pair of feet, and some species of the former (as those of *Glomeris*) even resembling the latter quite closely in form, articulation, and antennæ, and many of them having also the habit of some *Oniscidæ* (Tetradecapods) of rolling into a ball.

Thus, the *second* order of Insecteans is related, as regards form, to the *first* of Crustaceans; and the *third* of Insecteans to the *second* of Crustaceans.

The earliest of Crustaceans, the *Trilobites*, one of the *comprehensive* types as styled by the writer, are therefore not only intermediate between Entomostracans and Tetradecapods, but also, in some respects, between these and the Myriapods. Moreover, like the latter, Trilobites are abnormal in the very large number of segments of which the body is composed; and sometimes also they present no distinction between the cephalothorax and abdomen.

The facts pointed out prove conclusively that Insecteans and Crustaceans constitute classes of equivalent value.

2. *Megasthenes and Microsthenes.*

The two grand divisions of typical brute Mammals, the *Megasthenes* and *Microsthenes*, are not separated by any very marked difference in type of structure; and still there is a profound fundamental difference between them—that to which the names refer. This is in contrast with the fact among Crustaceans, the Megasthenic and Microsthenic divisions of which (the *Decapods* and *Tetradecapods*) stand widely apart. But in the class of *Crustaceans* the structure varies between remote extremes, while in that of Mammals there is a remarkable fixedness or an extremely limited range of variation. Hence, in the distinctions of *Megasthenes* and *Microsthenes,* among Mammals, we cannot look for the marked diversity that subsists between *Decapods* and *Tetradecapods,* although the naturalness of the subdivisions is none the less real. The words *Megencephals* and *Micrencephals* (signifying *large-brained* and *small-brained* Mammals) may better satisfy the desire for names expressing something tangible in the structure. Yet they do not appear to indicate the fundamental distinction between the groups. A general structural characteristic may yet be detected corresponding to these megasthenic and microsthenic qualities; but even then the distinctive idea of the subdivisions could hardly be better expressed than by the names proposed.

The parallelism between the Megasthenes and Microsthenes among Mammals, and the Decapods and Tetradecapods among Crustaceans, suggests that if the subdivisions be called *orders* in the latter case, they should be so called in the former.

The distinction between Megasthenes and Microsthenes may perhaps become more intelligible if we regard a living structure as a *life-system,* or, speaking dynamically, a *life-battery.* In order that such batteries may have a very wide range of size, two or more plans of construction, more or less different, appear to be requisite. With one plan, there is a certain magnitude which is that of most efficient action and power; and from this magnitude there may be a series of larger and smaller sizes, reaching to the outer limits of normal perfection, and then, if these limits be passed in either direction (that is, either on the side of too great magnitude or of too little), degradation in the structure and its powers begin to appear.

To carry the species through another range of sizes, with normal perfection of structure, another somewhat different plan is required. The Megasthenes represent one such plan, the Microsthenes another.

This idea is brought out by the writer in his chapter on the Classification of Crustaceans already referred to. He there says, speaking of the orders of Crustaceans, viz. Decapods, Tetradecapods, and Entomostracans:—

"I. Each type corresponds to a certain system of force more or less centralized in the organism, and is an expression of that force,—the higher degree being such as is fitted for the higher structures developed, the lower such as is fitted for structures of inferior grade and size. In other words, the life-system is of different orders for the different types, and the structures formed exhibit the extent of their spheres of action, being such as are adapted to use the force most effectively, in accordance with the end of the species.

"II. In a given type, as the first, for example, the same system may be of different dimensions, adapted to structures of different sizes. But the size in either direction for structures of efficient action is limited. To pass these limits, a life-system of another order is required. The Macroura, as they diminish in size, finally pass this limit, and the organisms (Mysidæ, for example) are no longer perfect in their members; an obsolescence of some parts begins to take place, and species of this small size are actually complete only when provided with the structure of a Tetradecapod.

"The extreme size of structure admitting of the highest efficient activity is generally three to six times lineally the average or mean typical size. Of these gigantic species, three or four times longer than the mean type, there are examples among the Brachyura and Macroura, which have all the highest attributes of the species. There are also Amphipoda and Isopoda 3 inches in length, with full vigorous powers. Among Entomostraca, the Calanidæ, apparently the highest group, include species that are 3 lines long, or three times the length of the mean type.

"III. But the limit of efficient activity may be passed; and when so, it is attended with a loss of active powers. The structure, as in the female Bopyrus and Lernæoids, and the Cirripeds, outgrows vegetatively the proper sphere of action of the system of force within. This result is especially found in sedentary species, as we have exemplified in our remarks on the Cirripeds.

"IV. Size is, therefore, an important element in the system of animal structures. As size diminishes, in all departments of animal life, the structure changes. To the human structure there is a limit; to the quadrupeds also, beyond which the structure is an impossibility; and the same seems to be the case among Crustacea. The Decapod, as the size diminishes, reaches the lowest limit; and then, to continue the range of size in species, another structure, the Tetradecapodan, is instituted; and as this last has also its limit, the Entomostracan is introduced to continue the gradation; and, as these end, the Rotatoria begin. Thus Crustacea are made to embrace species from a length of nearly two feet (or 250 lines) to that of a one-hundred-and-fiftieth of a line. These several types of structure among Crustacea do not graduate, as regards size, directly from one to another, but they constitute overlapping lines, as has been sufficiently shown."

While on this subject of life-batteries, the writer would suggest that the grand dynamical distinction between Mollusks and Articulates may be this:—

A Mollusk corresponds to a *quantity-battery*, but one of very weak force; that is, it is analogous to a galvanic battery of *two or three small pairs at the most*. This is indicated, (1) by the structure of the species, especially the absence of all articulations, the animal (a locomotive digestive system) being, as it were, in one simple bag; (2) by the number of ganglions, limited to three; and (3) by the sluggishness of the animal.

An Articulate, on the contrary, corresponds to an *intensity-*

battery, or is analogous to a galvanic battery of *many small pairs*; for (1) the body consists of many segments; (2) there are nearly as many nervous ganglions as segments (normally as many); and (3) the animals in the more typical species have extreme rapidity of movement and high instincts. The small number of ganglions in most Spiders is evidently due to a coalescence of several in the one central thoracic ganglion, as in Crabs.

In the highest Mollusks, the Cephalopods (Cuttle-fish, &c.), the Invertebrate *quantity-battery* reaches its greatest power.

Vertebrates also appear to correspond to a quantity-battery (as shown by the simplicity of the nervous system), but to one admitting of vastly greater power.

XX.—*On the Value of the "Villi" on the surface of* Amœba *as a Specific Distinction.* By H. J. Carter, F.R.S. &c.

In Article XIII. of the 'Annals' for August 1863, vol. xii. p. 111, Dr. Wallich calls upon me to account for many things—more than I have time now to answer.

I rejoice, however, to see that he has taken up the study of the freshwater Rhizopoda so zealously, and hope that he may make much progress in it; for, regarding a correct knowledge of these elementary forms of life as, at present, the alphabet, so to write, of organized creation, I shall not be found wanting in gratitude to him for every moment that he may devote, and for the smallest trifle that he may add, to our information respecting the *Amœbæ*; while, if I fail in this, or am guilty of the opposite, viz. of detracting from him, which has not been, nor ever will be, done intentionally, I am certain, on the other hand, that he will obtain that justice and be allowed that priority from those acquainted with the subject, which truth and right in the end always secure in matters patent to public scrutiny. But not being particularly ambitious of such awards myself (as I am for the most part satisfied if I can obtain the publication of anything which I think may be useful, in a truthful form and to the best of my ability), I may perhaps on this account be backward in acknowledging the assistance that I derive from others, where this does not appear to me to be absolutely necessary for the subject on which I may be writing.

I would, however, wish it to be understood that my remarks on *Amœba princeps* ('Annals' for July 1863, p. 30) were chiefly derived from observations made on this species of *Amœba*, in Devonshire, in April last; while those by Dr. Wallich were made in London about the same time on an *Amœba* which he then considered to be such "a well-marked species" that he adds

"I accordingly propose that it should be named *A. villosa*" ('Annals,' May 1863, p. 366). Thus our observations were made independently of each other, and, as I thought, on different species; for I could not conceive then that any one possessing a knowledge of the freshwater *Amœbæ* could confound *A. princeps* with any other form of *Amœba*, or give it a new name without making *particular* mention of this circumstance. Nor had I subsequently any reason to think otherwise, until I had the pleasure of making Dr. Wallich's acquaintance personally towards the end of May, when I learnt from him that he regarded *A. villosa* and *A. princeps* as one and the same; upon which I added this remark to the rough (as it now stands in the printed) copy of my paper (*loc. cit.* p. 44)—not pointedly, at the commencement, but cursorily, in the latter half of the paper.

But what is the value of this "villous surface" on *Amœba*, as a specific character, if Dr. Wallich assumes that "many of the so-called species of *Amœba*, if not all," are mere "varieties" (vol. xi. p. 287, and vol. xii. p. 115) of his *A. villosa*? since they certainly all do not present the "villi." And where is the specific character to determine that all the other *Amœbæ* are mere varieties of *A. villosa* when the "villi" are absent?

Independently of not agreeing with Dr. Wallich in such an assumption, I saw that the presence of the "villi" in *A. princeps* was inconstant, which induced me to lay stronger weight on that which appears to me to be a peculiar form of the nucleus in this species; and until convinced to the contrary, I must adhere to these views. My opinions regarding the specific value of the villi and the form of the nucleus respectively in *A. princeps* will be found in my paper; so I need not repeat them here.

Let anyone conversant with the subject compare my figures of "*Amœba radiosa* (?) Duj." (Annals, vol. xviii. 1856, pl. 5), diagrammatic as these are, with Auerbach's *A. bilimbosa* (Siebold und Kölliker's Zeitschr. vol. vii. pl. 19. figs. 1–10), and see if they are not so much alike that they may be assumed to be the same species. And then let him compare these with Ehrenberg's, Dujardin's, and my own figures of *A. princeps*, and see if the differences between these two *Amœbæ* are not quite sufficient for specific distinction. Yet Dr. Wallich assumes that *A. bilimbosa* and *A. princeps* are mere varieties of one species, of which the typical form is his *A. villosa*, whether they have the villous surface (his chief specific character) or not; while he further adds that "the balance of evidence" appears to be in favour of the "*whole* of the varieties of *Amœba*" being reducible to a single specific type! (Annals, ser. 3. vol. xi. p. 443): the italics are mine.

With these views, then, I saw that it was impossible for Dr. Wallich and myself to get on together in this subject, and therefore I sent my paper on *Amœba princeps* to the press with the *few* allusions which it contains to what Dr. Wallich had previously published on *A. villosa*.

As to this paper conveying the impression that "every one of the characters peculiar to the *Amœbæ* of which Dr. Wallich wrote had been or were "for the first time" brought to notice by myself (p. 115, vol. xii.), that I have not been "just" to Dr. Wallich (*ibid.*), and that I have "assailed directly or indirectly nearly every opinion and statement" that he has made in the communications under reference (p. 151), I certainly do not think that my paper calls for any such expressions, and, without defending myself in long explanatory notes which no one would read, am quite content to receive the verdict which those acquainted with the subject may be disposed to give after reading Dr. Wallich's and my own papers respectively in the 'Annals' for 1863, Nos. 64 to 68 inclusive.

Dr. Wallich (p. 115) has completely distorted the application of the term "nomenclature" as I have used it in the commencement of my paper (p. 30). The passage runs thus:—"It may be remembered by those who have read my 'Notes on the Organization of Infusoria, &c.' [published in 1863], that I have therein proceeded upon a certain nomenclature of *their parts* generally; and I shall pursue the same course here in the description of *A. princeps* specially." Yet, to read Dr. Wallich's objections, it would appear that I had used the word "nomenclature" with reference to *species*. It was not until 1863 that I ever met with *A. princeps* in such numbers as to be able to make so much out of it as I have done of the other freshwater Rhizopods, viz. as regards its "reproductive cells." And as in this paper the *Amœbæ* are not referred to generally, my remarks must be considered to apply to *A. princeps* specially, where it is not stated otherwise.

Of Dr. Wallich's criticisms on my "Communications" on the Infusoria generally previous to 1863, I must also leave the public to judge; and if I ever carry out my intention of writing more at length on the subject, I shall then, in the general review of what I have written since 1856 inclusive, hope to benefit by what my friend Dr. Wallich has written in 1863.

XXI.—*On the Nomenclature of the* Foraminifera.

By W. K. Parker, Esq., and Prof. T. R. Jones, F.G.S.

Part IX.—*The Species enumerated by De Blainville and Defrance.*

De Blainville, in the article "Mollusques" (Dictionnaire des Sciences Naturelles, xxxii. 1824), enumerates several forms of Foraminifera under various names, obtained from Fichtel and Moll, Lamarck, Montfort*, and Defrance; but the nomenclature adopted requires revision, and the classification is necessarily erroneous, since these microzoa were at that time still grouped among the Cephalopods, and no clue had been obtained to the right understanding of their zoological relations. Defrance at the same time revised the several genera and species, especially those of which he had obtained specimens in the fossil state, and added accounts of some previously unrecognized forms.

Besides the Foraminifera thus treated of, there are several others which De Blainville and Defrance arranged as "Polypiers" (*Dactylopora, Fabularia, Larvaria, Lycophris, Orbitolites, Oryzaria, Ovulites, Polytrema*, and *Polytrypa*).

In his 'Malacologie'† and 'Actinologie' ‡, based on articles in the 'Dict. Sc. Nat.,' De Blainville also treats of these forms.

The publication of the 'Dict. des Sc. Nat.' (60 vols. 8vo, Paris and Strasbourg) extended from 1816 to 1830, during which time Alcide Dessalines D'Orbigny also was busy with the study of Foraminifera, and a systematic catalogue (in the "Tableau méthodique de la Classe des Céphalopodes") was published by him in the 'Annales des Sciences Naturelles,' vii. 1825–26. Defrance and Blainville, in the later volumes of the 'Dict. Sc. Nat.,' refer to D'Orbigny's work; whilst, in the latter, references are made to the early volumes of the 'Dict. Sc. Nat.'

De Blainville seems to have added very little to the knowledge of Foraminifera, having chiefly laboured in their systematization on false grounds. Defrance, by careful observation, added a few new forms, chiefly fossil, to those already known, and appears to have had a clearer perception of the relationships of certain of the Foraminifera than some of his contemporaries had.

1. Alvéolite. 1816. Dict. i. p. 557. Under this head G. L. Duvernoy here confounds Lamarck's genus of corals (*Alveolites*) and Bosc's "Alvéolite grain de fétuque" and "Al. grain de millet," the first of which is an *Alveolina*. In the Supplement to the same volume (art. "Alvéolites," p. 136) Defrance refers to these little fossil forms (see Ann. Nat. Hist. ser. 3. viii. p. 162); and

* Notes on the generic and specific names derived from the works of Linnæus, Fichtel and Moll, Lamarck, and De Montfort, have already been published, in our papers on the Nomenclature of the Foraminifera, in the 'Annals of Natural History,' 1859 & 1860.

† Manuel de Malacologie et de Conchyliologie, par H. M. De Blainville, 2 vols. (text and plates), 8vo, Paris, 1825.

‡ Manuel d'Actinologie ou de Zoophytologie, par H. M. De Blainville, 2 vols. (text and plates), 8vo, Paris, 1834.

subsequently in 1820 (Dict. Sc. Nat. xvi. p. 103) he again treats of them, referring one to *Oryzaria Boscii* and the other to *Fabularia Discolithus* (*loc. cit.*). *Alveolina Boscii*, Defr., is illustrated by D'Orbigny's 'Modèle,' No. 50, and *Fabularia Discolithes* by Modèle No. 100. Defrance also alludes (Dict. i. p. 137) to another form of *Alveolina* under the provisional name of *Alveolites Larva*, fossil, from Valognes, smooth, pointed at the ends, and sometimes 8 lines in length.

2. Chrysaora damæcornis, *Lamouroux*. The specimen figured in the Atlas, Zooph. pl. 42. f. 2, and Blainv. Actinol. pl. 64. f. 2, is not described in the Dict. Sc. Nat., but is treated of by Blainville in his 'Actinologie,' 1834, p. 414, pl. 64. f. 2, as a zoophyte, and is probably a *Carpenteria*, which is a peculiar form of Rhizopod, related to the *Globigerinida*; it is tent-like, or like a small Barnacle, and fixed by the base; the frame is calcareous and basket-like, boldly perforate, and containing the sarcode, which appears to be full of spicules. It forms a link between the Foraminifera and the Spongiadæ. See Carpenter's 'Introduction to the Study of Foraminifera' (Ray Society), 1862.

3. Cibicides refulgens, *De Montfort*. Dict. ix. p. 188, xix. p. 2, xxxii. p. 187; Atlas, Conch. pl. 19. f. 2; Blainville, Malac. p. 391, pl. 10. f. 2. This is *Truncatulina refulgens*. [Type: *Planorbulina farcta*.] See 'Annals Nat. Hist.' ser. 3. v. p. 177, vi. p. 340, and Carpenter's 'Introduction,' p. 206.

4. Crepidulina Astacolus, *De Blainville* (*Astacolus crepidulatus*, De Montfort). Dict. xix. p. 8, xxxii. p. 188; Atlas, Conch. pl. 19. f. 8; Blainv. Malac. pl. 10. f. 8. This is *Cristellaria Crepidula*. [Subtype: *Crist. Calcar*.] See Ann. Nat. Hist. ser. 3. v. p. 114.

5. Crepidulina Auricula, *Fichtel* and *Moll*, sp. Dict. xxxii. p. 188; Bl. Malac. p. 383. This is *Pulvinulina Auricula* (var. β), F. & M. sp. [Type: *Pulvinulina repanda*, F. & M.] See Ann. Nat. Hist. ser. 3. v. p. 177, and Carpenter's 'Introduction,' p. 210.

6. Crepidulina elongata, *De M.* sp. Dict. xxxii. p. 188. This is a variety of *Cristellaria Calcar*. See Ann. Nat. Hist. ser. 3. vi. p. 344.

7. Cristellaria Calcar, *Defr.* Dict. xi. p. 615. Defrance adopted this name (used also by Linnæus) for the rowel-like forms found on the Italian shores and in the Tertiary deposits of Tuscany, and figured by Soldani; and he defines them as being smaller and more convex than *C. Cassis*, and having the keel produced into projecting points. Defrance assures naturalists that this *Cristellaria* really occurs in both the recent and the fossil state.

8. Cristellaria Cassis, *F.&M.* sp. Dict. xi. p. 614, xxxii. p. 188. See Ann. Nat. Hist. ser. 3. v. p. 115.

9. Cristellaria lævis, *Defrance,* 1818. Dict. xi. p. 614. This is a subvariety of *C. Cassis,* having no septal ribs, and a smaller umbonal knob. Defrance does not insist on its being specifically distinct.

10. Cristellaria producta, *Lam.* Dict. xi. p. 614. Under this name Lamarck placed two of Fichtel and Moll's varieties (*β* and *γ*) of *Cristellaria Cassis*; fossil, from Coroncina, Italy.

11. Dactylopore. Dict. xii. p. 443. *Dactylopora cylindracea,* Lamarck; Atlas, Zooph. pl. 47. f. 4, pl. 51. f. 6; Blainv. Actinol. pl. 72. f. 4, pl. 76. f. 6. Defrance obtained his specimens from the "Calcaire coquillier" of Grignon, near Versailles, and the sand of Pontoise. In the Ann. Nat. Hist. ser. 3. v. pp. 20–27, we described several varieties of *Dactylopora,* recent and fossil: these descriptions have since been revised and illustrated in Dr. Carpenter's 'Introduction,' pp. 127–137, pl. 10. The varieties now adopted are *D. Eruca, D. Annulus, D. digitata, D. clypeina* (*Clypeina marginoporella,* Michelin; *Dactylopora marginoporella,* P. & J. 1860), *D. reticulata* (*Larvaria reticulata,* Defrance), *D. glandulosa* (*Prattia glandulosa,* D'Archiac), and *D. cylindracea,* Lamarck.

The microscopic fossils (from Podolia and Volhynia) figured and described by A. Zborezewski in the 'Nouv. Mém. Soc. Nat. Moscou,' 1834, p. 308, pl. 26. f. 1–3, as *Cellulina Eichwaldii, C. Besseri,* and *C. Puschii,* are probably *Dactyloporæ.* Accompanying these, *Polymorphina lactea,* var. *tubulosa,* is figured both as *Raphulina Humboldtii* (p. 311, pl. 28. f. 1 *a*) and as *Apiopterina D'Orbignii* (f. 2 *a*). Montfort's odd figure of his *Lagenula* is here also referred to *Apiopterina*; and an obscure two-celled form is figured and described as *Lyrina Fischeri.*

The little annular Foraminifer from the "Sables IV^res de Grignon," described by A. Zborezewski, under the name of *Dactylina Fischeri,* in 1843 (Bulletin de la Soc. Imp. des Naturalistes de Moscou, xvi. p. 363), appears to be the same as *Dactylopora Annulus.* Zukowa in Podolia is also given as a locality, with a note of interrogation. The woodcut illustrating *D. Fischeri* is a rough diagram, but characteristic. A figure of what seems to be a Gyrogonite accompanies the woodcut above mentioned, and is named "Spirostegina;" but no description follows. The author also mentions some others of his species of Foraminifera under the names "Baphulina," "Cepiopterina," and "Pnylomorphina" (p. 364).

12. Discorbites Pedemontanus, *Defr.* 1819. Dict. xiii. p. 347. Indeterminable from the description given—"Orbicular, discoidal; spire entirely visible on one side only; chambers smaller and

more numerous than in *D. vesicularis*; fossil in Piedmont and Italy." Defrance mentions also having obtained three recent forms referable, he thinks, to *Discorbis*.

13. Discorbites vesicularis, *Lamarck*. Dict. xiii. p. 346, xxxii. p. 186; Atlas, Conch. pl. 14. f. 2; Blainv. Malac. pl. 6. f. 2. This is *Discorbina Turbo*, D'Orb., var. *vesicularis*; the same as *Rotalia Gervillii*, D'Orb. See Ann. Nat. Hist. ser. 3. v. p. 293, and Carpenter's 'Introduction,' p. 204.

14. Discorbites vesicularis. Atlas, Conch. pl. 13. f. 3; Blainv. Malac. pl. 5. f. 3. This figure probably represents a *Dendritina*, that is, a Nautiloid form of *Peneroplis planatus*, F. & M. sp.

15. Fabularia Discolithus, *Defr.* 1820. Dict. xvi. p. 103; Atlas, Zooph. pl. 48. f. 5; Blainv. Actinol. pl. 73. f. 5. "Alvéolite grain de millet." Fossil, from Grignon; and a flattened variety from Valognes. See Ann. Nat. Hist. ser. 3. v. p. 471. This *Fabularia* from Grignon was figured by Fortis in his Memoir on Discolithi, Mém. Nat. Hist. Italie, ii. pl. 2. f. Z, 1, 2, p. 109 (*Discolithus IX.*), and was named *Nummulites ovata* by De Roissy, Hist. Nat. Mollusques, 1804, v. p. 59; hence De Roissy's is the oldest specific name, and the species should stand as *Fabularia ovata*.

A full account of *Fabularia* is given by Dr. Carpenter in his 'Introduction,' p. 82 &c., pl. 6. f. 37, 38.

16. Fabularia sphæroides, *Defr.* 1820. Dict. xvi. p. 103. Fossil, from Chaumont. Given as a variety of the foregoing by Defrance.

17. Frondicularia complanata, *Defr.* 1824. Dict. xxxii. p. 178; Atlas, Conch. pl. 14. f. 4; Blainv. Malac. p. 371, pl. 6. f. 4. This is a fine large Frondicularian form of *Nodosarina*; fossil; probably from Italy.

It was also termed *Renulina complanata* by De Blainville (xxxii. p. 178). "Renulina" was also applied by him (*loc. cit.*) to the reniform variety of *Vertebralina* = *V. opercularia* (see Ann. Nat. Hist. ser. 3. v. p. 471), a very different form.

Frondicularia complanata is one of the most beautiful of the Foraminifera, and often of a relatively large size in the Italian Tertiary clays and sands, and in those of Malaga, San Domingo, and the Vienna Basin. The Chalk, Chalk-marl, and Gault have numerous individuals of varieties of this form, but they are of less size than those of the Tertiary deposits. Similar forms, but still smaller, are also common in several of the older clays of the Secondary epoch. In the recent state it is not common, but occurs of full size at Jamaica (the late Mr. L. Barrett's dredgings); and we have met with a long narrow *Frondicularia* (like *F. striatula*, Reuss) in Commander Dayman's dredgings, made in July 1859, off Lisbon, at 700 fathoms. Prof. Williamson has figured two specimens of *Frondicularia* (regarded by him and Mr. Jeffreys as being recent, but most probably, we think, derived from the chalk cliffs) from the coast of Kent. In the sea-sand from Rimini worn specimens of *F. complanata* occur; some, however, are not more worn than many of the undoubted *Planularia Cymba* so common in, and characteristic of, the Rimini coast, while others are filled with ferruginous clay, and have been derived from Subapennine strata.

If we go back to the Liassic period, we find the *Nodosariæ* (then forming a large proportion of the Rhizopodous fauna in certain clays) presenting innumerable gradations through somewhat flattened forms of *Nodosaria* (*Lingulinæ*) into true *Frondiculariæ*, and through them to *Flabellinæ*, *Planulariæ*, and *Cristellariæ*. It seems as if, in later times, these minor varieties have become more specialized as to locality; and nowadays, having gradually lost its potency as a genus, *Nodosarina* seldom, in any recent deposit, shows such comprehensive suites of varying forms as we find in the Lias, one subspecies now predominating over the others in the several Rhizopodal faunæ.

As regards size, the largest individuals of all the Nodosarine group are found in the Tertiary deposits above referred to,—the recent Jamaica specimens (dredged by the late Mr. L. Barrett in from 100 to 250 fathoms) alone rivalling them.

The passage from *Frondicularia* to *Flabellina* is very easy, as may be seen in many specimens from the Cretaceous and other deposits, in which the eccentricity of the primordial chamber is so slight, or, in other words, the tendency to coiling so weak, that the distinction between *Frondicularia* and *Flabellina* can scarcely be said to exist in them, the shell in other respects presenting the general characters common to the two forms. *Flabellina* is to *Frondicularia* as *Marginulina* and *Vaginulina* are to *Nodosaria* and *Lingulina*; that is, the shell is dimorphous, having had two successive plans of growth—the first spiral, like that of *Cristellaria*, the later rectilinear, like that of *Nodosaria*. The *Flabellinæ* of the Gault and Chalk-marl rival the largest *Frondiculariæ*, and have been figured and described by D'Orbigny, Reuss, and others. *Palmula sagittaria*, Lea (Contributions to Geology, 1833, p. 219, pl. 6. f. 228), from the Cretaceous deposits of Timber Creek, New Jersey, is either a *Frondicularia* or *Flabellina*, almost certainly the latter; for, although the early chambers are not shown, the later chevron-shaped chambers are not quite symmetrical. *Planularia cuneata*, S. G. Morton (Journ. Acad. Nat. Sc. Philadelphia, 1842, viii. pl. 11. f. 5), from the Middle Cretaceous Limestone of New Jersey, is also most probably a *Flabellina*, closely resembling *Fl. ovata*, Münster, sp. Reuss has pointed out that Von Münster's *Frondiculinæ* are

Flabellinæ: see N. Jahrb. 1849, p. 839, where *Flabellina ovata*, M. sp., *Fl. oblonga*, M. sp., *Fl. striata*, M. sp., and *Fl. cuneata*, M. sp., are figured in pl. 10. f. 23–26. In the 'Galerie des Mollusques, ou Catalogue méthodique, descriptif et raisonné de mollusques et coquilles du Muséum de Douai,' par V. L. V. Potiez et A. L. G. Michaud (2 vols. 8vo, Paris, 1858), pl. 9. f. 1–3 illustrate their *Frondicularia scutiformis*, which is a *Flabellina*; and f. 4–6 illustrate their *Textularia scapelliformis*, which is a *Frondicularia*. These are Belgian fossils from Autreppe, near Mons.

18. Hélicite. Dict. xx. p. 456. A name given by Gesner to *Nummulites*.

19. Helicites perforatus, *De M.* sp. Dict. xxxii. p. 179; Bl. Malac. p. 373. This is a small granulate *Nummulina*, the *Nautilus lenticularis*, var. ε, of Fichtel and Moll, Test. Micr. pl. 7. fig. *h*. See Ann. Nat. Hist. ser. 3. v. p. 108 & p. 111. (See also Nummulites, further on.)

20. *Helicites radiatus, De M.* Dict. xxxii. p. 179; Bl. Malac. p. 373. This is a small *Nummulina*, the *Nautilus lenticularis*, var. δ, of Fichtel and Moll, Test. Micr. pl. 7. fig. *g*. See Ann. Nat. Hist. ser. 3. v. p. 108 & p. 111. (See also Nummulites, further on.)

21–23. Larvaire. Dict. xxv. p. 287. (Larvaria.) Defrance found, in the Calcaire grossier of the vicinity of Paris, and in the Tertiary sands at Bracheux and at Abbecourt, near Beauvais, some little cylindrical bodies, tubular, tapering at both ends, and composed of rings that readily fall apart, and grouped them, as three species of *Larvaria*, among the "Polypiers." These we have already recognized as allied to *Dactylopora cylindracea* (Ann. Nat. Hist. ser. 3. v. p. 473, and Carpenter's 'Introduction,' p. 132, pl. 10).

Larvaria reticulata, *Defr.* 1822. Dict. xxv. p. 287 (Bl. Actin. pl. 71. f. 3), has the axial hollow large.

L. limbata, Defr., *ibid.*, has one end larger than the other, and a smaller central hollow; and its circular ranges of holes are less apparent.

L. Encrinula, Defr., *ibid.*, is from the Tertiary beds of Hauteville (Manche), and has the central hollow very small; and the cylinder has its rings constricted at intervals.

Both *L. limbata* and *L. Encrinula* may well be varieties of *L. reticulata*. (See also *Dactylopora* and *Polytrypa*.)

24. Lenticulina araneosa, *De M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. A variety of *Cristellaria Calcar*. Ann. Nat. Hist. ser. 3. vi. p. 344.

25. Lenticulina Calcar, *Linn.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. This is the typical *Cristellaria Calcar*. See also Ann. Nat. Hist. ser. 2. xix. p. 290, & ser. 3. v. p. 111.

26. Lenticulina costata, *F.* & *M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. *C. Calcar,* var. *costata.* See Ann. Nat. Hist. ser. 3. v. p. 113.

27. Lenticulina cucullata, *De M.* sp. Dict. xxxii. p. 182. This is a variety of *Cristellaria Calcar,* Linn. sp. Ann. Nat. Hist. ser. 3. vi. p. 344.

28. Lenticulina cultrata, *De M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. *Cristellaria Calcar,* var. λ, Fichtel & Moll, Test. Micr. pl. 13. f. *e–g.* Ann. Nat. Hist. *l. c.* p. 343.

29. Lenticulina diaphanea, *De M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. The typical form of *Cristellaria Calcar,* Linn. sp. Ann. Nat. Hist. *l. c.* p. 339.

30. Lenticulina incrassata, *F.* & *M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 389. *Nonionina asterizans,* F. & M. sp., var. *incrassata.* Ann. Nat. Hist. ser. 3. v. p. 101.

31. Lenticulina margaritacea, *De Bl.* Dict. xxxii. p. 182; Bl. Malac. p. 390. *Cristellaria Calcar,* Linn. var. δ; F. & M. Test. Micr. pl. 11. f. *i, k.* It is the "Pharame perlé" of De Montfort.

32. Lenticulina querelans, *De M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 389. This is Fichtel and Moll's *Cristellaria Calcar,* var. η. See Ann. Nat. Hist. ser. 3. v. p. 112, and vi. p. 343. It is the same variety as *C. rotulata.*

33. Lenticulina rostrata, *De M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. This is *Cristellaria Calcar,* var. ε, Fichtel & Moll, Test. Micr. pl. 12. f. *a–c.* Ann. Nat. Hist. ser. 3. v. p. 112.

34. Lenticulina rotulata, *Lam.* Dict. xxv. p. 453, xxxii. p. 181; Atlas, Zooph. pl. 15. fig. 7; Bl. Malac. pl. 7. f. 7. The common Cretaceous variety of *Cristellaria Calcar.*

35. Lenticulina Trithemus, *De M.* sp. Dict. xxxii. p. 182; Bl. Malac. p. 390. *Cristellaria Calcar,* var. ζ, Fichtel & Moll, Test. Micr. pl. 12. f. *d–f.* A modified individual of the var. *cultrata.*

36. Lenticulites complanata, *Defr.* 1822. Dict. xxv. p. 453. *Operculina complanata.* The small recent form is *O. ammonoides*; see Ann. Nat. Hist. ser. 3. viii. pp. 229, 230.

37. Lenticulites (et Lenticulina) planulata, *Lam.* Dict. xxv. p. 452; Atlas, Conch. pl. 14. f. 1; Bl. Malac. pl. 6. f. 1. *Nummulina planulata.* See Nummulites, further on. The figure represents a rather convex variety of *Nummulina planulata**, Lam. sp. See Ann. Nat. Hist. ser. 3. v. p. 295, and viii. p. 233.

* An interesting series of small individuals of this subspecies, varying in amount of convexity and other features, are figured and described by J. G. Bornemann, under the name of *Nummulina Germanica* (*Amphistegina nummularia,* Reuss), in the 'Zeitschr. deutsch. geol. Gesell.' 1860, xii. p. 158, pl. 6. f. 3–9.

38. Lenticulites rotulata, *Lam.* Dict. xxv. p. 453; Bl. Malac. p. 389. *Cristellaria rotulata,* from the Chalk of Meudon. This is the common form of *Cristellaria Calcar* as it occurs in the Chalk of Europe.

39. Lenticulites variolaria, *Lam.* Dict. xxv. p. 453. *Nummulina variolaria,* a small convex variety of *N. planulata.* See also Nummulites, further on.

40. Licophris. Dict. xxvi. p. 270. See Lycophris.

41. Linthuris Cassis, *F.* & *M.* sp. Dict. xxvi. p. 555, xxxii. p. 188; Atlas, Conch. pl. 19. f. 3; Bl. Malac. p. 384, pl. 10. f. 3. *Cristellaria Cassis,* F. & M. sp. [Type: *C. Calcar.*] See Ann. Nat. Hist. ser. 3. v. p. 115.

42. Lituola [et Lituolites] nautiloides, *Lamarck.* Dict. xxvii. p. 81, xxxii. p. 190; Atlas, Conch. pl. 20. f. 3; Bl. Malac. p. 381, pl. 11. f. 3. A common *Lituola,* recent and fossil. See Ann. Nat. Hist. ser. 3. v. p. 297.

43. Lycophris Faujasii, *Defr.* 1823. Dict. xxvii. p. 272 (*Orbitoides*?). From a deposit at Mirambeau, regarded by Defrance as equivalent to the Chalk of Maestricht. Prof. Reuss (in the Sitzungsbericht Akad. Wien, xliv. p. 313) has corrected our mistake in referring "Lycophris Faujasii" of the Maestricht Chalk to *Orbitolina* instead of to *Orbitoides* (Ann. Nat. Hist. vi. p. 36).

44. Lycophris lentille [lenticularis]. Atlas, Zooph. pl. 49. f. 3; Bl. Actinol. pl. 74. f. 3. This is an *Orbitoides,* and is not Montfort's *Lycophris lenticularis* (Fichtel & Moll's *Nautilus lenticularis,* var. β), which is a small granulate *Nummulina* (*N. Lucasana,* Defrance, MS., according to D'Archiac and Haime). See Nummulites, further on.

45. Mélonie. *Melonia* [erroneously for *Melonis*]. Dict. xxx. p. 17. *Melonis Etruscus,* De M., is the same as *Nonionina pompiloides,* F. & M. sp. *Polystomella Etrusca,* Bl. Malacol. p. 389.

46. Mélonie. Dict. xxx. p. 18. Defrance expresses the difficulty he finds in matching this with any of Lamarck's "Mélonies" (An. s. Vert. vii. p. 615), or with the one figured in Encycl. pl. 467. f. 1 *a, f, g* & *h.*

47. Melonia sphærica, *Lam.* Dict. xxxii. p. 176; Atlas, Conch. pl. 15. f. 2; Bl. Malac. p. 369, pl. 7. f. 2.

48. Melonia sphæroidea, *Lam.* Dict. xxxii. p. 176; Atlas, Conch. pl. 15. f. 3; Bl. Malac. p. 370, pl. 7. f. 3. This and the preceding are the varieties of *Alveolina Melo* originally figured by Fichtel and Moll. See Ann. Nat. Hist. ser. 3. v. p. 181, & viii. p. 163.

49. Miliola birostris, *Lam.* Dict. xxxi. p. 69. (Quinqueloculina.)

50. Miliola Cor-anguinum, *Lam.* Dict. xxxi. p. 68; Bl. Malac. p. 369, pl. 4. f. 3. A swollen *M. trigonula.*

51. Miliola obscura, *Defr.* 1824. Dict. xxxi. p. 69. A flat discoidal shell with a rough surface; probably a *Spiroloculina.* Fossil; Italy.

52. Miliola opposita, *Lam.* Dict. xxxi. p. 69. (Quinqueloculina.)

53. Miliola planulata, *Lam.* Dict. xxxi. p. 68. (Spiroloculina.)

54. Miliola ringens, *Lam.* Dict. xxxi. p. 68. (Biloculina.)

55. Miliola Saxorum, *Lam.* Dict. xxxi. p. 69, xxxii. p. 176; Atlas, Conch. pl. 15. f. 1; Bl. Malac. p. 369, pl. 7. f. 1. (Quinqueloculina.)

56. Miliola trigonula, *Lam.* Dict. xxxi. p. 68, xxxii. p. 176; Bl. Malac. p. 369. (Triloculina.)

For notes on the foregoing varieties of *Miliola Seminulum,* Linn. sp., see Ann. Nat. Hist. ser 3. v. p. 469 &c. See also Carpenter's 'Introduction,' pp. 74 *et seq.*

57. Miliolite; Miliolites. Dict. xxxi. p. 69. De Blainville expresses a doubt as to what Montfort's *Miliolites sabulosus* (which is an *Alveolina*) may be.

58. Miliolites Cor-serpentis, *De Bl.* Dict. xxxi. p. 69; Atlas, Conch. pl. 11. f. 3; Bl. Malacol. p. 369, pl. 4. f. 3. *Miliola Cor-anguinum,* Lam. A swollen *M. trigonula.*

59. Nodosaria Bacillum (Nodosaire Baguette), *Defr.* 1825. Dict. xxxv. p. 127, xxxvi. p. 487; Atlas, Conch. pl. 13. f. 4; Bl. Malac. pl. 5. f. 4. Fossil, from Italy. This is *Nodosaria Raphanistrum,* Linn. sp., a large variety of *Nodosaria Raphanus,* Linn. sp., which is the type of the very various Nodosarian and Cristellarian forms grouped in the great genus *Nodosarina.* Ann. Nat. Hist. ser. 3. iii. pp. 477, 478, and Carpenter's 'Introduction,' p. 159 &c.

60. Nodosaria dentalina, *Lam.* Dict. xxxv. pp. 125, 126. *N. Raphanus,* Linn. sp., var. *dentalina*; *Dentalina communis,* D'Orb. See Ann. Nat. Hist. ser. 3. vi. p. 39.

61. Nodosaria fragilis, *Defr.* 1825. Vélins du Mus. no. 48. f. 13; Dict. xxxv. p. 126. From the Maestricht Chalk of St. Peter's Hill. Occurring in fragments; long, pointed, slightly curved towards one end, with small gibbose chambers, some of them slightly sulcated. A delicate form of *N. obliqua,* Linn., and equivalent to Lamarck's *N. acicula,* which is a Dentaline variety of *N. Raphanus.*

62. Nodosaria Radicula, *Linn.* sp. Dict. xxxv. pp. 125, 126. *N. Raphanus,* var. *Radicula.* See Ann. Nat. Hist. ser. 3. iii. p. 479. Defrance obtained specimens from the Maestricht Chalk.

63. Nodosaria Siphunculus, *Linn.* sp. Dict. xxxv. pp. 125, 126.

A *Serpula*. See Ann. Nat. Hist. ser. 3. iii. p. 480. See also Orthocera and Orthoceras, further on.

64. Nubecularia lucifuga, *Defr.* 1825. Dict. xxv. p. 210; Atlas, Zooph. pl. 44. f. 3; Bl. Actinol. pl. 66. f. 3, 3 *a*–3 *d*. From the Calcaire grossier and the Falunière of Hauteville, Dép. de la Manche.

Blainville and Defrance here grouped the curious Miliolitic genus *Nubecularia* with the Zoophytes, giving some characteristic figures of it. Soldani has depicted numerous individuals in his great work 'Testaceographia,' placing them with the *Serpulæ*. We have found *Nubeculariæ*, associated with other Foraminifera, in very many recent sea-sands from shallowish water, and have been enabled to recognize their relations with the Miliolite group*. These are very protean shells: in deep water they are neither common nor large, but in the Algal belt they attain the size of hemp-seeds and even of split peas; and, growing attached to sea-weeds, shells, and other bodies, they become scale-like, or resemble lichens; or, winding about stalks and fronds, they form ring-like incrustations, shooting off into irregular processes and forming grotesque cervicorn figures (*N. lucifuga*). Similar forms occur in abundance in some of the French tertiaries. From the Clam-shells of the East Indian seas, and from the *Strombus gigas* of the West Indies, we get minute rectilinear individuals of *Nubecularia*, with a spiral commencement (*N. Tibia*). An allied variety, without a spiral beginning, is shown by D'Orbigny's *Webbina rugosa* (For. Canar. pl. 1. f. 16–18; and For. Vien. p. 74, pl. 21. f. 11, 12). In several clays of the Oolitic formations we have met with these elongate varieties attached to *Gryphææ*, &c.

All these Nubecularian forms have an opake shell, frequently arenaceous, and are composed of minute, tent-like, plano-convex chambers, the base often being more or less imperfect; the aperture is produced, oval, and often lipped, and becomes enveloped in the base of the new chamber, as in the true *Miliolæ*.

The foregoing varieties of *Nubecularia* (*N. lucifuga, N. Tibia,* and *N. rugosa*), however dissimilar among themselves, are all referable to the same specific type, which is sufficiently well represented by *N. lucifuga*, Defr., above referred to.

65. Nummulites complanata, Lam. Dict. xxv. p. 224. *Camerina nummularia*, Bruguière. Defrance notices one specimen having a width of 3 inches and a thickness of 3 lines; giving the following localities:—Egypt, Soissons, Languedoc, Transylvania, Mont Aubrey en Suisse, Vicentin, et Véronnais; and he remarks that "It is doubtful whether one and the same

* See Quart. Journ. Geol. Soc. xvi. p. 455, pl. 20. f. 48–56; and Carpenter's 'Introduction,' p. 69, pl. 5. f. 1–15.

species be spread over so great an extent of country; but no difference can be established except on the size and thickness; and so it is difficult to fix it in this respect." See also Ann. Nat. Hist. ser. 3. viii. p. 234.

66. Nummulites concava, *Defr.* 1825. Dict. xxxv. p. 325. "White, like ivory." Brought from the Crimea by Dr. E. D. Clarke ("par le célèbre voyageur Klark"). "It has a little round central cavity in the interior, is complanate;" "probably those from Cairo are the same." Hence probably it is a variety of *N. complanata*. Ann. Nat. Hist. *l. c.* p. 234.

67. Nummulites globularia, *Lam.* Dict. xxxv. p. 224. A globular variety of *N. lævigata*, as Defrance judiciously suggested.

68. Nummulites lævigata, *Bruguière.* Dict. xxxii. p. 179, xxxv. p. 224; Bl. Malac. p. 372. *Nummulina lævigata*: a subtype, characterized by inosculation of the septa of the alar lobes. See Ann. Nat. Hist. ser. 3. v. p. 290, & viii. p. 232.

Defrance remarks,—"Il est extrêmement probable que c'est la même espèce, modifiée par les localités, que l'on trouve en Suisse, dans le Véronnais, en Dalmatie, sur le mont Pilate près de Lucerne, à Stubbington dans le Hampshire, et dans d'autres endroits."

69. Nummulites(?) Lenticula, *Defr.* 1825. Dict. xxxv. p. 226. Sienna, Pisa, Vicentin, Oise, La Somme, Belgium, &c. This is, according to D'Archiac and Haime, an *Amphistegina* (Monogr. p. 161); and, judging from specimens brought from Pisa, we are of the same opinion.

70. Nummulites lenticularis, *De Bl.* Dict.; Atlas, Conch. pl. 11. f. 2; Bl. Malac. pl. 4. f. 2. This is in the index to the Atlas, not in the text. It is *Nummulina lævigata*, Bruguière.

71. Nummulites Lenticulus, *De Bl.* 1824. Dict. xxxii. p. 179; Malac. p. 373. *Lycophris lenticularis*, De M.; Fichtel & Moll's *Nautilus lenticularis*, var. *β*. A small granulose *Nummulina* (*N. Lucasana*, Defr. var. *a*, D'Archiac and Haime). De Blainville says, "Of a species of this section (*Lycophris*, De M.) Defrance makes a genus of 'Polypiers.'" Apparently they mistook a rough *Orbitoides* for the little granular Nummulite figured and described by Fichtel and Moll, and subsequently by De Montfort. See Ann. Nat. Hist. ser. 3. v. pp. 108, 110, vi. p. 342, and viii. p. 233.

72. Nummulites Moneta, *Defr.* 1825. Dict. xxxv. p. 226. One inch wide. Ronca; Dalmatia; lowest beds of the Isles of Veglia, Pago, and Arbe; Croatia; Alicante. According to D'Archiac and Haime, this is the *N. Spira* of Roissy, "Discolithe no. 6" of Fortis. An Assiline form of *Nummulina*.

73. Nummulites Ramondi, *Defr.* 1825. Dict. xxxv. p. 226. Mont Perdu; Montagne de Lex-d'Argentin; Valley of Auzeindre

audessus de Bex; Placentin?; Bayonne? A small *Nummulina* adopted by D'Archiac as a species (Monogr. p. 128, pl. 7. f. 13–17).

74. Nummulites Rotula, *Defr.* 1825. Dict. xxxv. p. 224. Morlaie. A variety of *N. lævigata,* in company with which it occurs. See also D'Archiac and Haime's Monogr. p. 105.

75. Nummulites scabra, *Lam.* Dict. xxxv. p. 224. The granulose variety of *N. lævigata.* Ann. Nat. Hist. ser. 3. v. p. 296, & viii. p. 235.

76. Nummulites spissa, *Defr.* 1825. Dict. xxxv. p. 225. Locality unknown. According to D'Archiac and Haime (Monogr. p. 115), this is a young *Nummulina perforata,* Montf. sp.

See also *Helicites* and *Lenticulites,* for other Nummulites.

77. There is another *Nummulina* named specifically by Defrance, in MS., namely *N. Lucasana,* adopted by D'Archiac; see D'Archiac's 'Progrès de la Géologie,' 1850, iii. p. 238, and D'Archiac and Haime's 'Monograph,' p. 124. It is included with a granulate *N. Spira* under the name *N. verrucosa* by De Roissy. Ann. Nat. Hist. ser. 3. viii. p. 238.

78. Another Nummulite, named by Defrance *N. nummiformis* in Alex. Brongniart's 'Vicentin' (1823), p. 51, was not reproduced in the Dict. Sc. Nat. It is related to *N. complanata,* and is named *N. Brongniarti* by D'Archiac and Haime, 'Monograph,' p. 110, reasons for not using the name given by Defrance being advanced at p. 111.

79. Orbiculina adunca, *F.* & *M.* sp. Dict. xxxii. p. 180; Bl. Malac. p. 375.

80. Orbiculina angulata, *F.* & *M.* sp. Dict. xxxii. p. 180; Bl. Malac. p. 374.

81. Orbiculina numismalis, *Lam.* (*Nautilus Orbiculus,* F. & M.) Dict. xxxii. p. 180, xxxvi. p. 291; Atlas, Conch. pl. 15. f. 4; Bl. Malac. p. 373, pl. 7. f. 4 (*O. nummata*). This and the two preceding are *Orbiculina adunca,* F. & M. sp. and varieties. See Ann. Nat. Hist. ser. 3. v. pp. 180 &c., and Carpenter's 'Introduction,' p. 93 &c.

82. Orbiculites lenticulata, *Lam.* sp. Atlas, Zooph. pl. 51. f. 5; Blainv. Actinol. pl. 76. f. 5. See Orbitolites.

83. Orbitolites complanata, *Lam.* Dict. xxxvi. p. 294; Atlas, Zooph. pl. 47. f. 2 (Bl. Actinol. pl. 72. f. 2). Paris; Hauteville. Defrance notices that this species has a very close relationship with that found living in the seas of New Holland. Ann. Nat. Hist. ser. 3. v. p. 291.

84. Orbitolites concava, *Lam.* Dict. xxxvi. p. 295. This is *Patellina concava,* Lam. sp. In 1860 we referred this and other forms to D'Orbigny's genus *Orbitolina* (Ann. Nat. Hist. ser. 3. vi. p. 29 &c.); but, in consequence of later researches by Dr.

Carpenter, our list of the *Orbitolinæ* at p. 38, *ibid.*, is considerably modified: thus—

Orbitolina simplex, O. semiannularis, O. corrugata, and *O. annularis* now stand under *Patellina corrugata*; *Orbitolina concava* and *O. lenticularis* under *Patellina concava*; *Patellina Cooki* (fossil at Scinde) is an added species (Carter); *Orbitolina vesicularis, O. congesta, O. lævis, O. sphærulata,* and *O. sphærulo-lineata* are grouped under *Tinoporus vesicularis* ("Tinoporus" being preferred by Dr. Carpenter to "Orbitolina" as a generic term).

85. Orbitolites lenticulata, *Lam.* Dict. xxxvi. p. 295; Atlas, Zooph. pl. 51. f. 5. *Madreporites lenticularis,* Blumenbach. This is *Patellina concava,* Lam. sp., var. *lenticularis.* See Ann. Nat. Hist. ser. 3. vi. p. 29 &c., and especially Carpenter's 'Introduction,' p. 231.

86. Orbitolites macropora, *Lam.* Dict. xxxvi. p. 295. A large-celled variety of *O. complanata,* Lam. See Ann. Nat. Hist. ser. 3. vi. p. 38.

87. Orbitolites Pileolus, *Lam.* Dict. xxxvi. p. 295. A concavo-convex variety of *Patellina concava,* Lam. sp. Ann. Nat. Hist. ser. 3. vi. p. 39.

88. Orbulites planulatus, *Bl.* Dict. xxxvi. p. 295; Atlas, Zooph. pl. 47. f. 2; Bl. Actinol. pl. 72. f. 2. *Orbitolites complanata,* Lam. See *Orbitolites.*

89. Oreas auricularis, *Bl.* Dict. xxxii. p. 188, xxxvi. p. 155; Atlas, Conch. pl. 19. f. 4; Bl. Malac. p. 383, pl. 10. f. 4. This is the subglobose form of *Cristellaria Calcar* known as *C. acutauricularis,* F. & M. sp. See Ann. Nat. Hist. ser. 3. v. p. 114.

90. Orthocera Acicula, *Lam.* Dict. xxxvi. p. 487. *Nodosaria Raphanus,* Linn. sp., var. *Acicula* (probably the same as *N. obliqua,* Linn. sp.). See Ann. Nat. Hist. ser. 3. vi. p. 39.

91. Orthocera Fascia, *Linn.* sp. Dict. xxxvi. p. 486. *Nodosaria.* Ann. Nat. Hist. ser. 3. iii. p. 478.

92. Orthocera Legumen, *Linn.* sp. Dict. xxxvi. p. 487. *Nodosaria* (*Vaginulina*) *Legumen,* Linn. sp. See Ann. Nat. Hist. *l. c.* p. 479.

93. Orthocera obliqua, *Linn.* sp. Dict. xxxvi. p. 487. *Nodosaria. Ibid.* p. 477.

94. Orthocera Raphanistrum, *Linn.* sp. Dict. xxxvi. p. 486. *Nodosaria. Ibid.* p. 478.

95. Orthocera Raphanus, *Linn.* sp. Dict. xxxvi. p. 486. *Nodosaria. Ibid.* p. 477. The typical *N. Raphanus* is termed *N. Rapa* by D'Orbigny (Ann. Sc. Nat. vii. p. 253, no. 27), probably from the intermediation and retranslation of the French word "*rave.*" For its Marginuline form D'Orbigny used the term *N. Raphanus*: this often occurs in the Adriatic and else-

where (D'Orb. Ann. Sc. Nat. vii. p. 258; Modèles, No. 6), and is well figured by Soldani in his Testac. i. pt. 2. pl. 94, and by Ehrenberg in the Abhandl. k. Akad. Berlin, 1838 (1839), pl. 1. f. II. A, B, *a*, *b*, *c*. See also 'Nodosaria,' above.

96. Orthoceras Radicula, *Linn.* Dict. xxxii. p. 192; Bl. Malac. p. 179. The simple form of *Nodosarina* known as *Nodosaria Radicula*, Linn. sp. Ann. Nat. Hist. ser. 3. iii. p. 479.

97. Orthoceras Raphanus, *Linn.* sp. Dict. xxxii. p. 192; Bl. Malac. p. 379. This is the typical *Nodosaria Raphanus*, Linn. sp. *Ibid.* p. 478.

98. Orthoceras Scorpiurus, *De M.* sp. Dict. xxxii. p. 192. This is the *Lituola Scorpiurus*, De Montf. [Type: *Lituola nautiloidea*, Lam.] See Ann. Nat. Hist. ser. 3. vi. p. 346.

99. Oryzaria Boscii, *Defr.* 1820. Dict. xvi. p. 106; Atlas, Zooph. pl. 48. f. 4; Blainv. Actinol. pl. 73. f. 4. "Alvéolite grain de fétuque." *Alveolina Melo*, F. & M. sp., var. *sabulosa* (*Miliolites sabulosus*, Montfort). See Ann. Nat. Hist. ser. 3. viii. p. 162.

100. Ovulites elongata, *Lam.* Dict. xxxvii. p. 134; Atlas, Zooph. pl. 48. f. 3; Bl. Actinol. pl. 73. f. 3. This is the var. *elongata* of *O. Margaritula*, Lam. See Ann. Nat. Hist. ser. 3. v. p. 292; and Carpenter's 'Introduction,' p. 179, pl. 12. f. 9, 10.

101. Ovulites globulosa, *Defr.* 1825. Dict. xxxvii. p. 134. (Vélins du Mus. no. 48. f. 9.) This is described as being smaller than a mustard-seed, almost spherical, the apertures at each end scarcely discernible. Fossil at Grignon and Villiers (Seine et Oise), and Courtagon near Rheims. Defrance also speaks of a similar little globular fossil, of the same size, but solid and more spherical, found in the same bed at Villiers, and also at Rimini.

The first of these is most probably a globular *Ovulites*, such as occur in the Grignon deposits; and the latter may be spherical atoms of carbonate of lime, not unusual in some marine deposits.

102. Ovulites Margaritula, *Lam.* Dict. xxxvii. p. 134; Atlas, Zooph. pl. 48. f. 2, & pl. 50. f. 6; Bl. Actinol. pl. 73. f. 2, pl. 75. f. 6. Ann. Nat. Hist. *l. c.*

103. Peneroplis Auris, *Defr.* sp. Dict. xxxii. p. 178; Atlas, Conch. pl. 14. f. 5; Blainv. Malac. pl. 6. f. 5. This, wrongly referred by De Blainville to *Peneroplis*, is the *Planularia Auris* of Defrance, which see.

104. Peneroplis dilatata, *Lam.* sp. Dict. xxxii. p. 178; Bl. Malac. p. 372. This is a variety of *Nautilus planatus*, F. & M.; misnamed by Lamarck "Cristellaria," and rightly referred to *Peneroplis* by De Blainville.

105. Placentula asterizans, *F. & M.* sp. Dict. xxxii. p. 180;

xli. p. 193. This is the *Polystomella* (*Nonionina*) *asterizans*, F. & M. sp. See Ann. Nat. Hist. ser. 3. v. p. 101.

106. Placentula pulvinata, *Lam.* Dict. xxxii. p. 180, xli. p. 193; Atlas, Conch. pl. 15. f. 5; Bl. Malac. pl. 7. f. 5. This is the *Pulvinulina repanda*, F. & M. sp.

107. Planularia Auris, *Defr.* 1824. Dict. xxxii. p. 178, xli. p. 244; Atlas, Conch. pl. 14. f. 5; Bl. Malac. p. 371, pl. 6. f. 5. This is a very thin outspread variety of *Cristellaria Cymba*, D'Orb. (*Planularia Cymba*, Ann. des Sc. Nat. vii. p. 260, no. 4, pl. 10. f. 9; Modèles, no. 27; Soldani, Testac. i. pt. 1, pl. 58. f. *c, c.*) It is the same as Soldani's *Orthoceras Auris* (Testac. i. pt. 2, pl. 104. f. A).

Defrance's term *Planularia* is applicable to a group of elegant forms connecting the Nautiloid *Cristellariæ* with their Marginuline varieties and with *Vaginulinæ*, and thus constituting a noticeable member of the great genus *Nodosarina*.

108. Polystomella ambigua, *F. & M.* sp. Dict. xxxii. p. 183; Bl. Malac. p. 388. A common variety of *P. crispa*. See Ann. Nat. Hist. ser. 3. v. pp. 103, 104.

109. Polystomella Etrusca, *De M.* sp. Dict. xxxii. p. 183; Bl. Malac. p. 389. This is *P.* (*Nonionina*) *pompilioides*, F. & M. sp. See Ann. Nat. Hist. ser. 3. v. p. 102.

110. Polystomella macella, *F.* & *M.* sp. Dict. xxxii. p. 183; Bl. Malac. p. 388. This is Fichtel and Moll's var. β of *P. macella*, a flat form of *P. crispa*. *Ibid.* p. 104.

111. Polystomella margaritacea, *De M.* sp. Dict. xxxii. p. 183; Bl. Malac. p. 389. This is *P.* (*Nonionina*) *Faba*, F. & M. sp. See Ann. Nat. Hist. ser. 3. v. p. 102, vi. p. 339.

112. Polystomella planulata, *Lam.* Dict. xxxii. p. 183; Atlas, Conch. pl. 15. f. 8; Bl. Malac. p. 388, pl. 7. f. 8. A flat *P. crispa*. The same as *P. macella*, F. & M. sp.

113. Polystomella Vortex, *F.* & *M.* sp. Dict. xxxii. p. 183; Bl. Malac. p. 389. This is *Cristellaria Vortex*, F. & M. sp. See Ann. Nat. Hist. ser. 3. v. p. 113.

114. Polytrema miniacea, *Esper*, sp. Polytrème rouge, *Bl.* Atlas, Zooph. pl. 44. f. 4, 4 *a*; Actinol. p. 410, pl. 69. f. 4, 4 *a*. This was first recognized as *Millepora miniacea*, Esper, Zooph. i. pl. 17; Gmel. Syst. Nat. 3784; afterwards as *M. rubra*, Lamarck, Hist. An. s. Vert. ii. p. 202, no. 8; *Polytrema corallina*, Risso, Eur. Mérid. v. p. 340, no. 91; *Polytrema miniacea*, Blainville, Actinol. p. 410, pl. 69. f. 4, 4 *a*. It is a fixed, reddish, often branching Rhizopod, related to *Orbitolina* (*Tinoporus*), *Patellina*, and other *Rotalinæ*. See Carpenter's 'Introduction,' p. 235, pl. 13. f. 18–20.

115. Polytrypa elongata *vel* Polytrypes elongatus, *Defr.* 1826. Dict. xlii. p. 453; Atlas, Zooph. pl. 48. f. 1 (Bl. Actinol. pl. 73. f. 1).

Polytrypa was referred by Defrance to the "Polypiers à réseau;" and his specimens were obtained from the Eocene Tertiaries of France. He acutely observed that the individuals "vary according to the localities." From Grignon he had it 5 lines long and about 1 line thick; from Orglandes (Manche) half as thick again, and shorter; from Villiers, near Grignon, scarcely a line long; and from Mortefontaine (Oise), from the Grès marin supérieur, 4 lines long, not half a line in diameter. He justly remarks that "these are probably varieties of one species"—a conclusion at which we have arrived by a careful examination of numerous specimens, as explained in the Ann. Nat. Hist. ser. 3. v. pp. 473 &c., where *Polytrypa, Larvaria,* and *Dactylopora* are shown to be one. See also Carpenter's 'Introduction,' p. 127 &c.

116. Pyrgo lævis, *Defr.* 1824. Dict. xxxii. p. 273; Atlas, Zool. pl. 88. f. 2; Bl. Malac. p. 482, pl. 62 *bis,* f. 2. Referred by De Blainville to the Pteropods. This is the common *Miliola* (*Biloculina*) *ringens,* Lam., var. *bulloides,* D'Orb., and was regarded by Defrance as belonging to the same group (the *Sphærulacea* of De Blainville).

117. Renulina complanata, *Defr.* sp. Dict. xxxii. p. 178. This is Blainville's name for *Frondicularia complanata,* Defrance (which see).

118. Renulina opercularia [opercularis], *Lam.* Dict. xxxii. p. 178; Bl. Malac. p. 371. See Ann. Nat. Hist. ser. 3. v. p. 476 for an account of this curious and rare variety of *Vertebralina;* also Carpenter's 'Introduction,' p. 74, pl. 5. f. 18. Blainville's term "Renulina" is not required.

119. Rotalites Cidarollus, *Bl.* (*Cidarollus plicatus,* De M.). Dict. xxxii. p. 187. A common variety of *Pulvinulina repanda.* It is *R. pulchella,* D'Orb., Modèles, no. 71. Ann. Nat. Hist. ser. 3. vi. p. 340.

120. Rotalites Cortalus, *Bl.* (*Cortalus Pagodus,* De M.). Dict. xxxii. p. 187. Quite indeterminable. See Ann. Nat. Hist. ser. 3. vi. p. 340.

121. Rotalites lenticulina, *Lam.* Dict. xlvi. p. 302. Probably a variety of *Discorbina Turbo.* See Ann. Nat. Hist. ser. 3. v. p. 294.

122. Rotalites depressa, *Lam.* Dict. xlvi. p. 303. Probably one of the Truncatuline varieties of *Planorbulina farcta.*

123. Rotalites discorbula, *Lam.* Dict. xlvi. p. 303. This is *Rotalia Beccarii,* Linn. sp.

124. Rotalites Storillus, *Bl.* (*Storillus radiatus,* De M.). Dict. xxxii. p. 187. An indeterminate Rotaline. See Ann. Nat. Hist. ser. 3. vi. p. 341.

125. Rotalites (et Rotulites) trochidiformis, *Lam.* Dict. xxxii.

p. 187, xlvi. p. 303; Atlas, Conch. pl. 14. f. 3, & pl. 19. f. 1; Bl. Malac. p. 391, pl. 6. f. 3, & pl. 10. f. 1. Defrance remarks that both dextral and sinistral shells occur.

This is a well-developed variety of *Discorbina Turbo*, D'Orb. See Ann. Nat. Hist. ser. 3. v. p. 294; and Carpenter's 'Introduction,' p. 204.

126. Saracenaria italica, *Defr.* 1824. Dict. xxxii. p. 177, xlvii. p. 344; Atlas, Conch. pl. 13. f. 6; Bl. Malac. p. 370, pl. 5. f. 6. Fossil; from Italy: a trihedral *Cristellaria.* Defrance likens it to "un petit grain de sarrasin:" $\frac{1}{2}$ line to $1\frac{1}{2}$ line in diameter.

This is found, both recent and fossil, where *Cristellariæ* are abundant. D'Orbigny had this from Rimini in the Adriatic, and recognized it as a Cristellarian form, making it a subgenus of *Cristellaria*, and illustrating it by his Models, nos. 19 & 85 (Ann. Sc. Nat. vii. p. 293).

127. Siderolina calcytrapoides et Siderolites calcitrapoides, *Lam.* sp. Dict. xxxii. p. 180, xlix. p. 98; Atlas, Conch. pl. 13. f. 7; Bl. Malac. pl. 5. f. 7. From Maestricht. *Calcarina Spengleri*, Gmel. sp. See Ann. Nat. Hist. ser. 3. iii. p. 480, & v. p. 291; and Carpenter's 'Introduction,' pp. 216–223.

128. Siderolites Spengleri, *Gmel.* sp. Dict. xxxii. p. 179; Bl. Malac. p. 373. This is *Calcarina Spengleri*, Gmel. sp.

129. Spirolina (et Spirolinites) cylindracea, *Lam.** Dict. vol. l. p. 298; Atlas, Conch. pl. 13. f. 1; Bl. Malac. pl. 5. fig. 1; and

130. Spirolina (et Spirolinites) depressa, *Lam.* Dict. vol. l. p. 298; Atlas, Conch. pl. 13. f. 2; Bl. Malac. pl. 5. f. 2. Defrance alludes also to a recent species, apparently identical with *Sp. cylindracea*, and living in the Mediterranean. He remarks that, in the 'Tabl. Méth. Céph.' (Ann. Sc. Nat. vii. p. 287), D'Orbigny notices also *Spirolina striata, Sp. lævigata*, and *Sp. Pedum*, found fossil near Paris, and groups these with *Lituola* (*Lituolites*) *nautiloides*; but he thinks the difference in the aperture does not depend on age, as D'Orbigny thinks. In this indication of D'Orbigny's mistake, Defrance is correct; the *Lituolæ* are very distinct from the so-called *Spirolinæ*, which are narrow forms of *Peneroplis planatus*, F. & M. sp. See Ann. Nat. Hist. ser. 3. v. pp. 297 & 466 &c.

131. Spiroloculina, *D'Orb.* Dict. vol. l. p. 299. Under this head Defrance quotes nine fossil species from D'Orbigny's Tabl. Méth. Céph. (Ann. Sc. Nat. vii. p. 298).

132. Spirula cylindracea, *Lam.* sp. Dict. xxxii. p. 190; Bl.

* Lamarck figured two distinct forms under this name, namely *Peneroplis cylindracea*, and a Clavuline variety of *Valvulina triangularis* (*Valvulina Clavulus*). See Ann. Nat. Hist. ser. 3. v. p. 467 &c.

Malac. p. 382, pl. 5. f. 1. This is De Blainville's name for Lamarck's *Spirolina cylindracea* (which see).

133. Textularia Sagittula, *Defr.* 1824. Dict. xxxii. p. 177, liii. p. 344; Atlas, Conch. pl. 13. f. 5; Bl. Malac. p. 370, pl. 5. f. 5. "This is Soldani's *Polymorphum Sagittula,* Testac. vol. i. part 2. p. 120, pl. 133, vas 260. f. o. It occurs fossil near Sienna and Castel d'Arquato, and lives in the Mediterranean. We have only this one species; but, in his Tabl. Méth. Céphal., D'Orbigny enumerates twenty-six other species, of which most are fossil."

This is a common *Textularia*—indeed, the most common variety. It is not the type of the genus, however, which is best typified by *T. agglutinans,* D'Orb., a more inflated form, and generally of a larger size. *T. gibbosa,* D'Orb., attains still larger proportions, being a more exaggerated variety.

The figure given by Blainville and Defrance (Atlas, Zooph. pl. 13. fig. 5) differs somewhat from that in Soldani's book. The specimen was of smaller size, flatter, the earlier chambers smaller, and the newest chambers more contracted—the shell well representing an unbarbed arrow-head in miniature. Soldani's figure seems to indicate the presence of a third series of chambers on one of the sides; but we think that this feature was probably only a low ridge arising from an irregular form of the chambers on the unattached surface of the shell, and not really due to an intercalated series of chambers. The specimen figured by Soldani was of rather large size; and we have met with several in the Mediterranean of equal magnitude: they take on the more regularly sagittate form in their smaller condition; when largely developed, they often approximate to *T. agglutinans,* D'Orb.

T. Sagittula is very common, ranging from shallow water to a depth of 150 fathoms. The subgroup typified by Defrance's and Soldani's figures, above referred to, comprises a large and variable series of forms, recent and fossil, which have been abundantly supplied with names. *T. Sagittula* and *T. agglutinans* are the commonest of all the *Textulariæ*; they are world-wide, and go far back in time. Of the *Textulariæ* on our own coasts they are the most abundant. In Prof. Williamson's Monograph, figs. 158 & 159 afford, we think, a good example of the small *T. Sagittula* (although that author refers it to *T. cuneiformis,* D'Orb., which appears to us to be a distinct variety). *T. Sagittula* and its larger allies become sandy in their adult state; smaller varieties of *T. agglutinans* (the type), such as *T. pygmæa,* D'Orb. (*T. aciculata,* D'Orb.), remain hyaline and poriferous. See also Ann. Nat. Hist. ser. 3. xi. p. 91 &c., and Carpenter's 'Introduction,' p. 189 &c.

D'Orbigny (Ann. Sc. Nat. vii. p. 264) refers to *Textularia Capreolus,* Defrance; but it does not appear in the Dict. Sc. Nat.

134. Vorticialis craticulata, *F.* & *M.* sp. Dict. xxxii. p. 181; Atlas, Conch. pl. 15. f. 6; Bl. Malac. p. 375, pl. 7. f. 6. A large variety of *Polystomella crispa,* Linn. sp. See Ann. Nat. Hist. ser. 3. v. p. 105, and Carpenter's 'Introduction,' p. 279, pl. 16.

135. Vorticialis crispa, *Linn.* sp. Dict. xxxii. p. 181; Bl. Malac. p. 375. This is the *Polystomella crispa,* Linn. sp. Lamarck's generic name "Vorticialis" is not required.

136. Vorticialis marginata, *Lam.* sp. Dict. xxxii. p. 181; Bl. Malac. p. 375. This is *Polystomella crispa,* Linn. sp., var. *strigilata,* subvar. *β,* F. & M. Ann. Nat. Hist. ser. 3. v. p. 105.

137. Vorticialis strigilata, *F.* & *M.* sp. Dict. xxxii. p. 181; Bl. Malac. p. 375. *Polystomella crispa,* var. *strigilata.* This, like the foregoing, is a somewhat flattened variety.

XXII.—*A List of the Formosan Reptiles; with Notes on a few of the Species, and some Remarks on a Fish* (Orthagoriscus, sp.). By R. Swinhoe, F.Z.S., F.G.S. &c., H.M. Vice-Consul at Formosa.

I procured at Formosa the following fifteen species of Reptilia, which have since been deposited in the British Museum. Dr. Günther has determined their species, and is describing the novelties in the British Museum Catalogue now publishing. To that gentleman's kindness I am indebted for the names.

Cistudina (Tortoises).

1. *Emys sinensis,* Gray.

Abundant about the pools and inland waters of South-west Formosa, near Taiwanfoo. They were brought to me by the natives there in large numbers. I forwarded five live specimens to England as a present to the Gardens of the Zoological Society. Three of them arrived safe, and are now exhibited in the menagerie at the Regent's Park.

2. *Trionyx sinensis,* Coregm.

Very abundant in the rivers near Amoy, but rather rare in South-west Formosa, where I procured but a very few examples. It has a long projectile neck, and very sharp teeth, with which it can inflict a severe bite. When once it seizes an object, it is with the utmost difficulty that it can be prevailed upon to let go. The Chinese boil it into soup, and esteem it a great delicacy for the table; hence it commands rather a high price.

Genus Cistoclemmys, J. E. Gray.

"Thorax convex, solid. Sternum nearly flat, rounded before and behind; the front lobe large, partly enclosed in the symphysis. The fore feet subclavate; the toes very short, nearly enclosed, not webbed; the claws short, blunt. The hind feet elephantine, subcircular; toes very short, enclosed. Soles with two series of large prominent shields; the hinder edge keeled, but scarcely produced. Tail shielded beneath. Asiatic.

"This genus, in the convex and solid structure of the thorax, is like *Cistudo*; but the foot is more like that of the land Tortoises; and the hind foot is subcylindrical, instead of elongate as in the American genus.

3. "*Cistoclemmys flavomarginata*, n. sp.

"*Cuora trifasciata*, var., Gray, Cat. Shield Reptiles in Brit. Mus. p. 42, specimen *c*.

"Dark brown; shields of the back deeply concentrically grooved; the sternum flat, black; the lower side of the margin of the thorax yellow; head olive, temple yellow, with a yellow streak on each side of the crown, becoming wider and triangular behind.

"The surface of the shell is often more or less eroded; the one which we first received from Mr. Reeves was so on the whole upper surface. The form of the foot, as well as the height and thickness of the shell, at once separates this species from *Cuora trifasciata*, with which I formerly confounded it." (J. E. Gray, P.Z.S. 1863, p. 175.)

In the British Museum there is a specimen of this species brought home by Mr. Reeves from Canton. I should think that it was more than probable that the animal had been carried to that port in a junk, and is not indigenous to that locality; for in Formosa I found it extremely local. It did not occur in the South-west at all; but about Tamsuy, North-west Formosa, it was the prevailing species. I frequently observed it in ponds about the rice-fields, with its round back showing above the surface of the water and its head peering out. At times several might be seen together on the tops of stones in the water, basking motionless, with limbs extended. On being alarmed they would shuffle off the stones with all the energy in their power, and plumping into the water, sink immediately. If the observer kept quite still, after the lapse of a few seconds they would again reappear at the surface.

4. *Chelonia virgata,* Schneid.

The Green Turtle of Europeans in China is of frequent occurrence, often of a large size in the warm waters of the Gulf Stream on the east of Formosa. At Sawo it is taken in large numbers, dried, and cut up into thin strips for food. It is of rarer occurrence on the west coast, where it is oftenest found in spring. On the Chinese coast it is a great rarity. There the fishermen have great reverence for it, as it is regarded as the emblem of longevity. When accidentally entangled in the fishing-nets, it is carried to the nearest large town and exhibited for a short time. It is then usually purchased from its captors by some well-to-do native, who has a few "good words" carved on its back, in company with his own name and the date, and fills-in the inscription with vermilion. The animal is then decked with ribbons, and carried in a boat, with much ceremony, out to sea, where it is consigned with state into its native element. Some very large specimens were brought from Sawo to Tamsuy; they were kept in a boat filled with water during the day. In the evening we used to bring them out on to the deck of a vessel. One of them, for several consecutive evenings at 8 o'clock precisely, would commence scratching the deck with her fore flappers, and then set-to laying eggs, usually twelve in number. She would then turn round and commence pushing and scraping with her hind flappers—evidently the manœuvre she was in the habit of going through on the sandy beach, first scratching a hole for the reception of the eggs, then filling it up. I had one alive for some time in the yard of my house. It used to lie motionless in the rain-puddles, with only the tip of its head uncovered. When the thermometer fell below 50° it would sally out of the water, and not return till it grew warmer.

5. *Caretta squamata,* Bont. (Tortoise-shell Turtle).

One of this species was brought to me at Tamsuy about the 25th of January 1861. It was very lively, and much more active than the Green Turtle, walking about the floor with an awkward but somewhat rapid gait. In walking it inclined the inner edge of its fore flapper up, so as to bring the claw of the outer edge as a purchase on the ground. It was killed by a deep incision in the neck above the thorax. Thus wounded, it flapped about from 1.30 till 4 P.M., when it ceased to move; but at 11 P.M., when I dissected the animal, I found the heart still beating, and the muscles sensible to touch and conveying motion to the limbs, though other signs of life had ceased. The stomach contained bits of algæ in small quantity; but the small gut was choked with bits of black stone and shell mixed with algæ. The measurements, taken from the fresh animal, were as follows:—

Length of carapace	14 inches.
Breadth of carapace	12
Length of flapper	$7\frac{8}{10}$
Greatest breadth of flapper	$2\frac{1}{10}$
Length of head	$3\frac{3}{10}$
Length of head to edge of carapace	$5\frac{3}{10}$
Hind flapper from knee	5
Greatest breadth of hind flapper	$2\frac{1}{2}$

Sauria (Lizards).

6. *Gecko Swinhonis,* Günther, n. sp.

The specimens of small *Gecko* I brought home from Taiwanfoo Dr. Günther of the British Museum has described as new. I did not observe it in North-west Formosa; but in the South-west it was especially abundant, and I had numerous opportunities of making notes on its habits. I therefore make no apology for extracting the following long account from my journal of observations on this animal, together with the strange native legend regarding it.

On the plaster-washed side of my bedroom, close to the angle of the roof, every evening when the lamp was placed on the table below, four little musical lizards used to make their appearance, and watch patiently for insects attracted by the light. A *Sphinx* or a beetle buzzing into the room would put them into great excitement, and they would run with celerity from one part of the wall to the other after the deluded insect as it fluttered in vain, buffeting its head, up and down the wall. Two or three would run after the same insect; but as soon as one had succeeded in securing it, the rest would prudently draw aloof. In running over the perpendicular face of the wall they keep so close, and their movements are made so quickly with one leg in advance of the other, that they have the appearance at a distance of gliding rather than running. The tail is somewhat writhed as the body is jerked along, and much so when the animal is alarmed and doing its utmost to escape; but its progress even then is in short runs, stopping at intervals and raising the head to look about it. If a fly perch on the wall, it cautiously approaches to within a short distance, then suddenly darts forwards, and with its quickly protruded glutinous tongue fixes it. Apart from watching its curious manœuvres after its insect food, the attention of the most listless would be attracted by the singular series of loud notes these creatures utter at all hours of the day and night, more especially during cloudy and rainy weather. These notes resemble the syllables "chuck-chuck" several times repeated, and, from their more frequent occurrence during July and August, are, I think, the call-notes of the male to the female. During the greater part of the day the little creature lies quiescent in some cranny among the beams of the roof or in the wall of the house, where however it is ever watchful for the incautious fly that approaches its den, upon whom it darts forth with but little notice. But it is by no means confined to the habitations of men. Every old wall, and almost every tree, possesses a tenant or two of this species. It is excessively lively, and even when found quietly ensconced in a hole, generally manages to escape,—its glittering little eyes (black, with yellow-ochre iris) appearing to know no sleep; and an attempt to capture the runaway seldom results in more than the seizure of an animated tail, wrenched off with a jerk by the little fellow as it slips away, without loss of blood. The younger individuals are much darker than the larger and older animals, which are sometimes almost albinos. In ordinary fly-catching habits, as they stick to the sides of a lamp, there is much similarity between this Gecko and the little *Papehoo* or wall-lizard of China; but this is decidedly a larger and more active animal, and often engages in a struggle with insects of very large size. I once watched a Gecko seize a *Sphinx* moth; but the insect, after a serious struggle, succeeded in breaking loose from it, not, however, without having been too seriously injured to live. I was assured by a medical friend at Amoy that he saw in his verandah there a large spider (*Mygale* species) quietly sucking the body of a *Papehoo*. I suspect it would take a very large spider to pay the same respects to a Formosan Gecko.

I have found the eggs of this Gecko in holes in walls or among mortar rubbish. They usually lie several together, are round, and did not seem to me to offer any appearance other than those of ordinary lizards. The young, when first hatched, keep much to themselves under stones in dark cellars, where they live until they attain two-thirds the size of the adults. At this stage they begin to show out in conspicuous places, but always evince alarm at the approach of their older brethren; for what reason, I could not make out. A little fellow that lived behind some small boxes on my table, and used to sally out to catch the smaller insects attracted by the lamplight, would always scurry away as soon as he spied one of the larger tenants of the roof-top gliding down with hurried strides. It may have been puerile modesty, or perhaps he was aware that his precocity had induced him to affect a field to which he had no right in the presence of his seniors.

The Chinese colonists show a respect for these animals, and will not suffer them to be molested on the walls of their houses. They relate a legend as the cause of this veneration. Many years since, some rebels had taken possession of the Fungshan Hien (the southernmost district of the Chinese territory in Formosa), and were threatening the capital itself, when the emperor sent across from China a celebrated general to quell the insurgents. This valiant warrior had made several onslaughts on the enemy, which only resulted in defeat and the decimation of his army. He sat one evening desponding gloomily, when suddenly his attention was drawn to something chuckling over his head. He looked up and spied a Gecko, which, to his astonishment, spoke out, and asked him the cause of his despondency. The warrior, thinking that perhaps some good spirit was embodied in the little creature, unbosomed his grief to it. The lizard replied that by means of certain secretions in its body it could speedily poison the supplies of the enemy's troops, and thus reduce their strength to a shadow, and that the general could proceed and make short work of them. The brave warrior was delighted at the project, and promised, should the plot succeed, that he would recommend the lizard to the emperor for distinction. The lizard was as good as his word, and next morning large numbers of his tribe were observed making their way to the Fungshan Hien; and in a few days rumour reached the anxious general that the enemy were dying off by scores, and that their strength was fast reducing to a shadow. Whereupon he gathered his troops together, and soon succeeded in cutting to pieces the miserable remnant of the once invincible rebel band. The warrior returned elate from his victory. The lizard was at his usual spot on the wall, and chuckled louder than ever at the success of his plans, claiming for himself and four-footed companions the promised distinction. The general was true to his word, and memorialized the emperor on the subject, who graciously ordained that henceforth the tribe of Formosan Geckos should receive the rank of *generals*, and be respected by all classes of men. The Geckos, on hearing the good news announced, assembled and chuckled in concert; and since then, every house possesses its small family of miniature generals, who manœuvre about the walls and destroy the mosquitoes and other insect pests that plague the colonists, as successfully as their forefathers did the rebels; and when the thunder roars and the lightning flashes, they think of the valiant deeds of their ancestors, and, in the true spirit of generals, chuckle louder than usual at what reminds them of the din of battle.

7. *Mabouia chinensis,* Gray.

Found near Tamsuy. Ascends plants, and basks among their leaves in the sunshine.

8. *Iapalura Swinhonis,* Günther.

One of the comb-backed tree-lizards; procured also at Tamsuy.

OPHIDIA (Snakes).

9. *Coluber rufodorsatus,* Cant.

From Tamsuy.

10. *Simotes Swinhonis,* Günther, Brit. Mus. Cat. 1863.

From Tamsuy.

11. *Tropidonotus annularis,* Hallow.

From Tamsuy.

12. *Tropidonotus stolatus,* L.

From Tamsuy.

13. *Bungarus semifasciatus,* Kuhl.

A black-and-white banded snake, also common at Amoy in China. Frequently resorts to cellars and under houses, where it feeds on rats. Its bite is very deadly.

14. *Pelamis bicolor,* Schneid.

Common about the coral-reefs at Kelung, North Formosa. Is occasionally washed into the Tamsuy River.

15. *Halys Blomhoffi,* Boie.

From Tamsuy.

The few fish I brought home from South-west Formosa and Tamsuy Dr. Günther has not yet had time to determine. I therefore cannot now give a list of them. I will only add a few remarks on a species of that extraordinary genus *Orthagoriscus,* which is probably the same as that described from Japan in Von Siebold's 'Fauna Japonica.'

Orthagoriscus, sp. (Sun-fish).

On the 21st of March 1862, some six miles up the Tamsuy River, a large fish was observed close to a ship in harbour. It floated near the surface of the water, moving lazily along, splashing about its dorsal flapper. It must have been injured; for when a boat pulled up to it, it made no resistance, but allowed itself to be taken hold of by the fin, and a rope to be passed round its body. The Chinese say that it is not rare in the adjoining sea. They call it *Tay-siun Ho.* They eat the skin, and describe it as crumbling in the mouth like biscuit; but the fleshy portions boil away to nothing, and are not worth the trouble of putting in the pot. The specimen measured in length 5 feet 6 inches; across from tip to tip of fins 6 feet; length of fin 18 inches. It weighed 187 lbs. The intestine was thick and fleshy, and measured 21 feet long, the duodenum being 3½ inches and the gut about 1½ inch broad. It had one thick fleshy cæcum about 9 inches from the anus, 3½ inches long by 2 broad. The urethra has an opening distinct from the anus, and squirted out water when the animal was stepped upon. Its stomach was empty; but in the cavity between it and the flesh was a long yellow tapeworm, with numerous small parasitic grubs like the larvæ of the lady-bird (*Coccinella*), yellow and black, attached to different parts of it. Outside the skin about the gills were sticking several large fish-lice. When first caught, several sucking-fish were found fastened to its skin; these had been torn off, and left bare and raw patches. Unfortunately they were thrown away before I saw them. I observe Cuvier says that this order of fish has no cæca. Has this genus ordinarily none?

XXIII.—*On Raphides and Sphæraphides of Phanerogamia; with a Notice of the Crystal Prisms of* Iridaceæ. By George Gulliver, F.R.S.

[Plate IV. fig. 13.]

Of the terms Raphides and Sphæraphides.—I have commonly used the term Raphides according to its etymological import (*ῥαφὶς, acus, subula*; fr. *ῥάπτω, suo, consuo*), as proposed by DeCandolle, for the needle-like forms, though it has generally been applied to all microscopic crystals, of what shape soever, occurring in plants—thus causing such inconvenience that the word should either be discarded or others used for crystals and their aggregations of totally different shapes. Whenever either the figure or chemical composition of them can be clearly defined, a satisfactory designation follows as a matter of course; but this often cannot be done, especially with those very minute crystals which occur most frequently. These, however, are so commonly grouped in a particular manner, and are so widely diffused throughout the phænogamous class, that a particular word seems to be required to distinguish them, for the present, from the typical raphides. As this last term has been so generally adopted, we might retain it generically, and add some prefix or affix for other forms of crystals. Among Phanerogamia they occur most commonly in a more or less globular congeries, either naked or within a cell; and these I shall in future call Sphæraphides (*σφαῖρα, sphæra,* and *ῥαφὶς,* ἀ *ῥάπτω,* as above).

Size and Form of the Sphæraphides.—Common sizes of the sphæraphides are $\frac{1}{4570}$th and $\frac{1}{2000}$th; but they often vary from $\frac{1}{6000}$th to $\frac{1}{1000}$th of an inch in diameter, and are occasionally still larger. They are of a round form, and often appear as the nucleus of a cell, and sometimes without any visible cell-wall. The diameter of the individual crystals is frequently about $\frac{1}{20000}$th, varying from $\frac{1}{35000}$th to $\frac{1}{4000}$th of an inch. Of these it is usually impossible to define the forms exactly, on account both of their minuteness and of the difficulty there is in getting them detached so as to roll about and display their shapes in the microscopic field of vision. We can generally see that they are more or less crystalline, and sometimes that they belong either to the octahedral or prismatic system. But whether the forms are primitive or secondary is not easy to determine; and, indeed, the angles and edges are often more or less rounded off, or otherwise so far modified as to make it difficult, without a careful examination, to recognize them as crystals.

Distribution of Sphæraphides.—For the above reasons the sphæraphides may often escape detection, as was the case in my first examination of plants belonging to the order Caryophyllaceæ, in which the individual crystals are commonly minute or obscure, and yet are regularly present in more or less abundance, either separately or aggregated into sphæraphides. In some species of this order (*Silene Armeria* for instance) the crystals are larger, and compose such very distinct sphæraphides as to afford good subjects for preliminary examinations; for though these sphæraphides vary much in size, numbers of them are about $\frac{1}{1000}$th of an inch in diameter. They are most irregularly scattered through the tissues of the plant. The diffusion of sphæraphides throughout Phanerogamia, especially in the leaves, and parts which are modifications of leaves, is so extensive that I have never failed to find them in a single species of of the orders Caryophyllaceæ, Geraniaceæ, Paronychiaceæ, Lythraceæ, Saxifragaceæ, and Urticaceæ, and believe that few, if any, orders could be named in which sphæraphides do not exist as part and parcel of the healthy and growing structure of the plant. Hence it would require a very extended series of observations to determine how far the sphæraphides might be available as botanical characters.

Sphæraphid-Tissue.—In some cases the sphæraphides, far from being very variable in size, and scattered without order among the plant-cells, are so nearly uniform in magnitude and regularly and beautifully dotted, in subcuticular cells, as to form what might well be called sphæraphid-tissue. Of this, excellent examples occur in Lythraceæ, Geraniaceæ, and many other orders. Sphæraphid-tissue may generally be best seen in the calyx, while the larger and more irregular-shaped sphæraphides occur abundantly in the leaves. Of the last, *Potentilla reptans* and its allies afford good specimens; the first, or sphæraphid-tissue, is shown in Pl. IV. fig. 13, drawn to a scale of $\frac{1}{4000}$th of an inch, from the calyx of *Lythrum Salicaria.* Observations are yet wanting to determine how far the sphæraphid-tissue may be characteristic of different orders.

Distribution of Raphides.—This is a subject, independently of its physiological interest, well deserving the attention of systematic botanists. Among Dicotyledones, raphides are not so widely distributed as sphæraphides, and certainly occur so regularly and plentifully in some plants, and sparingly or not at all in others, as to afford good characters by which certain orders may be readily distinguished from their allies of other orders, even by a minute fragment of the leaf alone, and at any period of its growth, which we have already exemplified ('Annals,' May 1861; Jan., April, and July 1863) in Onagraceæ and Rubiaceæ. Probably Balsaminaceæ and Cucurbitaceæ may be similarly characterized; but my examination of these orders and their allies is not yet complete. The orders allied to Vitaceæ must also be further examined, as I find that both the Grape-vine and Virginian creeper are true raphis-bearing plants. So are some Monocotyledones, as Asparagaceæ, Araceæ, Orchidaceæ, and part of Liliaceæ. In all the British Typhaceæ raphides also occur,—which is now noted because a remark to a contrary effect was in a former paper ('Annals,' Jan. 1863, p. 15), by my mistake, repeated from the preceding paragraph to the species of *Typha.*

Site of Raphides.—Though raphides are commonly described and depicted as contained within the cells of the leaf, and I have inadvertently so mentioned them in *Onagraceæ* ('Annals,' July 1863, p. 53), they are often not so situated. It was shown, in the 'Annals' for May 1861, that raphides are clearly distinguishable within the cells of *Lemna trisulca,* and that they are longer than the cells of *L. minor.* In many other plants it is certain that the raphides do not lie within the leaf-cells, such is the disproportion between them; for instance, in *Circæa lutetiana* the length of a bundle of raphides is often at least fifteen times the diameter of the leaf-cell. As to a special raphid-cell and cystolith, the article in the 'Micrographic Dictionary' should be consulted.

Crystal Prisms of Iridaceæ.—As is well known, the raphides usually occur in bundles, each crystal, like a thin needle, being very slender, long, and pointed at the ends. Unlike sphæraphides, the bundles of raphides are easily broken up, so that these crystals are most readily seen swimming freely and separately in the field of vision, though it is often difficult, if not impossible, to see on them any sharp edges or flat faces. But sometimes the crystals are larger and their shape very obvious, of which instances occur in some Liliaceæ (as *Yucca*) and in most Iridaceæ. These crystals are regular prisms, that is to say, with three parallel angles and faces, so that a transverse section thereof would be an equilateral triangle. They are also very long in proportion to their thickness, yet comparatively thicker than the acicular forms; and their ends are either abrupt or sharply pointed. Besides, these crystal prisms generally, if not regularly, appear either singly or in pairs, and are with difficulty detached from the tissue of the leaf in which they are imbedded, thus differing remarkably from the more slender fasciculated raphides. When we do succeed in getting the crystal prisms to float freely in the field of vision, they are seen to be beautiful objects; and it is probable that they might prove useful in experiments on the refraction, polarization, and decomposition of light. I have chiefly examined them in Iridaceæ, in which order they occur abundantly, as may be well seen in different species of *Iris*, *Trichonema*, *Crocus*, and *Gladiolus*. In the leaves of the common and showy cottage favourite with large blue or purple flowers (*Iris germanica* ?), the crystal prisms are quite as distinct as in any of the British plants; so that even humble town gardens may afford subjects for observations on these prisms when the more fugitive leaves of other genera of the order have disappeared.

Edenbridge, August 6, 1863.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Jan. 13, 1863.—George Busk, Esq., F.R.S., in the Chair.

CONTRIBUTIONS TO THE KNOWLEDGE OF THE BRITISH CHARRS. PART II. BY ALBERT GÜNTHER, M.A., PH.D., M.D., F.Z.S.

Since the publication of my first paper on this peculiar group of *Salmonidæ**, I have received very valuable materials for prosecuting my researches. The additional specimens show that I have been correct in distinguishing the three British species from those of the Continent and from one another, and that the differences between

* 'Annals,' Sept. 1862, p. 228.

the young and mature fish of one species may be apparently greater than between individuals of the same age but of two distinct species—the laws according to which the changes in the external form proceed from the young to the mature age appearing to be the same in the different species, as far as our present experience goes. It has been observed, in allied species of insects, that, whilst the perfect animals are so completely alike as to be scarcely distinguishable, their larvæ are very different in their external characters, and even in their habits. This is not the case with the Charrs: the young individuals of two species differ as much from each other as the old ones. But in order to find out the distinctive characters of two species, it is always necessary to compare specimens of the same age. This can be ascertained by the examination of the generative organs, by the development of the jaws, and finally by comparison of a series of examples from the same locality, assisted by actual observation or information from persons who have been for years acquainted with the Charrs of a certain locality, and know to what size they attain there.

Among mammals and birds, difference in the size of full-grown animals is admitted as a specific character, whilst ichthyologists have scarcely ever used it as a distinction between closely allied species, because numerous fishes continue to grow for an almost indefinite period after they have attained to maturity. However, if we should be able to ascertain for a series of fishes the age or the size at which they *first* attain to maturity, the differences observed might be of as great value for the distinction of the species of fishes as in the higher classes of vertebrate animals. I have been induced to make these remarks by the fact (to which we shall recur in the progress of this paper) that the *Salmo alpinus* of Scotland attains maturity at a size inferior to that of an immature Swedish *Salmo alpinus*. Now, if such a difference in the size should be considered as a specific character at a future time, the Scotch and Swedish fishes would be separated.

The specimens which I have examined since the publication of the first paper are the following; they have been deposited in the Collection of the British Museum:—

a. *Salmo Salvelinus* (L.), Nilss.

Diagnosis, taken from a male specimen from the Lake of Wettern, 17 inches long.—Body slightly compressed and elongate, its greatest depth being contained five times and a half in the total length (to the end of the middle caudal rays). The length of the head exceeds the height of the body, being contained four times and a half in the total; it is rather more than one-half of the distance between the snout and the vertical from the origin of the dorsal fin. The maxillary extends beyond the orbit in the adult fish. Eye rather small, its diameter being less than one-half of the interorbital space. The length of the pectoral fin of the mature fish is equal to, or less than, one-half of the distance of its base from the root of the ventral. Dorsal rays fourteen*; the length of its longest ray is much less than that of the pectoral, and not much more than one-half of the

* Including the rudimentary rays in front of the fin.

length of the head; the length of its base is twice that of its last ray. 190 transverse series of scales above the lateral line. Vertebræ 65. Teeth of moderate size.

This species is not represented by any of the British Charrs that I have examined. The Irish Charrs form quite a distinct group, the characters of which I shall point out hereafter. *S. Willughbii* and *S. cambricus* have larger scales, much longer pectoral fins, and differ besides in many other points. *S. alpinus* has the same number of scales; but in specimens of a corresponding age and size the pectorals are much longer, the maxillary is less developed, &c. The Iceland Charr has the dorsal fin much more elevated. This Swedish *S. Salvelinus* may be identical with a part of the specimens comprised by Heckel under the same name.

b. *Salmo alpinus*, L.

Diagnosis.—Body slightly compressed and elongate, its greatest depth being one-fifth or one-sixth of the total length (to the end of the middle caudal rays). The length of the head equals the height of the body in mature specimens, but is somewhat more in immature; it is two-ninths or one-fifth of the total; it is rather less than, or equal to, one-half of the distance between the snout and the vertical from the origin of the dorsal fin. The maxillary extends but little beyond the orbit in the fully adult fish. The eye is one-half, or rather less than one-half, of the width of the interorbital space. The length of the pectoral of the mature fish is more than one-half of the distance of its base from the root of the ventral; in immature specimens its length is considerably less. Dorsal rays thirteen; the length of the longest ray is much less than that of the pectoral, and three-fifths or one-half of the length of the head; the length of its last ray is a little more than one-half or two-thirds of the length of its base. 195–200 transverse series of scales above the lateral line. Vertebræ 62 in the Scandinavian variety, and 59 in the Scottish. Teeth of moderate size.

At the time when I first compared the Charrs of Windermere and Llanberris* with Linné's and Nilsson's descriptions of *Salmo alpinus*, I had not had the opportunity of examining specimens from Lapland. Now, having specimens before me which, in all probability, are identical with the species described by Linnæus and Nilsson, I see that I have misunderstood a part of the description of the former, and that the latter has given his notes from young specimens. When Linnæus says that the head of his specimen (12 inches long) was $1\frac{1}{2}$ inch, he measured only the top of the head from the end of the snout to the occiput; whilst ichthyologists of the present time take the lateral length of the head from the end of the snout to the gill-opening. Nilsson says that *S. alpinus* has shorter pectoral fins than *S. Salvelinus*; this is correct if we examine specimens of the former only 8–10 inches long, but in a mature state *S. alpinus* has the longer pectorals. Therefore the characters by which I have formerly distinguished the *S. alpinus* from *S. Willughbii* and *S. cambricus*

* 'Annals,' Sept. 1862, p. 230.

cannot be retained, whilst others, affording easy specific distinctions, become evident on comparison of actual specimens. The two British species mentioned have a less number of transverse series of scales; *S. Willughbii*, besides, has the body more elevated, whilst *S. cambricus* has a longer head, and the base of the pectoral overlapped by the gill-cover apparatus. The Iceland Charr, again, differs from *S. alpinus* in its elevated dorsal fin.

I have mentioned above that I refer to this species a number of specimens from Lapland, Scotland, and from the Orkneys. After having hesitated for a long time, I prefer doing so, as they certainly are more closely allied to one another than to any of the other forms. Future observations on a more perfect series than that which I have at present, and especially an examination of a greater number of immature and of very old specimens, will settle this point. The specimens from Scotland and Lapland appear to agree in almost every point of importance, but in the number of vertebræ and in the size: whilst the Lap Charr does not attain to maturity before it has attained to a length of 12–13 inches, the Scotch individuals are mature at a size of 9 inches. The specimens from the Orkney Islands are 6 inches long, and apparently correspond in age to a Lap specimen of 10 inches in length. The immature state of *S. alpinus* of both countries is distinguished by short pectoral fins; but, whilst those fins have attained to their full relative length in Scotch specimens of 9 inches in length, the Lap specimens are 13 inches long at the same period. Other differences may be observed on comparing these young Charrs, especially in the form of the head, which is considerably less elongate in the Scotch individuals; but in order to ascertain whether this character is constant, it would be necessary to compare a greater number of specimens than I have at present.

I shall first describe one of the mature specimens sent by Mr. Wheelwright from Quickjock.

Description of a male specimen, length 13 *inches* 8 *lines*.—Head and body compressed, but slightly elevated; its greatest depth is below the origin of the dorsal fin, where it is *one-fifth* of the total length (to the end of the middle caudal rays). The least depth of the tail is rather less than the length of the base of the dorsal fin. The height of the head above the mandibulary joint equals the distance between the posterior margin of the orbit and the end of the operculum. The top of the profile of the head is somewhat elevated above the margin of the orbit, the diameter of which is nearly one-sixth of the length of the head, two-thirds of the extent of the snout, and rather less than one-half of the width of the interorbital space; the latter is convex, with a rather prominent ridge along the middle, and with a pair of series of pores. Snout compressed, conical, with the jaws equal anteriorly. The *maxillary* extends to the vertical from the hind margin of the orbit; in the two largest specimens (15–17 inches long) it reaches slightly beyond that vertical. It is armed with 20–22 *teeth* of moderate size; six teeth in each intermaxillary, fifteen in each mandible; three pairs on the vomer, arranged in two longitudinal series slightly converging behind; nineteen on each palatine bone, and six pairs on the tongue. *Operculum* obtusely rounded behind, its length being two-thirds of its height; the suboperculum projects but little beyond the hind margin of the opercle, its vertical width being one-half of that of the operculum.

D. 13. A. 12. P. 13. V. 10.

The origin of the dorsal fin is a little nearer to the end of the snout than to the root of the caudal; *the length of its base is one-third more than that of its last ray, and contained once and a fourth in that of the fourth ray.* The fifth and sixth rays form an acute point, and the upper margin of the fin is straight. The first ray is rudimentary, the second half the length of the third, the third two-fifths the length of the fourth, the fifth simple, the sixth branched, the last split to the base. The distance of the adipous fin from the dorsal is but little more than twice the base of the latter.

The origin of the anal fin is exactly in the middle between the root of the caudal and that of the outer ventral ray; the length of its base is somewhat less than that of the dorsal, and is contained once and a fourth in the length of the fifth ray.

Caudal fin forked, one of the middle rays being two-fifths as long as the outer ones, the length of which is contained six times and a half in the total; lobes pointed.

The base of the pectoral is entirely free, and not overlapped by the gill-cover apparatus; *it terminates at a considerable distance from the vertical from the origin of the dorsal,* equals the length of the head without snout, *and is contained once and a third in the distance between its root and that of the ventral.*

The ventral is inserted below the middle of the dorsal.

A specimen, 12 *inches long,* from the same locality, agrees very well with the one first described; its operculum, however, is as long as high, and the length of the pectoral fin is nearly one-half of the distance between its root and that of the ventral.

An immature specimen, 10 *inches long,* differs widely from the preceding, its body and its head being much more elongate. The length of the head is more than the height of the body, the former being one-fifth, the latter one-sixth of the total length; the operculum is longer than high, and the height of the head above the mandibulary joint is less than the distance between the posterior margin of the orbit and the end of the operculum; the maxillary extends nearly to the vertical from the hind margin of the orbit. The length of the pectoral fin is considerably less than one-half of the distance between its root and that of the ventral.

With regard to the coloration, this species does not differ from *S. Willughbii*; the immature specimen has the sides silvery, and the red of the lower parts is replaced by a slight tinge of orange-colour.

Some of the specimens from Quickjock had the stomach filled with food, which consisted of specimens of small species of *Planorbis* and *Limnæa*, of *Ephemeridæ*, of the larvæ of *Libellula*, and of small fresh-water Crustacea. The number of pyloric appendages is forty-four.

The largest of our *Scotch* specimens is a mature male 11 inches long. It differs from the male from Quickjock in having a more elongate body, the depth of which is one-sixth of the total length. The operculum is as high as long; the pectoral fin terminates at a considerable distance from the vertical from the origin of the dorsal, equals the length of the head without snout, and is contained once and a quarter in the distance between its root and that of the ventral. The *females* do not differ from the males. The *immature specimens* have the same short pectorals which we have found in the young Lap Charr; but the operculum is much less elongate.

The stomach of the Orkney Charr contained large common earthworms (*Lumbricus*).

We distinguish, therefore, one of the Scotch Charrs by the name of *Salmo alpinus,* which, although not entirely agreeing with a Charr from Lapland described by Linnæus under the same denomination, is nevertheless closely allied to it,—the Scotch variety being considerably smaller in size at the period of first maturity. This Scotch species is found in Lake Helier in Hoy, Orkneys, and very probably in certain other lochs of Scotland*.

c. *Salmo Willughbii.*

This species has been described and figured in the former paper as the Charr of Windermere. A Charr for the knowledge of which I am indebted to Lord Lovat is very closely allied to it. It is found in Loch Bruiach (North Scotland); all the specimens sent are of nearly equal length, between 7 and 8 inches; nevertheless they are mature, and the development of the milt and ova indicates that their spawning-season is the end of October. Lord Lovat writes that "those specimens are smaller in size than usual; but they are the largest we have caught this season."

This Charr of Loch Bruiach differs but slightly from the typical *S. Willughbii*; it is somewhat more elongate; it has thirteen dorsal rays, the base of the dorsal fin being rather longer than the last dorsal ray. The number of vertebræ is sixty or sixty-one, and that of the pyloric appendages is thirty-five.

d. *Salmo nivalis. Iceland Charr.*

In the original description of *S. Willughbii* I mentioned several specimens of a Charr from Iceland, which were not fit for an accurate examination, owing to the manner in which they had been preserved. Meanwhile I have received from Mr. G. G. Fowler two very fine examples of the same species, which, although young (10 inches long), prove that it is distinct from the other European Charrs. It is probably identical with the dark variety of *S. alpinus,* mentioned by Faber (Fische Islands, p. 169), for which he proposed the name of *S. nivalis,* if some future ichthyologist should point out its distinctive characters.

* The specimens purchased of Mr. Stevens for the collection of the British Museum are from Scotland; but the exact locality whence they have been procured is unknown.

Diagnosis.—Body slightly compressed and elongate; its greatest depth equals the length of the head, and is one-fifth, or somewhat less than one-fifth, of the total length; the length of the head is rather more than one-half of the distance between the snout and the vertical from the origin of the dorsal fin. The maxillary extends beyond the orbit in the adult fish (15–20 inches long). The eye is less than one-half of the interorbital space in the adult fish. The length of the pectoral fin is, in mature and immature specimens, more, or much more, than one-half of the distance of its base from the root of the ventral. Dorsal rays fourteen; the length of the longest ray equals that of the pectoral, or that of the head without the snout; the length of the last ray is two-thirds of the length of the base. 190 transverse series of scales above the lateral line. Vertebræ 62. Teeth of moderate size.

Pyloric appendages 41. Specimens from 10–12 inches long are still immature. The stomach of one contained numerous very small freshwater bivalves.

e. *Salmo Grayii.*

The Earl of Enniskillen has sent several very fine specimens of this species from Lough Melvin for the collection of the British Museum; they were all males, and perfectly like, even in size, those from which I have taken my description. A few of them showed the red of the belly of a deeper hue than the individual figured. A female fish, however, has been discovered among a collection of *Salmonidæ* purchased of Mr. Stevens: this specimen does not differ from the males; but the colours have disappeared, the specimen being preserved in spirits. The eggs are of the size of a hemp-seed.

The number of pyloric appendages is thirty-seven; and that of the gill-rakers of the lower branch of the outer branchial arch varies from nine to thirteen.

f. *Salmo Colii*, n. sp. *The Charr of Lough Eske.*

In the former paper on Charrs, I mentioned several Irish specimens, the property of the Museum at Belfast, said to be *perhaps* from Lough Melvin. I then doubted the accuracy of the "habitat," as those specimens, although allied to the Charr of Lough Melvin, differed in several not unimportant points from the types, and as they evidently belong to a very small species which is mature at a size of 5 inches. Owing to the kind assistance of the Earl of Enniskillen and of Th. Brooke, Esq., I have been able not only to ascertain the exact locality where those specimens are found, but also to determine the characters of this new species (for such has the Charr of Lough Eske proved to be); and I name it after that nobleman, who has taken untiring interest in these researches.

Salmo Colii is not confined to Lough Eske; a specimen procured by R. H. Scott, Esq., from Lough Dan, agrees in every respect with the Charr of Lough Eske. The following description, given strictly in accordance with that of *Salmo Grayii*, will show the distinctive characters on which this species is founded:—

Body slightly compressed and rather elongate, its greatest depth being contained four times and three-fifths or five times in the distance of the snout from the end of the middle caudal rays. The length of the head is one-half of the distance between the snout and the vertical from the origin of the dorsal fin. Head compressed; interorbital space nearly flat, its width being less than twice the diameter of the eye. Jaws of the male of equal length anteriorly; *teeth very small*, four to six in each intermaxillary, fourteen to seventeen in each maxillary. Pectoral shorter than the head, terminating at a considerable distance from the origin of the dorsal and of the ventral. Dorsal rays fourteen. 160 transverse series of scales above the lateral line.

Description of a male and female specimen, $7\frac{3}{4}$ inches long.—Head and body slightly compressed, not elevated, the greatest depth being below the origin of the dorsal fin, where it is contained four times and three-fifths (female) or five times (male) in the total length (to the end of the middle caudal rays). The least depth of the tail is considerably less than the length of the base of the dorsal fin. The height of the head above the mandibulary joint is more than the distance between the posterior margin of the orbit and the end of the operculum. The top of the profile of the head is scarcely elevated above the margin of the orbit, the diameter of which is one-fifth of the length of the head, somewhat shorter than the snout, and two-thirds of the width of the interorbital space; the latter is but very slightly convex, with a very indistinct ridge along the middle. The nostrils are situated midway between the end of the snout and the orbit. The maxillary extends scarcely to the vertical from the posterior margin of the orbit, and is armed with from thirteen to seventeen very small teeth. All the other teeth are small; four to six in the intermaxillary, fifteen in each mandible, three on the vomer, fifteen on each palatine, and four pairs on the tongue. The suboperculum forms the hindmost part of the gill-covers, and does not cover the exposed portion of the humerus above the root of the pectoral; its vertical width is one-half of that of the operculum.

D. 14. A. 12. P. 13. V. 9.

The origin of the dorsal fin is a little nearer to the end of the snout than to the root of the caudal; the length of its base is considerably more than that of the last ray, and contained once and a third in that of the fourth ray; the upper margin of the fin is straight. The first ray is nearly half as long as the second, the second and third half as long as the third and fourth; the fifth, sixth, and seventh are the longest, the former simple, and the two latter branched; the last is split to the base, and half as long as the sixth. The distance of the adipous fin from the dorsal is equal to, or rather less than, twice the length of the base of the latter.

The origin of the anal fin is in the middle between the root of the caudal and that of the outer ventral ray; the length of its base is less than that of the dorsal and two-thirds of the length of the fifth ray. The fourth, fifth, and sixth rays are the longest, and form an acute point; the lower margin of the fin is slightly emarginate. The fourth ray is simple, the fifth branched; the last is split to the base, half as long as the fourth.

Caudal fin forked, one of the middle rays being two-fifths as long as the outer ones, the length of which is less than one-fifth of the total. Lobes pointed.

The base of the pectoral is entirely free, and not overlapped by the gill-cover apparatus; it is shorter than the head, terminating at a considerable distance from the vertical from the origin of the dorsal; its length is one-half, or not much more than one-half, of the distance between its root and that of the ventral.

The ventral is inserted below the tenth and eleventh dorsal rays, its length being four-fifths of that of the pectoral, and two-thirds of that of the head.

Back bluish black; sides silvery, with scattered light salmon-coloured dots; belly reddish; fins black, the anal and the paired fins with a reddish tinge, the anal and the ventrals with a narrow whitish margin.

Number of vertebræ 63.

This is evidently one of the smallest species of this genus; it is mature when it has grown to a size of 5–6 inches, and, according to inquiries made by the Earl of Enniskillen, it never exceeds the length of the specimens described, viz. 7–8 inches. The locality where it is found is Lough Eske, a small lake in the county of Donegal, the circumference of which is not above eight miles. Mr. Brooke, whose family were residents on the shores of that lake for more than two centuries, writes that "Lough Eske (Eske, or Yesk, meaning Fish) was the crater of an extinct volcano, as suggested by Dr. Wilde, of Dublin; a high mountain-range runs close to the north-east shores. In the season, salmon, white trout, and the common lake-trout are in abundance. The Commissioners of Fisheries have decided that the Charr of Lough Eske are the *Salmo alpinus*, thus placing them in the same Act as salmon; so that, except for scientific purposes, we are not permitted to take them after August. Formerly, in the months of October and November the fish were taken in large quantities by the country-people, without any apparent diminution of their numbers. Now, at the permitted season of fishing they remain in such deep waters, the people have not nets sufficiently large to take them. The Charr are not at all like the only 'freshwater Herring' with which I am acquainted, that of Lough Neagh*, the flesh of which is quite white; and the shape of the fish was like Sea-Herring."

Conclusion.

When we recapitulate the results of our examinations contained in this and in the preceding papers, we hope we have shown—

1. That three very distinct species of Charrs are found in Great Britain, namely, *S. Willughbii* in the Lake of Windermere and in Loch Bruiach, *S. cambricus* in Wales, and *S. alpinus* in certain parts of Scotland.

* Mr. Brooke evidently alludes here to the *Coregonus Pollan.*

2. That those three species differ by most constant characters from the *S. Umbla* and *S. Salvelinus* of the Continent; but that *S. alpinus* of Scotland is closely related to the *S. alpinus* of Lapland, differing merely by its smaller size when first attaining to maturity, and by the number of vertebræ.

3. That Iceland is inhabited by a distinct species (*S. nivalis*).

4. That the Charrs of Ireland form a separate group by themselves, distinguished by the feeble development of their dentition; and that the Charr of Lough Melvin (*S. Grayi*) is a distinct species from that of Lough Eske and Lough Dan (*S. Colii*).

In conclusion, I subjoin a synopsis of the species which I have examined up to the present time, observing, however, that this synopsis is given merely for the purpose of showing *a few* of the principal characters by which the *mature* individuals of the different species are distinguished:—

I. *Jaws well developed; teeth of moderate size.*

A. The length of the pectoral fin in the mature fish less than one-half of the distance between the roots of the pectoral and ventral fins.

1. Thirteen dorsal rays. Intermaxillary teeth much stronger than those of the maxillary. L. lat. 185. Lower parts silvery. *S. Umbla.*
2. Fourteen dorsal rays; intermaxillary and maxillary teeth equal in strength. L. lat. 190. Lower parts red. *S. Salvelinus.*

B. The length of the pectoral fin in the mature fish more than, or equal to, one-half of the distance between the roots of the pectoral and ventral fins.

1. The height of the body one-fifth or one-sixth of the total length; the height of the dorsal fin three-fifths or one-half of the length of the head. L. lat. 195–200. *S. alpinus.*
2. The height of the body one-fifth of the total length; the height of the dorsal fin equals the length of the head without snout. L. lat. 190. The gill-cover not overlapping the root of the pectoral. *S. nivalis.*
3. The height of the body one-fifth or one-sixth of the total length; the height of the dorsal fin two-thirds of the length of the head. L. lat. 170. The gill-cover overlapping the root of the pectoral. *S. cambricus.*
4. The height of the body one-fourth of the total length; the height of the dorsal fin equals the length of the head without snout. L. lat. 165. The gill-cover not overlapping the root of the pectoral. *S. Willughbii.*

II. *Lower jaw very feeble; teeth minute.*

1. The pectoral extending to, or beyond, the origin of the dorsal fin. *S. Grayi.*
2. The pectoral terminating at a considerable distance from the origin of the dorsal fin. *S. Colii.*

On Atheris Burtonii, a new Snake from West Africa. By Dr. Albert Günther.

A collection made by Major Burton, H. M. Consul in Fernando Po, during an excursion in the Camaroon country, contained several species of Snakes, namely, *Grayia triangularis, Dryiophis Kirtlandii,* a brood of newly-born *Clotho nasicornis**, and, finally, a specimen of a Snake distinguished by its form, scales, and shields, and by a coloration which is almost unique in the whole order of Ophidians. I had named this genus *Pœcilostolus* (Ann. & Mag. Nat. Hist. Jan. 1863); but having since received the last part of 'Proc. Acad. Nat. Sc. Philad. 1862, I find that Mr. Cope has already proposed the generic name of *Atheris* for congeners of our species (p. 337).

Atheris.

Head thick, broad, triangular, covered above with strongly-keeled scales; body compressed; tail prehensile. Scales keeled. Subcaudal shields entire.

Atheris Burtonii.

The head and neck are rough, in consequence of the keels of the single scales forming prominent spines. The rostral shield is very low, linear, with other scale-like shields above; nine upper labials. Nostril in the middle of a single subquadrangular plate, situated above the first labial; eye surrounded by a ring of subequal scales; chin-shields scale-like, keeled, except the anterior pair, which are smooth; the posterior labial shields of the lower jaw keeled. Scales of the body in nineteen rows. Ventral shields 163; anal entire; subcaudals 58.

Entirely lemon-coloured; some greenish scales are scattered about on the upper surface of the body.

Total length 14 inches; head $\frac{2}{3}$ inch; tail $2\frac{1}{2}$ inches.

Note on Diemennia superciliosa. By Dr. A. Günther.

The Proceedings of this Society of last year† contain a very interesting observation of Mr. Krefft, of Sydney, according to which a small banded Snake, which he identifies with *Furina textilis,* Dum. & Bibr., is merely the young of a very large species, the adult of which is of a nearly uniform coloration. Mr. Krefft (who, for the benefit of the collection entrusted to his care, is very anxious to have his specimens identified with the types contained in European col-

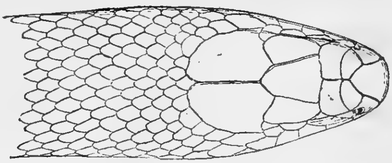
* There is also a specimen, in a very bad state of preservation, which appears to belong to *Neusterophis lævissima* (*Natrix lævissima,* Gthr.).

† 'Annals,' Nov. 1862, p. 393.

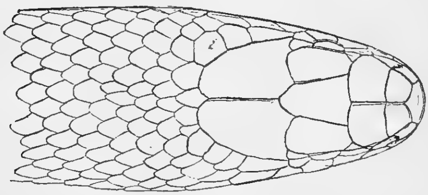
lections) has sent us an old and two young examples of this Snake; and having re-examined the species of *Diemennia* and the literature referring to them, I am enabled to settle some points on which doubts have been entertained.

The young specimens, then, found by Mr. Krefft do not belong to *Furina textilis*, Dum. & Bibr., which has three posterior oculars, but to *Diemennia annulata*, described by myself in the 'Catalogue of Colubrine Snakes,' p. 213; and the old individual sent by Mr. Krefft is identical with *Pseudoëlaps superciliosus*, Fisch. M. Jan, of Milan (who says that he has examined the Snakes of the Hamburg Museum), describes the adult Snake under two names, *Pseudoëlaps Sordellii* and *Ps. Kubingii*, the latter being founded on an accidental variety, in which some of the head-shields are confluent.

Mr. Krefft, in a letter addressed to me, alludes to *Pseudonaia nuchalis* as a species which, perhaps, might be identical with an old *Diemennia superciliosa*. These, however, differ *toto cœlo*, as may



a.



b.

be seen from the description given by myself (Colubr. Sn. p. 227), and from the figures (*anteà*, p. 1), where fig. *a* represents the head-shields of *Pseudonaia nuchalis*, and fig. *b* those of *Diemennia superciliosa*.

The synonymy of this species, therefore, would be:—

DIEMENNIA SUPERCILIOSA.

a. *Adult.*

1856. *Pseudoëlaps superciliosus*, Fischer in Abhandl. Geb. Naturwiss. iii. p. 107, taf. 2. fig. 3 (head, not quite correct).

1859. *Pseudoëlaps Sordellii*, Jan in Rev. & Mag. Zool. 1859, pl. C (head).

1859. *Pseudoëlaps Kubingii*, Jan, *l.c.* (founded on an accidental variety).

b. *Young.*

1858. *Diemansia annulata*, Günth. Colubr. Snak. p. 213.

1862. *Furina textilis*, Krefft, P. Z. S. 1862, p. 149.

Jan. 27, 1863.—G. R. Waterhouse, V.P., in the Chair.

Description of a New Species of the Genus Dromicia, discovered in the Neighbourhood of Sydney. By Gerard Krefft.

Dromicia unicolor, sp. nov.

Dentition.—Incisors $\frac{3-3}{1-1}$. Canines $\frac{1-1}{1-1}$. Præmolars $\frac{3-3}{3-3}$. Molars $\frac{3-3}{3-3}$. $=36$.

Of the grinders in the upper jaw, two are large and four cuspidate; but the last one is much smaller, of a triangular form, and furnished with three cusps only. The præmolars are three in number, of which the posterior one is large, and furnished with two fangs and two roots; the other two are rudimentary, with flat surfaces; there is an interspace between these teeth and the long canine; of the three incisors the anterior one is the largest.

In the lower jaw there are three true molars, with four cusps to each, but the last or posterior one smaller than the other two; these are preceded by a large two-rooted false molar (which, in one specimen examined, is furnished with one, in the other with two fangs), the anterior præmolars (two) and the canine being small and rudimentary, with flat crowns; the single incisor is very long.

Coloration.—Fur of a uniform mouse-colour, lighter on the sides and beneath, with a blackish patch in front of the eye.

All the hairs are slate-grey at the base, tipped with yellowish at the back and sides, and with grey beneath; longer black hairs, tipped with white, are interspersed, except on the underside of the body. Bristles black to within one-third of the tip, which is white; a few long bristly black hairs before and behind the eye. Tail somewhat longer than the body, prehensile, thin, showing every joint; slightly enlarged at the base, and gradually tapering; covered with a mixture of light-coloured and black hairs; apical portion, about $\frac{1}{2}''$ from the tip, wide beneath.

	inches.
Length from tip to tip	$6\frac{1}{4}$
Tail	$3\frac{1}{4}$
Face, to base of ear	$\frac{7}{8}$
Ear	$\frac{1}{2}$
Arm and hand	$\frac{7}{8}$
Tarsus and toes	$\frac{5}{8}$

This beautiful little creature was captured near St. Leonard's, North Shore, Sydney, feeding upon the blossoms of the *Banksiæ*, and lived a few days in captivity. In its habits it is nocturnal. The tongue of this *Dromicia* is well adapted for sucking the honey from the blossoms of the *Banksiæ* and *Eucalypti*, being furnished with a slight brush at the tip. This species differs from the *D. concinna* of Western Australia in being of a uniform dark colour without the white belly, and having the base of the tail slightly enlarged; it is of about the same size as *D. concinna*.

Notice of a New American Form of Marsupial. By R. F. Tomes, Corr. Memb.

Genus Hyracodon, Tomes.

General form somewhat slender. Tail as long as the head and body, tapering evenly to a fine point, Feet long, and furnished with an opposable thumb; nails somewhat long and pointed. Head rather long; muzzle pointed; ears of medium size, ovoid. *Upper incisors*: middle teeth simple, pointed, small, and in a vertical position; the following two large, thick, and short, but having a semi-acute point, which has a very backward direction; the following one, or fourth, similar, but very small; the fifth, or canine, separated from the preceding by a considerable interval, small, conical, acute, and nearly vertical in position; the two succeeding teeth nearly similar. *Lower incisors*: middle teeth long, nearly straight, and horizontal in position, as in the Shrews; the four following teeth more or less conical in form, closely packed together, and sloping forward, small in size, and evenly diminishing from the first to the last; the fifth tooth has a canine-like form, a little more prominent than the preceding, and curved forward; the sixth small, conical, vertical in position, and widely separated from the fifth.

H. fuliginosus, n. s.

Tail sparingly covered with short hairs of a dusky colour, throughout the whole of its length, both above and below; upper surface of the feet sparingly covered with hairs similar to those of the tail; ears nearly naked, and of a dark brown colour; fur on all parts of the body of a deep sooty-brown, scarcely paler on the under parts; all the naked parts brown.

	"	'''
Length of the head and body	3	8
——— of the tail	3	8
——— of the head	1	2

Hab. Ecuador; collected by Mr. Fraser.

On the Species of Craspedocephalus which occur in the Province of Bahia, Brazil. By Dr. Otho Wucherer, Corr. Memb.

In a former paper, containing the first portion of a list of the Ophidians which I had been able to collect in this province, I abstained from certain remarks on some species of the above genus until I should have collected more ample materials to corroborate them.

In the first place, I was struck by the fact that all the specimens of "Jararaca" which had up to that time come to my notice were very similar, and belonged to one species, *Craspedocephalus atrox.* Having collected more than thirty specimens, I proceeded to examine them more closely for comparison. Dr. Gray, in the 'Catalogue of Viperine Snakes in the Brit. Mus.' 1849, comments on the difficulty of separating the species of this genus. His diagnoses do not agree exactly with those of Schlegel in his 'Essai,' nor with those of Duméril and Bibron in their 'Erpétologie Générale,' I may therefore be excused if I offer the following remarks on my specimens. In my former paper I stated that I had neither seen *Craspedocephalus lanceolatus* nor *C. brasiliensis.* At the present time I have examined very nearly forty specimens of "Jararaca," all of which, except three, agree sufficiently in every character, and are, according to the descriptions of herpetologists, referable to *C. atrox.* These three specimens show certain slight differences which justify a doubt of their specific identity with the others.

Dr. Gray mentions *C. atrox* as having seven upper labial shields. Schlegel, in his 'Essai,' i. p. 189, and again ii. p. 535, describes this species as having eight labial shields; still this may perhaps be considered a mistake, for in his plate 19 of the above work *C. atrox* is represented as having only seven upper labial shields. Duméril and Bibron make no allusion to this character in *C. atrox.* Now all the specimens of *C. atrox* which I have had occasion to examine have seven upper labial shields. Only one has on one side eight, which must be considered an irregularity.

Dr. Gray describes *C. brasiliensis* as having nine or ten upper labial shields, the hinder ones of which are smaller; Schlegel decribes it as having nine; and Duméril and Bibron do not mention the number of labial shields at all.

The three specimens differing from those of *C. atrox* mentioned above have all eight upper labial shields on each side, the last one narrower than the last one in *C. atrox.*

A statement I made in my former paper, that my specimens of *C. atrox* differed from those described by herpetologists in having fewer longitudinal rows of scales, I now take the opportunity to rectify. The number of longitudinal rows of scales in the species of this genus is not always mentioned as a specific character, and indeed it does not appear very serviceable as such. Schlegel's *C. jararaca,* the *C. brasiliensis* of Dr. Gray's catalogue, has twenty-seven rows of scales; of *C. atrox* he says (Essai, ii. p. 536), "On compte quelquefois 29 rangées d'écailles," leaving it perhaps hence to be inferred that it has generally a lesser number, or twenty-seven, like the one just described, which is *C. brasiliensis.* Duméril and Bibron (vii. p. 1509 and p. 1511) give to *C. atrox* from twenty-nine to thirty-two, to *C. brasiliensis* twenty-seven rows. All my specimens of *C. atrox,* with few exceptions, have twenty-seven rows of scales, a few having twenty-five. Of the three specimens differing from them, two have twenty-five and one twenty-three rows of scales.

Schlegel and Duméril and Bibron draw some specific differences from the shape of the head, the former saying (ii. p. 535) that the snout of *C. atrox* is more conical, by which I suppose is meant more rounded, Duméril and Bibron stating that the sharp edge on the anterior part of the head is almost effaced, and does not reach back to the orbits, furthermore that the scales on the anterior part of the head are comparatively much larger than on the posterior part in *C.*

brasiliensis; but all these differences do not appear very striking in Schlegel's excellent figures on plate 19 of the 'Essai.' My three specimens distinct from *C. atrox* would rather agree in these points with the descriptions of *C. brasiliensis* of these authors.

Schlegel points to the larger size of the superciliary and superior labial shields in *C. atrox*, to its larger and more numerous mental shields, to the stronger keel on its scales, showing a strong tendency to take the form of a tubercle, by which I understand that it is higher and shorter, not reaching the tip. Now these characters, if they occurred simultaneously, might very well serve as some of the specific characters; and it does not appear just in Duméril and Bibron to say (vii. p. 1508), "M. Schlegel, dans l'embarras où il s'est trouvé, n'a indiqué que des différences peu importantes, tirées de la forme des écailles dont la carène paraît plus forte; des lames noires alongées, ou de l'étendue relative des plaques surciliaires ainsi que les plaques labiales,"—although they confess their inability to suggest any better characters, and still persist in considering them individuals belonging to two species, having no other basis for their separation than the frequent occurrence of *C. atrox* in Guiana, whilst the other species is never found there.

Comparing my three specimens, which differ from those of *C. atrox* in the last-mentioned respects, and first as regards the size of the superciliary shields, I cannot come to any very precise decision, as they are not full-grown. Comparing with one another old and young specimens of *C. atrox*, I find that not only the superciliary, but all other head-shields are proportionately larger in young individuals, so is the pit in the cheek; and the whole head is flatter, especially the occiput, and more elongate in adult specimens. I compared the three specimens with those of corresponding size of *C. atrox*, but I could not arrive at any decided opinion; and, considering the difference in size of the figures in Schlegel's plate 19, they also do not allow me to draw any safe inference from the relative size of the superciliary shields in each species. Besides, I am not acquainted with the absolute size each species may attain. As regards the size and number of the mental shields, I cannot find any very striking difference; in some specimens of *C. atrox* I have found one, in others two, and even three pairs of chin-shields; in the three specimens which differ in other respects from them, I always found only one pair. The labial shields are certainly smaller in my three specimens which do not agree with *C. atrox*. But more striking still is the shape of the scales and their keel. The three specimens I am inclined to regard as referable to *C. brasiliensis* have narrower scales, their keel lower, narrower, longer, and reaching to their tip. At first glance these specimens have a less hirsute appearance than those of *C. atrox*. In accordance with the narrowness and the smaller number of their scales, their body appears more slender.

I am well aware that the coloration does not afford safe specific characters, except in comparatively few instances; but as all the specimens I referred to *C. atrox* agree so well in this respect, differing from my three supposed *C. brasilienses,* which again agree among themselves, I may be allowed to state in what one and the other are peculiar. The specimens I refer to *C. atrox* are all greyish yellow or olive, and have along the body irregular brown, black-edged spots with sinuated margins, which occupy about as much space as the ground-colour. In young specimens the colours are generally brighter, and the spots more distinct. Underneath they are all, without exception, chequered with dark grey or black.

The three specimens of supposed *C. brasiliensis* are olive-green; similar brown, black-edged spots, with sinuated margins, occupy their back, but occur at much wider intervals, so that they occupy much less space than the ground-colour; underneath, all three are dirty-yellow, punctulated with black, but not at all chequered.

These differences appear very striking, but I refrain from attaching undue weight to them. Schlegel describes some specimens of *C. brasiliensis* with "larges taches carrées" (Essai, ii. p. 533). Duméril and Bibron are not explicit as regards the coloration of *C. brasiliensis.*

In Prof. Jan's 'Prodrome d'une iconographie descriptive des Ophidiens,' published in 1859, I find *Trigonocephalus Neuwiedi,* which is synonymous with *C. atrox,* enumerated as a distinct species. I also find that Duméril and Bibron consider specimens with a white tip to the tail as a variety; I may therefore be allowed to make the following remarks. Seven of my specimens of *C. atrox* are quite young, their total length ranging from 0·333 to 0·382; in all the tip of the tail is white. Besides these, I have seen many other small specimens, which always showed the same peculiarity. In two specimens of 0·620 and 0·530 total length, which may be considered half-grown, the tip of the tail is lighter-coloured than the rest of the body, showing the transition to the black colour in the tail of adults. From this I think it reasonable to infer that the difference in the colour of the tip of the tail in individuals of *C. atrox* depends on their age, and does not constitute a variety, much less a species. The Brazilians, however, consider small individuals as a distinct species, which they call "Caisacca." Of the young of *C. brasiliensis* Schlegel states expressly (Essai, ii. p. 533), "Les petits offrent le bout de la queue blanc."

The largest of my three supposed specimens of *C. brasiliensis* has a total length of 0·872, and may be considered therefore about half-grown; the tip of its tail is lighter-coloured than the body; underneath to a greater extent, and above at the extreme tip it is quite white. In one of the other two specimens the tip of the tail is lighter-coloured, in the other white.

According to the statement of Schlegel, the iris of *C. brasiliensis* is dark red; he does not mention how the iris of *C. atrox* is coloured. In many live specimens of the latter species which I have seen, I always found it of a dark grey. I never saw a live specimen of a snake corresponding to my supposed specimens of *C. brasiliensis.* In these the colour of the iris is not preserved.

As to *C. lanceolatus,* I very much doubt whether it occurs in Brazil at all.

Trigonocephalus Landsbergii, Schl., *Bothrops Castelnaudi*, and *Bothrops alternans*, D. & B., have not yet come under my notice.

Of *Craspedocephalus bilineatus* I have seen eight specimens—seven from the vicinity of Villa Vicosa (where the Prince of Wied, who first described the species), found his specimen, and one of unknown origin.

I had previously observed that some Brazilian species of Snakes (as *Spilotes variabilis* and *S. pœcilostoma*, *Coryphodon pantherinus*, *Xenodon colubrinus*, &c.) have the habit of striking the ground rapidly with their tail when irritated; I had lately occasion to notice the same peculiarity in a large specimen of *Craspedocephalus atrox*.

MISCELLANEOUS.

Additional Observations on Chelymys dentata. By Dr. J. E. Gray, F.R.S. &c.

In the previous Number of the 'Annals' (p. 98), I described a new species of *Chelymys*, from the Upper Victoria River, brought to England by my late friend Mr. Elsey, and not by Mr. Macgillivray, as inadvertently stated in that paper.

When I made that description, I had forgotten that we had also an adult specimen, brought from the same locality at the same time, which is doubtless the adult of this species; and this specimen proves that the dentated form of the margin is only a peculiarity of the younger state of the species; and therefore the specific name is not one that I should have chosen if I had had the adult form of the species before me when I selected it. But as the margin is not dentated in the young of the other species, it is still characteristic. The species is easily known from the other, both in its adult and young state, by the absence of the nuchal plate.

The adult shell is oblong-ovate, solid, and high; the back is worn smooth, and the margin is entire, the edge over the legs being rather expanded, and the hinder part over the tail rather inflexed; the vertebral plates are very long, slender, with straight parallel sides, nearly twice as long as they are wide; the hinder part of the fourth shield is rather narrowed. The sternum is narrow, rounded in front, and with a deep semicircular notch behind, high on the sides. The underside is black, with a few unequal-sized yellow blotches. The length is 13 inches; width over the back $10\frac{1}{2}$ inches.

On a New Genus of Humming-Birds. By John Gould, F.R.S.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—I send for insertion in your next Number a description of a new and very singular Humming-Bird which I have lately received from Ecuador. Not only does it differ specifically from every other with which I am acquainted, but it also differs in its structure from every form comprised in the great family of Trochilidæ. I therefore propose to call it

Androdon æquatorialis.

This new bird is so very singular that it is not easy to say to which section of the family it is most nearly related; but in some of its characters it assimilates with *Gryphus*, *Eutoxeres*, and *Doryfera*. In size it is about equal to *Lampornis Mango*; the edges of its mandibles are thickly set with fine teeth, like those of *Gryphus*, but are more strongly developed; the bill is very long for the size of the bird, and has rather an upward curvature; the wings are moderate in proportion to the body, and the tail is square or slightly rounded. The bird must be ranked among the dull-coloured species of its extensive family; at the same time it exhibits some approach to a metallic lustre in the blue or bronzy-red colouring of the hinder part of the crown. I say blue or bronzy-red, because the only two specimens I have seen differ in this way, as they also do in the form of the bill,—the one with a blue crown having the toothing very strongly developed, and the bill terminating in spiny hooks which cross each other when that organ is closed; while the other with a bronzy-red crown has a longer bill, the serrations less developed, and the spiny hooks wanting. The tarsi are bare of feathers; and the feet are small, pale in colour, and with very long black nails. The back in both is bronzy green; the rump apparently crossed with white feathers, while the upper tail-coverts are bluish; the tail-feathers are pale olive-grey at the base, crossed with a band of blackish green near the tip, the three outer ones on each side being largely tipped with white; wings purplish brown, with epaulets of light grey, similar in form to those seen in *Helianthea Eos*; all the under surface grey, with a conspicuous streak of blackish brown down the feathers of the throat, as in *Eutoxeres*.

Total length $5\frac{3}{8}$ inches; bill $1\frac{7}{8}$; wing $1\frac{5}{8}$; tail $1\frac{3}{4}$.

Habitat. Ecuador.

I remain, Gentlemen,
Your obedient Servant,
JOHN GOULD.

26 Charlotte Street, Bedford Square,
August 26, 1863.

Description of a New Species of Lemur.
By A. D. BARTLETT.

In size this animal nearly equals the Ruffed Lemur (*Lemur Macaco*), which it also much resembles in form and habits.

The living specimen now exhibited was purchased for the Society from a dealer in Liverpool, in the month of October 1861, and has been in the Menagerie since that time. It was stated, by the person who brought it to this country, that the natives of Madagascar, from whom it was obtained, said it was of a very rare kind, and that it had been kept as a pet upwards of two years in that country.

I have compared this animal with the descriptions and specimens that I have been able to find in the British Museum and several museums on the Continent, and I feel satisfied that this animal is specifically distinct from any that I have met with. I therefore propose to call it the White-whiskered Lemur (*Lemur leucomystax*)—a name that will, I think, enable any one to recognize the species, it being remarkable for its long and perfectly white whiskers, in which its ears are almost entirely concealed; the face is greyish black, darkest on the nose and back part of the head; the feet are brown, inclining to black on the toes. The prevailing colour of the body, limbs, and tail is reddish brown on a grey ground, darkest on the middle of the back; on the lower part of the back, at the base of the tail, is a white patch; the tail is lighter in colour than the body, the underside and tip nearly white; the belly is greyish white; the eyes are yellow-brown. On examination, I find the animal is a female; and I imagine, from her voice, which is a kind of hoarse croaking bark rapidly and frequently repeated, that the male would probably produce a louder and more powerful note.

I am led to infer this from having repeatedly heard the voice of both male and female of *L. Macaco*. The voice of the male of this species is certainly very astonishingly powerful, and can be heard a great distance; while the voice of the female, although loud and discordant, is comparatively weak. Nevertheless it is a very unpleasant series of loud, grunting, grating barks, sufficient to alarm a nervous traveller should he be in the forest at dark and unacquainted with the size and nature of the animal producing these loud and dismal sounds.—*Proc. Zool. Soc.* Dec. 9, 1862.

On a New Species of Chameleon. By Dr. J. E. Gray, F.R.S. &c.

Chamæleo lævigatus.

Grey or bluish in spirits. Scales small, flat, subequal, uniform; dorsal line nearly smooth, scarcely crested. Belly with a crest of larger acute white scales. Occiput slightly raised in the centre by a slight keel; the superciliary ridges and the central keel scarcely dentated. The legs elongate, very slender. *Hab.* Khartoom.

This species is very like *Chamæleo senegalensis*; but the scales on the ridges of the head and the ridges of the back are of the same size as those of the neighbouring parts, and therefore do not form any appreciable crest. The occiput is rather differently shaped, the hinder central keel being a little more prominent. The scales of the head, body, limbs, and tail are smaller and less raised. The limbs are longer and more slender.

This species is very different from the *Chamæleo affinis* of Rüppell (which is the *C. abyssinicus* of the Berlin Museum), from Abyssinia, which differs from both *C. senegalensis* and *C. lævigatus* in the scales being much larger and more convex, and in the scales of the ridges of the head and back being larger than those on the neighbouring parts, so as to form distinct crests; and in *C. affinis* the body is grey or blackish, with two or three broad, irregular-shaped, opake-white spots, forming an interrupted streak on each side of the back of the animal.—*Proc. Zool. Soc.* March 24, 1863.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 70. OCTOBER 1863.

XXIV.—*On the Presence of Chlorophyll-cells and Starch-granules as Normal Parts of the Organism, and on the Reproductive Process, in* Difflugia pyriformis, *Perty; also on a Freshwater Species of* Echinocystidia. By H. J. Carter, F.R.S. &c.

For some time past I have been inclining to the view that, although the Rhizopoda must be placed on the animal side of organized beings, still they have very strong alliances with the vegetable kingdom; and this opinion has been confirmed by what I have lately observed in *Difflugia pyriformis*, Perty (mihi), wherein the body, apparently after conjugation similar to that of the contents of the cells of *Spirogyra*, contracts itself into an elliptical form, densely charged with chlorophyll-cells and starch-granules. I cannot now state confidently that the contents of both tests, after amalgamation, finally become fixed in one only, as in *Spirogyra*; nor, on the contrary, am I prepared to state that they become divided between the two individuals, for reasons which will be mentioned hereafter; but this much may be stated—that the number of chlorophyll-cells and starch-granules greatly increases in the body of this *Difflugia* just previously to subsequent changes, in which they seem to disappear altogether (at all events, the former) and are replaced by a mass of colourless granuliferous cells which may be inferred to be the elements of a new generation.

Before, however, proceeding to that which I have to offer on the subject, it is desirable to describe the species which is about to come under our consideration; and this may stand as follows:—

Difflugia pyriformis, Perty.

Test ovate-elongate, closed and rounded posteriorly, open and truncate, with even or undulating aperture, anteriorly; composed of hyaline grains of quartz-sand, held together by a glutinous (albuminous?) substance. Animal consisting of diaphane and sarcode, the former disposed in a transparent layer around the latter, and sending off processes of attachment from its posterior third to the inner surface of the test; sarcode more or less clouded by the presence of chlorophyll-cells, which impart a green colour to the body, by the "moleculæ," the "granules," and portions of food in process of digestion. Granules abundant, minute, colourless. Nucleus situated in the posterior end of the body, fixed, and consisting of a transparent spherical cell bearing on one part of its inner surface the nucleolus in the form of a circular, colourless, opake, discoid body much less in diameter than the nuclear cell. Contracting vesicles or "vesiculæ" not seen, but probably in plurality, and situated round the border of the posterior end, as in *D. tricuspis*, Cart.

Hab. Fresh water, in stagnant pools, with decaying leaves and vegetable matter. Active in the spring (April), passive and more or less retracted within the test in the autumn (August). Locomotion and capture of food performed by digital prolongations of the body slowly projected through the aperture of the test, and into which the chlorophyll-cells do not enter.

Size. Length $\frac{1}{66}$th, greatest breadth $\frac{1}{150}$th, and width of aperture $\frac{1}{360}$th of an inch. Thus the test is a little longer than twice its breadth. In upwards of 200 specimens the measurements varied very little from those given.

Loc. England, south coast of Devonshire.

Observations.—I learn from MM. Claparède and Lachmann (Etudes sur les Infusoires et Rhizopodes, p. 448, for a copy of which work, received since my return from India, I now beg to acknowledge myself under great obligation to the authors—the latter, alas! removed by death too soon for the interests of science) that there is a *Difflugia pyriformis*, Perty (Zur Kenntniss, &c., p. 187, pl. 9. ob. Abth. f. 9); and I see a figure of *D. pyriformis* in pl. 21. f. 17 of Pritchard's 'History of the Infusoria' (ed. 1861) without further mention, but so much like the one which I have above described, that, on the evidence altogether, I do not hesitate to call the Devonshire specimens *D. pyriformis*, Perty. Also, among upwards of 200 specimens of *D. pyriformis*, I have only found five with that diverticulum at the posterior end which led Ehrenberg to call it *D. acuminata*, but in other respects so like, in the *green* body and sandy composition of the test, that I cannot help thinking it is only a variety of *D. pyriformis*. Each of these five, however, were only about $\frac{1}{100}$th of an inch long, including the diverticulum, while *D. acuminata* (ap. Pritchard) is set down at $\frac{1}{70}$th of an inch in length. Lastly, among the 200 were also three or four subglobose specimens, like *D. proteiformis*, Ehr., which are set down as $\frac{1}{240}$th of an inch in Pritchard (p. 553), but mine averaged only $\frac{1}{900}$th of an inch in length; yet in April last I found two others in the same place larger than Pritchard's measurement, viz. $\frac{1}{160}$th of an inch long; so that all three of these *Difflugiæ* are found together here; and although the latter, in the few specimens of it which I obtained, did not present the green colour of the two former, yet it is so like them in every other respect, that I cannot help thinking that *D. acuminata* and *D. proteiformis* are but small varieties of *D. pyriformis*, which is by far the largest in body of all, because the measurement assigned to *D. acuminata* (viz. $\frac{1}{70}$th of an inch) probably includes the diverticulum. Still the Rhizopoda vary so much both in size and form, that the tailed variety may be the largest, and the pyriform one subordinate in size and number, or the subglobose one, and so on, in another locality. In the present instance, however, it is *D. acuminata* and *D. proteiformis* which are so very subordinate in size and number. The absence of the green colour in *D. proteiformis* may have taken place in the process of generation, as it will hereafter be shown to do in *D. pyriformis*; at the same time, if future evidence should prove that it is never green, then it will be necessary to regard *D. proteiformis* as a different species; for the green colour in *D. pyriformis* and *D. acuminata* is due to the presence of chlorophyll-cells, as much as the green colour in the body of *Hydra viridis*.

Of the 200 specimens of *D. pyriformis* mentioned, there were eighteen colourless ones, owing, as just stated, to the total absence of chlorophyll-cells, which appears to indicate the stage in the generative process to which I have just alluded.

There were also fourteen empty tests (and I have found many more since, with a less number of filled ones), which may have arisen from their contents having left them during the process of conjugation, or, in a more advanced stage of the generative process, from the old animal having become effete, and the new generation having left the test, or from the death of the animal accidentally. The number, however, is so much out of proportion to the filled tests, both green and colourless, that it stands much against the possibility of the conjugation being exactly like that of *Spirogyra*, *i. e.* of the result of this conjugation being always to leave one cell empty.

All my specimens were collected from the same place where I found *Amœba princeps* in April last (see Annals, vol. xii. p. 30, 1863), and in the following way, viz. by taking up the surface of the bottom of the little pools of water among the dead leaves with an india-rubber bottle and tube, and transferring it to a glass bottle, then taking out the sediment by portions with a large hair pencil, and spreading it over a glass slide with a piece of white paper under it for the green, and one of black for the colourless specimens, after which the *Difflugiæ* may be easily recognized with a magnifying-glass, separated with a needle, and finally transferred to some clean water previous to further examination.

On the sides of the bottle holding the sediment I have observed several specimens at different heights, and all green but one, which was colourless; besides, all the specimens which I have crushed under the microscope have contained portions of food; from which circumstances both green and colourless specimens may be assumed to be still more or less active, although not near so much so as in the spring of the year,—thus not differing from other beings (as will be seen hereafter) in continuing to take in nourishment throughout the greater part of the generative process. During the time that the body is densely charged with chlorophyll-cells, and the grains of sand of which the test is composed are thick and irregular, it is impossible to see the different parts of the animal *in situ*; hence it was only a chance specimen which fell under my eye in April last, from the locality to which I have alluded, that, with few grains of sand on it, and very few chlorophyll-cells in the interior, then permitted me to make the drawing from which the above description has been taken.

It is remarkable, too, that in no instance have I yet found a *coloured* grain of sand in the test; all have been composed of hyaline quartz, as if the animal had exerted a choice in this respect—a choice of those particles only which allowed the light to pass through them uninterruptedly.

Further, with the exception of *one* adult specimen of *Amœba princeps*, I have not seen a single *Amœba*, large or small, during these examinations, where, in April last, *A. princeps* so abounded. It should perhaps be added that there had been very little rain previously for many days, the water had become low, and there was no development, at this place, of the Confervoid Algæ, which, on decomposing, afford so much nutriment to the Rhizopoda. Whether this, or the season of the year, has led to the scarcity of *Amœbæ* at this time or place I have not yet had an opportunity of proving.

With this short introduction, let us turn our attention, first, to the composition of the green spore-like body, as it is now found in the tests of *Difflugia pyriformis*, and then to the colourless one; for which purpose it will be necessary to remove one of the *Difflugiæ* with the green body (as that is the first to be examined) to a slide, with a little water, and then cover it with a light thin bit of glass; after which it should be placed under the microscope, and, watching it while it gradually becomes crushed and its contents issue, by abstracting part of the water with a little bibulous paper we shall observe that these contents are composed of—

1. A small quantity of thin protoplasm, with its imbedded "moleculæ," which suspends and holds together the general mass. This frequently oozes out, too, in spherical portions, of different sizes, each of which may contain more or less of the moleculæ, but must not be mistaken for separate cells—the variety in size helping to show that they do not belong to any special set of cell-organs.

2. A great number of spherical cells, of a fresh green colour, about $\frac{1}{6000}$th of an inch in diameter, containing chlorophyll and granular protoplasm.

Iodine with sulphuric acid causes their contents to assume a dark brown colour. Sulphuric acid alone gives them first a sea-green or bluish-green tint, and then extracts the colour*.

These cells are exactly like the chlorophyll-cells of *Hydra viridis,* with the exception of being a little smaller. Fortunately this animal was present for me to make the comparison.

3. A nearly equal number of colourless refractive granules, of globular, oval, and irregularly round forms, more or less compressed, and of different sizes, varying from $\frac{1}{3000}$th to $\frac{1}{600}$th of an inch in their greatest diameter respectively, the smallest being the most numerous.

Very diluted sulphuric acid, followed by iodine, gives them for the most part a deep claret colour, and, to many, very frequently the deep blue colour characteristic of genuine starch. Strong sulphuric acid, preceded by iodine, causes on its approach much blue colour to appear, indicative of the presence of amorphous starch in the mass, which colour disappears on the strong acid reaching it; it also causes a pellicle to appear on the large granules, which swell up and, bursting, frequently display a crevice in the centre, or radiating cracks which show that the interior of the granule is filled with a homogeneous, semitransparent, pulpy substance; while the small granules lose all their colour, but the pellicle remains, and still retains their forms respectively. Indeed the indications, both physical and chemical, in these granules, of an amylaceous composition are so strong, that although the genuine blue colour may not always be brought out in them by chemical means, yet no doubt can remain that they are starch in some form or other.

4. There are also a few oil-globules frequently present; but

* By "iodine" I mean a solution of iodine in one of iodide of potassium.

the great bulk of the mass is composed of the chlorophyll-cells and starch-granules in nearly equal proportions.

5. The nucleus is no longer a discoid semiopake body attached to the inner surface of a transparent spherical cell; but this spherical cell, which is now about the $\frac{1}{461}$st part of an inch in diameter, is filled (lined?) with refractive spherules, about $\frac{1}{6000}$th of an inch in diameter, mingled with minute granules and protoplasm. These contents are *now* adherent to the external thick cell of the nucleus (or "nuclear utricle," as it has been termed by Nägeli), but subsequently become separated from it, while in one part of the spheruliferous mass may be observed a small transparent area, about $\frac{1}{1500}$th of an inch in diameter, which appears to be the nucleolus: the last is compressed in shape, and will hereafter be found to form a more intimate bond of union between the spheruliferous mass and nuclear utricle than any other part. The spheruliferous mass seems to be a thus altered state of the transparent protoplasm of the nucleus, and not an increased development of the opake nucleus, as I formerly thought.

Here I would take the opportunity of correcting what now appears to be an error in my description of the nucleus in *Amœba princeps*, viz. that whereas I have viewed the "transparent area" there as caused by the *nucleolus* partially spreading over the inner surface of the nucleus or nuclear utricle, from the opposite point, and thus leaving this area, I would now regard the "transparent area" as I have done that one which is similar to it in the granulated nucleus of *Difflugia pyriformis*, viz. as the nucleolus, and the opake portion as a thus altered state of the transparent protoplasm of the nucleus, which ultimately becomes granuliferous both in the "reproductive cells" and in what I have termed the "granulation of the nucleus." This, too, will, I think, accord better with Dr. Wallich's figure of the nucleus in his *Amœba villosa* (Annals, vol. xi. pl. 9. fig. 7, 1863); for I, of course, do not regard this condition now as the primitive state and form of the nucleus, which is that probably of a discoid opake body attached to the inner surface of a transparent globular vesicle, as in other cells, but, on the contrary, as the first phase of its generative development. Hence my assumption that the latter state may form a specific character for *A. princeps* falls to the ground, and the villous tail, first pointed out by Dr. Wallich, may prove a better indication.

Iodine causes the nucleus of *Difflugia pyriformis*, in the state last described, to assume a light amber-colour, which passes into a violet tint with undiluted sulphuric acid, when the whole body suddenly swells up, but does not burst, the spherular structure is destroyed, and the violet tint appears to be deepest in the situation of the nucleolus. Iodine alone, however, does not alter the colour of the spherules, even when, by forcibly bursting the nucleus, they are pressed out into the surrounding liquid.

6. Lastly, portions of food are always present, which show, by the yellow and brown state of their chlorophyll, that they are undergoing digestion, while they thus contrast strongly with the fresh green colour of the chlorophyll-cells, which form part of the organized structure of the *Difflugia*.

Thus we have gone through the contents of the body of *Difflugia pyriformis* under its *green* colour, and have seen that the bulk of these contents chiefly consists of chlorophyll-cells and starch-granules. Let us now examine the body in the colourless animal, where we shall find our attention drawn from the striking characters just mentioned, which so strongly connect *D. pyriformis* with the vegetable kingdom, to that part in the economy of this species which is intimately connected with the process of generation.

Taking, then, one of the colourless specimens and placing it in the field of the microscope under similar circumstances to the green one, we shall observe that in the body there is now—

1. The same kind of protoplasm as in the green state, but much more plentiful and much more plastic.

2. An *entire* absence of the green or chlorophyll-cells.

3. The number of starch-granules more or less reduced.

4. Little or no appearance of oil-globules.

5. The greater part of the bulk of the mass, now consisting of small, colourless, acapsular, granuliferous cells, of a globular or oval shape, about $\frac{1}{6000}$th of an inch in diameter, most of which are undergoing multiplication by duplicative division, in which condition they are just twice the length of the single ones. These bodies are smaller in some colourless specimens than in others, indicative of an earlier state of development.

Iodine gives them a light amber tint, which is slightly deepened by sulphuric acid.

6. The nucleus, of the same size as in the green specimens, viz. the $\frac{1}{461}$st part of an inch in diameter, but now more or less *effete*, inasmuch as the spherules have nearly or wholly disappeared, as the case may be, from the nuclear protoplasm, and have left a delicate deciduous structure, apparently sacciform, which, by the aid of chemical tests, is now found to be detached from the nuclear utricle at all parts, except where the nucleolus still connects it with this utricle. But the nucleolus, now that it can be more distinctly viewed, is seen to be composed of a circular compressed cell, which, while it unites the effete protoplasm to the nucleus, also presents a number of small spherules

in *its* interior, within which, again, is another cell or transparent area: that is, the nucleolus appears to be composed of its proper cell, then a protoplasm in which *its* spherules are developed, and then within this again a central cavity filled with some transparent fluid—being now, in fact, only a repetition in structure of the nuclear utricle which surrounds it, and of the vegetable cell generally.

Out of the fourteen colourless specimens, only two afforded me the opportunity of seeing the effete nucleus, it having previously disappeared in the rest through atrophy, or having become destroyed by contact during compression with the rough grains of sand of which the test is composed—a frequent occurrence in examining the contents of the green specimens.

One of these effete nuclei represented the description just given; and the other differed from it only in a large portion of the grumous contents of the nuclear protoplasm still remaining in it, but no spherules, while the nuclear utricle had become ruptured at one point, and a small portion of the nuclear protoplasm, now presenting a sacciform appearance, entangled in it, to which one of the granuliferous cells above mentioned adhered outside, and so strongly that it could not be separated by any means that would not destroy the whole structure of the nucleus. This granuliferous cell I therefore infer to have been one of the spherules, which was still so far united to the parent protoplasm; but whether the rupture was caused by the pressure to which the nucleus had been subjected, or had occurred naturally, to allow of the passage of the spherules from the nucleus into the body of the animal (as appears to be the case in the process of reproduction in the Rhizopodous cell which inhabits the protoplasm of *Nitella*, of which more hereafter), remains to be determined. There was also an appearance, on the external surface of the nucleus, of a minute hole extending through the nuclear utricle to the centre of the nucleolus; but whether, again, this was caused by the presence of the transparent area in the centre of the spherules of the nucleolus, or by a real hole, I was not able to decide. In much of this examination I was greatly assisted by the use of iodine and sulphuric acid, which, it should be remembered, must be used cautiously, and time given to them to produce their respective effects, or they will fail to elucidate that amount of structure which otherwise may be brought out by their application.

7. Lastly, surrounding the whole animal portion in one specimen of the colourless *Difflugia*, was a tough transparent membrane like a capsule, which, tested with iodine and strong sulphuric acid, showed a violet tint, and seemed to have been secreted for the protection of the young; but, as it only occurred in one

instance, I merely mention the circumstance for what it may hereafter prove worth.

Thus, from the granuliferous cells having been *added* to the animal mass, and their being smaller in some specimens than in others, owing apparently to an earlier stage of development, the absence of the spherules in the nucleus while it presented an effete form, and the diminution in the quantity of starch-granules—to say nothing of the total disappearance of the green or chlorophyll-cells, and the presence, in one instance, of a capsular membrane—the colourless specimens of this *Difflugia*, altogether, afford strong evidence of that stage of generative development in which the young brood, as yet without the power of locomotion, have passed from the nucleus into the body of the parent for further development.

Since the above was written, I have examined eight more colourless specimens with the same results. In four of these only, however, was the nucleus seen, and in all it was more or less emptied of the spherules, but not sufficiently well situated for more extended examination with chemical tests.

Of the value of the conjugation in this process it is not in my power to state more than that two tests become united at their apertures, and that in the pair which I found thus united the chlorophyll-cells were still present, and the whole of these, that is, the green matter at least, had gone over to one individual; but subsequently, part returned to their original test, and a flow of contents backwards and forwards between the two tests, which could be plainly witnessed under the microscope, went on for a whole day after they were first discovered in conjugation; at the end of which the tests separated, and the green or chlorophyll-cells became so unequally divided, that one test only contained one-fourth and the other the remaining three-fourths of these organs,—with what amount of the rest of the contents could not be seen.

This is similar to what I have already figured and described in *Euglypha* (Annals, vol. xviii. p. 230, 1856), observing that, "When we find *Euglypha* as well as *Arcella* united not only in pairs, but triply and quadruply in this way, and the same with *Euglena viridis*, the connexion of these phenomena with reproduction, as Claparède has stated, becomes exceedingly doubtful." Now the same kind of plurality in conjugation may, and probably does, take place with *Difflugia pyriformis*; but, then, has it no analogy with other organisms, where reproduction is evidently the effect of conjugation? Certainly in *Spirogyra*, wherein the protoplasm becomes richly charged with chlorophyll and starch just previous to conjugation, we occasionally see two cells tubulating towards one, and one towards two, or the whole of the contents of one cell going over to mingle with those of another, to form the rounded or elliptical spore, as the case may be; or a portion only of the contents doing this, that is, the mass ultimately becoming unequally divided, while *each* portion assumes the rounded spore-form in its respective cell; or an arrest of the process after union of these contents, when the two portions remain connected by an isthmus band through the tube of intercommunication; or, finally, the contents of each cell assuming the spore-like form in their respective cells, without ever mingling at all, &c. Nay, I have drawings of a *Spirogyra* trying to tubulate with the cells of a filament of *Cladophora*,—that is, the tube of intercommunication of the cells of the filament of the *Spirogyra* respectively being projected against those of the *Cladophora*, but ending upon the latter in a bunch of cæcal tubuli which present a rootlike appearance in each instance.

I have not data to state, as before mentioned, whether, in the conjugation of *Difflugia pyriformis*, the whole of the contents of the two individuals *normally* remains in one test or not; for, in the instance mentioned, although this was the case at first, the contents, as I have stated, subsequently became very unequally divided; nor have I found a sufficient number of the empty tests among the filled ones to indicate this; but as regards the union of more than two tests together throwing doubt upon the view that such is a true act of generative conjugation, we have seen that there is just as much variety in the conjugation of the cells of *Spirogyra*, where the conjugation is undoubtedly part of the process of reproduction. Whether the spore-shaped contents of the cells of *Spirogyra*, which thus appear to be imperfectly formed, ever germinate, has not, to my knowledge, been determined. I should think that at least the smaller portions became abortive.

Lastly, we have to consider the import of the small spherules of the nucleolus. Formerly, I thought that they might be sperm-cells, or impregnating-agents, when studying the germinative process in the Rhizopodous cell that inhabits the protoplasm of *Nitella* (see good drawings of this cell, and a description of them, in 'Annals,' vol. xviii. p. 237, pl. 7. figs. 93–98); but on looking over my sketches of this cell in connexion with what I have lately witnessed in the nucleus of *Difflugia pyriformis*, it seems to me that the "protoplasmic zone," which in this instance becomes mulberry-shaped, and which I then supposed to be developed around (outside) the nucleus, should have been regarded as homologous with the protoplasm in which the spherules of *Difflugia* are developed—that is, as the nuclear protoplasm. Certainly, here, in the Rhizopodous cell of

Nitella, the spherules become the new brood, and, on leaving the nucleus, pass into the effete cell of the parent, where still remain the contents (starch and chlorophyll) originally incepted by it in the internodal cell of its host; after feeding on which (for portions of it may be seen in their bodies), these mono- and diplo-ciliated monads (individuals of the new generation) find their way out through the effete parent-cell, and commence their independent existence.

It is thus, in all probability, that the granuliferous cells in *Difflugia pyriformis* leave the nucleus, multiply rapidly by duplicative division (for their number in the body of the parent far exceeds that of the number of the spherules of the nucleus), feed on the starch laid up for them, and finally, becoming ciliated, leave the effete parent, to obtain their future maintenance and development.

The granulation of the nucleus in *Difflugia*, as before stated, seems to be the same as that which I have described in *Amœba princeps*; but that of generation by the "reproductive cells" in *A. princeps* is altogether a different process. In the former, several centres of new individuals become developed in the protoplasm of the nucleus, while in the latter the nucleus appears to begin to form the "reproductive cells" by dividing at once into two equal portions, and so on. But both processes, in their generative imports respectively, are as yet very imperfectly understood; and at present we know no more of them, as regards impregnation, than we do of that of the conjugating Confervoid Algæ generally, the Diatomaceæ or the Desmidiaceæ.

Observations.—In the starch-granules of *Difflugia pyriformis* I cannot help seeing the refractive "cells" (or, rather, granules), with the small granules and protoplasm, which fill the globular cells of the seed-like body of *Spongilla*, each of which globular cells, in the early stage of this body, is a *bonâ fide Amœba*; and when the new sponge-substance issues from the hilous aperture (that is, when the seed-like body germinates), each of the globular cells (now become effete), with its contents, appears to pass into one of the "ampullaceous sacs" (see a description of this, "Ultimate Structure of Spongilla," 'Annals,' vol. xx. p. 21, 1857), while the refractive cells or granules gradually disappear, and are replaced by the polymorphic cells which chiefly enter into the composition of this "sac." Thus my original view, that these refractive grains are "ovules," is changed, as announced in 1859, in my observations "On the Identity in Structure and Composition of the Seed-like Body of *Spongilla* with the Winter-egg of the Bryozoa, &c." (Annals, vol. iii. p. 331), where I have also stated, for reasons therein mentioned, that these refractive granules appear to pass into the formation of the sponge-cells by the "vito-catalytic" influence of a thin film of protoplasm with which they become surrounded.

Now it seems to me that this thin film may be an expansion of one of the "small granules" of the globular cell of the seed-like body, and that these granules might have originated from a granulation of the nucleus of the globular cells respectively; for certainly no trace remains of the nucleus, which as certainly existed when the globular cell was in an active state. It must be understood here that the "granule" is viewed as a nucleus, or centre of vitality, capable of developing a cell around itself in the manner of the germ of the "cell" generally, which membrane in this instance would be plastic and polymorphic, and therefore become expansible into the thin film mentioned.

In this way we should have a direct analogy between the development of the amœbous cell, which, in its plurality, makes up a great part of the ampullaceous sac of *Spongilla,* and that of the new granuliferous cells of the colourless *Difflugia pyriformis,* assuming that the granuliferous cells are the new brood, and that in both instances, viz. in the amœbous cells of the ampullaceous sac and the granuliferous cells of *Difflugia,* respectively, the germs are derived from a granulation of the nucleus.

Further, should the conjugation of the tests of *Difflugia pyriformis* be hereafter shown to be connected with the impregnating process, then it may be fairly assumed that a similar conjugation takes place between two reproductive cells of *Spongilla,* which may lead to a granulation of the nucleus there also, and this, again, to the production of the number of amœbous cells which make up the chief bulk of the seed-like body at the commencement, and which, after the capsule has been secreted round them, ultimately enlarge and pass into the globular cells which fill the cavity of the seed-like body, and which, lastly, in their turn, on the issue of the sponge-substance, follow the development above mentioned.

If, then, the refractive "cells" or granules of the globular cells of the seed-like body in *Spongilla* be the same as the refractive amylaceous granules of *Difflugia pyriformis,* then in those *Amœbæ* in which I have described them as "ovules," and wherever they occur in the Rhizopoda, the same view must be taken of them, viz. that they pertain to the nature of, if they be not fully developed starch-granules.

I long since pointed out that *Spongilla* abounds with starch in all forms. Auerbach has demonstrated it in *Amœba bilimbosa,* and I have also shown that it exists in the chambers of the Foraminifera (viz. in *Operculina Arabica*), and now in *Difflugia pyriformis.*

Again, as in *Euglena* (where I also formerly thought similar refractive cells might be "ovules"), it seems to me now that they might also be considered as analogous to the refractive granules of *Spongilla*, &c. (that is, of an amylaceous composition), which, with the chlorophyll-vesicles of *Euglena*, would then constitute just as much a part of this and all similar organisms as the chlorophyll-cells and starch-granules have been shown to do of the body of *Difflugia pyriformis*.

Lastly, when we extend this analogy to the *Euglenæ*, &c., it passes us on to *Spirogyra*, *Œdogonium*, and the composition of the contents of the cells of all the Confervoid Algæ, where we find all these refractive granules are actually composed of genuine starch, as much as in the common vegetable cell.

Résumé.—This article is to show—

1. That chlorophyll-cells exist in the body of *Difflugia pyriformis* as part of its organization.
2. That starch-granules form part of its products.
3. That the tests conjugate.
4. That, apparently after this conjugation, when the body of the *Difflugia* is densely charged with chlorophyll-cells and starch-granules, the nucleus becomes charged with spherular, refractive, homogeneous bodies, which appear to be developed in the protoplasm that lines (?) the nucleus.
5. That the spherules pass from the nucleus into the body of the animal, and there, becoming granuliferous, so increase by duplicative division as to form the chief bulk of the whole mass, while the chlorophyll-cells have *entirely* disappeared, and the starch-granules have become more or less diminished in number.

It now remains to be shown whether the granuliferous cells become polymorphic and ciliated, like the spherules in the Rhizopodous cell of *Nitella*, and, finally, whether they pass into young *Difflugiæ*,—for which purpose I have collected a great many of the tests, both green and colourless, and have placed them aside for observation.

The first question is thus answered:—

Since the above was written, the bottom of a watch-glass, in which four of the colourless specimens were placed with a little water four days ago, has become covered with granuliferous cells of the same size and appearance as those peculiar to the colourless specimens, but with the following differences, viz. that they are all provided with a cilium (perhaps two); most are fixed to the watch-glass, and retain their globular form; others are swimming about by means of their cilium; many of the fixed globular forms are altering their shape by becoming polymorphic; and some have lost their cilium, and have become altogether reptant and amœbous. Their sizes average between $\frac{1}{6000}$th and $\frac{1}{1200}$th part of an inch in diameter, the former being that of the globular, and the latter that of the plane or amœbous forms. This has been confirmed by a repetition of this experiment.

Now, as the granuliferous cells on the watch-glass are so much like those in the interior of the colourless specimens of *Difflugia pyriformis* (which granuliferous cells have heretofore been inferred to have come from the spherules of the nucleus in the coloured or green state of the animal), and there is no other source in the watch-glass, apparently, from which they could have been derived, while the four *Difflugiæ* are still alive (for this is a necessary adjunct, since we are now among a class of beings where the death of one frequently affords nutriment for the almost instantaneous evolution of another species), and a gelatinous mass is projecting from their apertures respectively, which may also be inferred to be the protoplasm charged with the granuliferous cells, there can be no reasonable doubt that the granuliferous cells of the watch-glass came from these *Difflugiæ.* And when we find that a cilium is added to them, that they are polymorphic, and that some have lost this cilium and have assumed an amœbous state, which strictly accords with what has been seen in the generative development of the rhizopodous cell of *Nitella,* there can be just as little doubt that these *Amœbæ* are the young brood of *Difflugia pyriformis.* Thus the cycle of generative development in *Difflugia pyriformis,* by "granulation of the nucleus," is so far completed. It is probably the same in *Amœba princeps.*

The next step will be to follow the development of the young *Amœbæ* into the adult testaceous *Difflugia.* But this will be much more difficult, since it may not take place for many months, during which time these little *Amœbæ* may become *pro tempore* inhabitants, and probably subsequent destroyers, of vegetable cells into which they have penetrated for nutriment. Myriads, of course, as in every other case, are themselves destroyed by the contingencies which intervene between infancy and adult age.

While studying *Difflugia pyriformis,* it has been my good fortune to meet with two specimens of another Rhizopod containing chlorophyll-cells and refractive amylaceous granules as normal parts of the animal; but this novelty, if such it may now be termed, does not rest here; for this Rhizopod, which I at first thought to be a loricated *Actinophrys,* proves, on further examination, to be so nearly allied to *Acanthometra* among the Echinocystidia, that I cannot help viewing it as a freshwater species of this order, and shall for the present describe it as

Acanthocystis turfacea, n. sp. et gen.?

Globular, subround, of a green colour, loricated, spiniferous, and tentaculiferous. Lorica flexible, covered with minute, fusiform, slightly curved spicules, which give the outline a fibrous wavy appearance. Spines straight, hollow, of uniform breadth in the shaft, bifid or forked at the distal, and discoid at the proximal extremity, which rests upon the lorica; very numerous, apparently rigid, radiating or turned across each other and moveable as the spines in *Echinus*. Tentacula three times the length of the spines, colourless, delicate, rough or granular, and retractile. Interior of the body lined with granular protoplasm, chlorophyll-cells, and refractive colourless amylaceous granules. Nucleus peripheral? Contracting vesicle also peripheral, and in plurality, if certain temporary and conical projections of the lorica indicate this.

Size. Lorica $\frac{1}{411}$th of an inch in diameter; fusiform spicules $\frac{1}{8000}$th long; spines $\frac{1}{740}$th long, and disk of same $\frac{1}{14800}$th, or twice the width of the shaft; tentacles $\frac{1}{246}$th of an inch long.

Hab. Heath-bog water. Locomotive; progressing by means of the spines, which are ambulacral, and by the tentacles(?). Kind of nutriment and mode of incepting the same undetermined; probably in very minute portions, or by suction, as with *Acineta*.

Loc. South coast of Devon.

Observations.—I have found several specimens of this Rhizopod, one of which was one-third larger than the measurements above given; some are colourless. It at first looks like a spiniferous *Actinophrys*, and not unlike the figure of *A. viridis*, Ehr.

Dilute sulphuric acid, followed by iodine, gives a deep claret-colour to the refractive granules, and a dark brown colour to the chlorophyll-cells, which are thus seen to contain a granular protoplasm. Strong sulphuric acid colours the substance of the tubes apparently black, but, after deepening, extracts the colour of the refractive granules entirely. On the addition of more iodine (*i. e.* iodine in solution of iodide of potassium), the dark colour of the interior of the spines disappears from both ends towards the centre, thus showing that the spines are hollow. Neither strong sulphuric nor nitric acid dissolves the spines nor the "fusiform spicules" on the lorica; while their rigid nature, in addition, inclines to the view that they are both siliceous. During life, the free or forked extremity of some of the spines is closed and pointed. The tentacles disappear, and some of the spines (which are much longer than the general average in certain specimens) become detached under the effect of the acid, when they are easily examined. I have not been able to see any tentacles projected through the spines, as in *Acanthometra*, nor do the spines extend further inwards than the lorica. The whole organism very much resembles in its capsular elements those of the seed-like body of *Spongilla Meyeni*. I saw no crude food in the interior; but the nature of the nutriment, as well as other points in the history of this Rhizopod, may be elucidated by further examination.

XXV.—*Notice of a* Drassus *and* Linyphia *new to Science, and a* Neriene *hitherto unrecorded as British.* By JOHN BLACKWALL, F.L.S.

Tribe Octonoculina.

Family DRASSIDÆ.

Genus DRASSUS, Walck.

Drassus gracilipes.

Length of an immature male $\frac{3}{16}$ths of an inch; length of the cephalothorax $\frac{1}{14}$; breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{16}$; length of a posterior leg $\frac{1}{3}$; length of a leg of the third pair $\frac{1}{5}$.

The cephalothorax is convex, compressed before, rounded in front and on the sides, with slight furrows on the latter converging towards a narrow indentation in the medial line; it is soot-coloured, sparingly clothed with white hairs, and has a narrow fringe of hairs of the same hue on the lateral margins. The falces are conical and vertical; the maxillæ are convex at the base, and somewhat inclined towards the lip, which is nearly quadrate, and slightly hollowed at the apex. These parts are of a brown hue, the inner side of the maxillæ and the extremity of the lip and falces being much the palest. The sternum is heart-shaped, with small eminences on the sides opposite to the legs, and is soot-coloured, but rather browner than the cephalothorax. The eyes are disposed on the anterior part of the cephalothorax in two transverse, slightly curved, nearly parallel rows, the anterior row being rather the more curved; the lateral eyes are the largest, and the intermediate ones of the anterior row are the smallest and darkest of the eight. The legs are long, slender, and provided with hairs and spines, two parallel rows of long sessile spines occurring on the inferior surface of the tibiæ and metatarsi of the first and second pairs; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by two small curved claws, below which there is a minute scopula; the anterior legs have a black hue, with the exception of the base of the genual joint, the extremity of the tibia, the base of the metatarsus, and the entire tarsus, which have a brownish-yellow colour; the fourth pair resembles the first in colour, the coxa and exinguinal joint excepted, which are of a brownish-yellow hue, with a few soot-coloured marks; and the second and third pairs differ from the fourth pair in having the femur, tibia, and metatarsus marked with brownish yellow. The palpi are of a brownish-yellow hue, that of the base of the humeral joint being brownish black; the digital joint of all the specimens examined was of an elongated oval form, and very tumid, indicating that they had to undergo their final ecdysis before they became adult. The abdomen is of an oblong-oviform figure, convex above, glossy, and of a black hue, the under part being the palest; the anterior region of the upper part is sparingly clothed with white hairs, and a short, transverse, curved bar, consisting of white hairs, and having its convexity directed forwards, occurs in the posterior region, a little above the coccyx, which has a few white hairs distributed upon it; the colour of the branchial opercula is brown, and that of the spinners brownish yellow.

Three immature males of this species, captured in the vicinity of Lisbon, were presented to me by the Rev. Hamlet Clark.

Family Linyphiidæ.

Genus Linyphia, Latr.

Linyphia crucigera.

Length of the female $\frac{1}{12}$th of an inch; length of the cephalothorax $\frac{1}{20}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{24}$; length of a leg of the third pair $\frac{3}{20}$.

The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones form a trapezoid, the two anterior ones, constituting its shortest side, being the smallest of the eight; the eyes of each lateral pair are placed obliquely on a tubercle, and are almost in contact. The cephalothorax is slightly compressed before, rounded on the sides, convex, glossy, and has an indentation in the medial line; it is of a yellowish-brown colour, the sides and a spot at the posterior point of the cephalic region having a brown hue. The falces are long, conical, somewhat divergent at the extremity, inclined towards the sternum, and armed with teeth on the inner surface; they are of a pale reddish-brown colour, with an obscure brownish streak passing from their base, on the inner side, obliquely outwards. The maxillæ are straight, and have the exterior angle of their enlarged extremity curvilinear; the lip is semicircular; and the sternum is heart-shaped. These parts have a dark brown hue, tinged with red, the lip being the darkest, and the base of the maxillæ the palest. The legs of the specimen from which the description was made were mutilated, with the exception of one of the third pair; but, from the relative length of the uninjured joints, it is evident that the first pair is the longest, then the second, and the third pair is the shortest; and they are of a pale yellowish hue. The palpi are slender, and resemble the legs in colour. The abdomen is oviform, convex above, and projects over the base of the cephalothorax; the upper part has a yellowish-white hue; in the middle of the anterior half there is a soot-coloured cross, and on each side of the posterior half there is a strong longitudinal black band; these bands converge towards the spinners, immediately above which they unite; the colour of the sides and under part is brownish black, and that of the branchial opercula is yellow; the sexual organs are well developed, of a red-brown hue, and have in connexion with their posterior margin a long, slender, semidiaphanous process, tinged with red-brown at its extremity, which is directed backwards.

This *Linyphia* was taken in Wicken Fen, Cambridgeshire, and was received from Mr. R. H. Meade in the summer of 1862.

Genus Neriene, Blackw.

Neriene dentipalpis.

Theridion dentipalpe, Wider, Museum Senckenb., Band i. p. 248, taf. 17. fig. 1.

Length of the male $\frac{1}{11}$th of an inch; length of the cephalothorax $\frac{1}{18}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{24}$; length of an anterior leg $\frac{1}{7}$; length of a leg of the third pair $\frac{1}{10}$.

The male of this species is rather smaller than the male of *Neriene longipalpis*, but it bears a very close resemblance to it in structure and colour. Its most distinctive characters are, the deeply emarginated or somewhat crescent-shaped termination of the superior apophysis at the extremity of the radial joint, whose outer limb is the shorter; and a minute pointed process on the inferior surface of the apophysis at the extremity of the same joint, on the under side. The males of both species have a small pointed conical process at the extremity of the humeral joint of the palpi towards the outer side, and another on the upper part of the exinguinal joint of the anterior pair of legs.

Neriene dentipalpis may be found during the summer and autumnal months, among the grass of old pastures, in various parts of Denbighshire and Caernarvonshire.

XXVI.—*Second Communication on the Vasa Propria, Laticiferous Vessels, &c., of Plants.* By M. T. Lestiboudois*.

This second communication by M. Lestiboudois was made to the Academy of Sciences in April last, and forms a continuation of the memoir previously presented to that learned body, of which a translation appeared in the 'Annals' for June last (vol. xi. p. 402).

We have established (writes M. Lestiboudois) beyond doubt the existence, in certain plants, of vessels containing coloured liquids.

It has indeed been held that such vessels are primitively nothing more than passages or interspaces, permeated by a thread of granuliferous fluid, and that the formation of a wall to limit them as vessels is a subsequent event. But what does this signify? Are there not cells whose walls are only developed subsequently to the nucleus? and such cells are as perfectly characterized as others. If therefore these vasa propria have such delicate walls as can only be detected at a later period of their existence, they nevertheless constitute a vascular system distinguished by the characters heretofore described. In this we have an established scientific fact.

However, it must be conceded that this vascular system is not in all points a counterpart of that of the blood-vessels of animals. In the leaves these proper vessels form at their origin, by means of their ramifications, a capillary network; but at their termination they do not further divide into delicate branches, to distribute, like the blood-vessels of animals, the nutritive juices to the several organs; they do not extend themselves into all parts; they leave spaces, often of considerable extent, between them, and the liquids they enclose can only reach the surrounding tissues by percolation through their walls; and consequently they are not better adapted for the distribution of nutritive material than fibres and cells, and indeed not so well fitted for that purpose as are passages and lacunæ. There is therefore a notable difference between them and the sanguiferous system of animals, the distributor of nutritive material, and one such as may be held to intimate that they do not fulfil precisely the same purpose.

We have now to inquire whether the fluid contents of the vasa propria are engaged in an act of circulation. On placing under the microscope a petal which has been rendered transparent by soaking in oil, the globules are perceived in rapid motion. This movement may be very completely seen in the living parenchyma of the stipule of *Ficus elastica*, after the removal of the epidermis from both surfaces. In this preparation the micro-

* Translated by Dr. Arlidge from the 'Comptes Rendus' for April 27, 1863.

scope shows the liquid in rapid motion, dragging the globules along with it, taking its course through the vessels and their anastomotic ramifications, and reaching their collateral branches, where it encounters other currents either pursuing the same or an opposite direction. At times the globules accumulate at some part of the vessel, and appear to block it up, until, by an effort of organic power, the obstacle is removed, and the stream resumes its ordinary course, unless it be diverted into another.

At points where the vessels are contracted, the globules may be frequently seen to overcome the incomplete barrier to their course by a leaping movement. All these phenomena can be indisputably made out; they represent a circulatory or at least an oscillatory movement, which cannot be gainsaid. The term *cyclosis* has been applied to it to distinguish it from the ordinary circulation, which conducts fluids regularly and towards a certain organ.

It has been asserted that this movement is due simply to the escape of fluid consequent on the wounding of the vessels prior to examination, or on the effects of heat, or on those of pressure or twisting to which the tissues are subjected. However, this same movement may be observed in entire and uninjured organs, and neither its constancy nor its rapidity can be explained by the occurrence of pressure. If the act of cyclosis be denied, there are equal, and indeed stronger, reasons for denying the gyration or rotation of the liquids within cells. The movements in these are sometimes so complicated that their granules, as they course along in reticulated lines through a substance of mucilaginous consistence, seem to circulate in an outstretched capillary network, either from the centre to the periphery or from the periphery towards the centre, and either to collect in a mass or to distribute themselves abroad. The transfer of granular liquids in the vasa propria is not less remarkable nor less constant than is that witnessed in the interior of cells.

The explanations offered by M. Schultz may at the same time be rejected. For our part, we are not disposed to adopt the hypothesis of repulsion and attraction among the granules of the proper juices; we do not look upon the contractility of the vessels as proved, but we cannot overlook the constant phenomenon of the transportation of the liquid contents of the vasa propria—not regularly from one point towards another, but in such a manner that the granules are driven into all the ramifications of a more or less complicated network. The force which causes their circulation also contributes, in all probability, to their frequently rapid effusion when the tissues are wounded; and this force is destroyed with the cessation of life. Not a drop of coloured liquid escapes from the section of a plant which has been plunged for a few seconds in boiling water. [This seems, to our mind, not to prove the effects of death simply on the escape of the laticiferous fluid, but to show the coagulability of that fluid by the heat employed. In other words, is not the retention of the fluid a consequence of its coagulation by heat?—TRANS.]

A very high importance should therefore be assigned to the coloured juices and to the apparatus which contains them, if this structure be found to present a uniform character in all those plants which are provided with laticiferous fluid. Let us therefore inquire whether this system possesses in its organization that character of uniformity which the general function attributed to it seems to demand. In other words, have all lactescent plants a vascular system?

We have already remarked that vasa propria are more scarce in certain parts of lactescent plants than in others, and that they are not met with at all in some of their important organs, and notably in the roots. For example, these vessels, which occur so plentifully in the stem of *Asclepias syriaca*, are infrequent in that portion of the stock which is furnished with buds, and are nearly or altogether wanting in the inferior part of this organ.

Moreover the proper vessels may become altered in character, and, so to speak, lose their primitive conformation, their continuity, their divisions, and their anastomoses.

In *Sambucus Ebulus* I have met with, in the bark and medulla, rigid, isolated, straight, and thick-walled tubes, which contained a coloured substance of considerable consistence, that became of an intense red in contact with the air, and was collected in irregular masses, grouped confusedly. These tubes were certainly more like fibres than vasa propria, nevertheless they contained special juices. I have also seen the like in *Sambucus nigra*, except that here the contained matter was less deep in colour.

In *Ferula tingitana*, and in several plants of the family Umbelliferæ, the proper juices are likewise contained in thick-walled tubes.

On approaching the roots, the reservoirs of coloured juices are found to change their nature. Thus in *Chelidonium majus* the yellow juices of the stem circulate in long and continuous vessels, whilst in the root the juices, which have acquired an orange-colour, are contained in cells of greater or less thickness, united end to end, so as to form irregular fibres. Further, in several Convolvulaceæ the coloured juices in the roots are found collected in utricles—a circumstance observed in the external bark and in certain cortical layers interposed between the ligneous tissue of one of the Convolvuli from Brazil. The same thing may be seen in the *Convolvulus nervosus*.

In the root of *Convolvulus Turpethum* the proper juices are very abundant, and concrete into a yellow resinous substance enclosed in utricles, often considerably elongated.

This modification of form of the reservoirs of the coloured juices is not encountered only in the roots of plants, but also elsewhere. Thus, both in the external and intermediate cortical laminæ of the stem of *Glycine,* red points are seen scattered here and there on the outside of the cortical fibres, formed of cells (utricles) varying in length, more or less regular, and having their internal wall lined with a substance which appears yellow under the microscope. These utricles are disposed in such a fashion as to constitute fibres or bundles, which cannot be regarded otherwise than as analogues of vasa propria, although no exudation of coloured fluid ensues when sections of this plant are made. Certain species of Sapindaceæ also present series of coloured utricles, which, on a section of the stem, look like coloured specks, and whose organization is analogous to those of *Glycine*.

It follows, therefore, that the appellation "vessels" cannot be always given to those organs that contain coloured juices, and that the more general term *reservoirs* is better adapted to them.

This conclusion is so much the more necessary, inasmuch as, in certain instances, the utricles are not even disposed in linear series. For example, in *Piper Siriboa* the parenchyma of the external bark, as well as that of the intermediate cortical layers and the pith, has numerous reddish spots scattered throughout it, composed of cells having walls discernible with difficulty on account of their being overspread with a coloured material that is unequally diffused and analogous to that which lines the cells of *Glycine* and Sapindaceæ; but these utricles, instead of being placed in rows, and thereby approaching the characters of vessels, are accumulated in irregular masses of a more or less rounded outline.

Further, the elaborated juices of plants are met with not only enclosed within vessels and utricles, but also diffused in intercellular passages, or the natural interspaces between the cells, found especially at their angles of junction. They are likewise met with in regular lacunæ, formed by the separation of adjoining cells, and also in irregular lacunæ resulting from lacerations of the tissues. When they occupy intercellular spaces, they do not attain the same dimensions as the cells, inasmuch as they are contained in the intervals left between those portions only of the cell-walls which are not adherent throughout their whole extent. It is this which distinguishes them from reservoirs formed by lacunæ of greater or less size, resulting from a complete severance between contiguous cells. They exhibit themselves as flexuose vessels, of very unequal diameter—an appearance due to the circumstance that the line of junction of the cell-walls, which is obscure to a certain extent, resembles a special wall, and that the passages (*meati*) follow exactly the outlines of the cells between which they occur, and exhibit enlargements at the angles of junction of the cells. Their granular liquid occasionally intrudes into the transverse lines of junction between the cells; and when this does not happen, the obscure line which bounds the reservoir inflects itself between the cells, and no vascular wall passing directly in face of or across the line of junction can be perceived—indicating thereby that the reservoir of the elaborated fluid is not a true vessel. I have observed this arrangement in several Monocotyledons—a division of plants less frequently provided with milky juices than Dicotyledons,—as for instance, in several Aroïdeæ, such as the *Pothos aurita* and the *Caladium seguinum*, where utricles occur filled with granular fluid, and where such fluid is particularly found in intercellular spaces. In certain cases, the mass of proper juices accumulated in these meati is so dense and dark, that it cannot be determined whether it is contained in a vessel or in a space formed by the separation of adjoining cell-walls; in most instances, however, it can be made out, from the indications above pointed out, that it does not occupy a vascular cavity. In *Caladium seguinum* the milky juice is less abundant than in *Pothos aurita*; and in some old leaves the section of the petioles does not give issue to any white fluid; but when young and fresh leaves are selected, a pale though an undoubted milky liquid escapes, which, after the preparation has been boiled, may be demonstrated under the microscope to be contained within cells, but particularly in the intercellular passages.

We shall, moreover, find that, though the *Colocasia odorata* has no distinct latex, a section of its petiole gives vent to a copious discharge of mucilaginous, thick, and granular juice, which is enclosed within cells as well as diffused in a characteristic manner in the intercellular spaces. This observation proves beyond cavil that a great analogy subsists between the different proper juices of plants, and that these fluids may disseminate themselves in the intercellular passages.

Let us now examine those lacunæ, of a more or less regular character, which result from the disunion of tissues.

In *Rhus typhina* (Sumach) we find reservoirs of proper juices which may perhaps retain in a considerable degree a vascular appearance, but in reality have a structure still more widely removed from what we are accustomed to regard as that of vessels properly so called.

In the external layers of the bark the juices are contained in cylindrical straight channels, simple or at times having some anastomoses, which occupy the centre of the fibrous bundles of the cortex. Their diameter is so considerable that they can be detected by the naked eye; and if their surface be scraped with the edge of a sharp instrument, the fluid is seen to flow back under the pressure.

In the deeper layers of the bark, these channels of the proper juices become smaller and smaller and more ramified, but they occupy the same relative position; that is to say, they occur in the centre of the fibrous bundles.

On the internal surface of the bark they assume the form of a vascular network, with very slender ramifications and very irregular anastomoses.

These channels, however, notwithstanding their appearance, are not true vessels. On examining under the microscope the walls of such of them as occupy the centre of the bundle of primitive cortical vessels, they are seen to be formed of short cells (utricles) of a rectangular shape having thin walls, which appear to be filled with the milky liquid. These channels consequently are very analogous to the lacunæ which enclose the resinous secretions of the Coniferæ, and to those of the Cycadeæ which contain the gummy juices; and there is no more reason for regarding them as vessels with cellular walls than for giving the same appellation to the lacunæ holding the gummy and resinous secretions just referred to. The precise limit of their walls cannot be assigned. The channels of the laticiferous juices of the middle cortical layers have their walls similarly organized to those of the external lacunæ.

With respect to the network of the inner cortical layers, it is made up of cells apparently opake from the laticiferous fluid they contain; and no appreciable lacunæ can be discovered between them. Their actual existence, however, cannot be denied; for on cutting very thin sections of the tissue which contains this network, and placing them under the microscope, the reticulations, naturally of an opake white, will be found to have entirely vanished, as if the liquid to which the opacity is due had escaped, and the cells which surrounded it had become similar to the others in the tissue, and were no longer distinguishable from them.

The root of the Sumach contains lactescent juices which exude abundantly from the recently cut bark both of its larger divisions and of its most minute ramifications. On making a transverse section of a large root, the white juices are observed to escape from a number of points disposed circularly and concentrically betwixt the cortical layers, and separated by the thickness of those layers in such a manner that these latex-carrying canals appear to be limited to the external aspect of the several cortical layers. The juices of the outer layers are somewhat yellow, at least at the period when I have examined them (between November and February), whilst those which exude from the outer aspect of the innermost layers of the bark have a pure white hue. These juices thicken and coagulate with much rapidity, and are very glutinous. They are contained in lacunæ of smaller size, less apparent and less regular in character than those met with in the stem. Their cavity is very visible in the external layers, but very much smaller and even quite inappreciable in the internal; so that these lacunæ are no longer distinguishable except by the opake speck formed by the milky juice. They are surrounded by large, short, rectangular cells filled with rounded granules of variable size. These cells are placed end to end in such a manner as to resemble wavy fibres united in a network; but these fibres form bundles less defined than those in the stem, so that the lacunæ also are less regularly circumscribed than their like in the stem, and no longer present the appearance of cylindrical canals with cellular walls; for the tissue that surrounds them is confounded with that adjacent to it. Besides these cells filled with numerous and large granules, a thin tissue is often discoverable immediately around the lacunæ, either empty or occupied with a yellowish granular matter, apparently a special secretion ["proper juice"]. Sometimes, however, the cavity of the lacunæ is immediately enveloped by a tissue of rounded granules, the thin tissue failing, at least, at parts.

If a drop of the milky liquid be placed on a piece of moistened glass, although it be partially coagulated, it is seen (at least from November to February) by the microscope to be composed of a multitude of globular granules, of all sizes, identical in appearance with those which fill the cells adjoining the lacunæ; and the impression is, that these latter contain a proper juice separated into globular particles. However, it can be shown that the grains in these cells are starch-corpuscles; for, when compressed or rolled about under the microscope, they are found to retain their globular shape, and are moreover turned blue when moistened with tincture of iodine; whereas the globules of laticiferous juice coalesce when placed between two pieces of glass and subjected to a gliding or rolling movement, and, further, instead of being coloured blue with iodine, they acquire only a yellowish tint. The tincture of iodine has often, moreover, the peculiar effect of inducing a remarkable segmentation in them, so that these granules, particularly those of considerable magnitude, appear to be constituted of a multitude of others of extreme tenuity. When the granules are allowed to dry upon the glass slide, they at times continue distinct, and retain their globular aspect; but, on the other hand, they often collapse and spread out, uniting together to form films, excessively thin and transparent, and singularly irregular. On dropping tincture of iodine upon a slice of cortical tissue, this agent quickly removes numerous granules of the milky fluid which were contained in the lacunæ. The largest number of the cells become coloured blue as well before as after boiling, although this process causes the disappearance of the starch-corpuscles by transforming them into an amorphous mass. There are nevertheless certain cells which are not so coloured by the iodine, but contain a yellowish granular matter. The elongated cells are either empty or contain a few yellowish granules. Hence, in the Sumach, the coloured juices may be contained in cells, and are certainly met with distributed in the lacunæ; these latter are met with as well in the root as in the stem, and are sometimes regular like vessels, but at other times less distinctly defined and less uniformly cylindrical. The milky juice of *Acer platanoides* is likewise composed of rounded granules capable of coalescing and of forming regular or irregular spots when allowed to dry upon a glass slide. Lastly, there are plants, such as certain *Euphorbiæ*, the proper juices of which become extravasated, and occupy irregular lacunæ formed by the laceration of the tissues.

It follows from what has been stated, that the proper juices of plants are enclosed within reservoirs of widely different structure, which may constitute vessels, or cells, or channels (meati), or lacunæ. Those which must be looked upon as vessels are sometimes long, rigid, thick tubules, without anastomoses, or with few intercommunicating branches; whilst at other times they are thin, flexuose, and branching, with frequent inosculations, and form a more or less delicate network; they present, moreover, at times constrictions here and there, sometimes joints without septa, and at others articulations with septa. Those reservoirs which are nothing more than utricles retain in certain plants a vascular appearance, by reason of the grouping of the cells in linear series more or less marked. Further, these cells are either short or elongated, regular or irregular, thin or furnished with firm and thick walls. In other plants the cells are collected so as to form rounded masses, of very variable figure, making no approach in appearance to a series of vessels. The reservoirs which are intercellular passages (meati) present themselves in the form of slightly branching vessels, constituting now and then a sort of framework around cells. Those which are lacunæ occur in the form of large regular vessels, but slightly anastomotic, or otherwise they constitute a network with anastomoses more or less numerous and meshes in considerable though varying number and regularity of arrangement. Lastly, the reservoirs may be nothing more than irregular cavities produced by laceration.

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

[Continued from p. 109.]

Genus Lophopœum, nov. gen.

Head, antennæ, and general shape of the body as in *Alcidion*. The thorax differs from that and the allied genera in being armed near the centre of each side with an acute tubercle or spine. The surface of the thorax is generally smooth on the disk, but is in some species slightly uneven. The elytra are subtrigonal in shape and depressed as in *Alcidion*; the shoulders are moderately prominent, and in most species a lateral carina extends thence towards the apex, but, as in *Alcidion*, this becomes very obtuse or almost obliterated in some of the species. The apex of the elytra is more or less truncated and spined, and the centro-basal ridges are always prominent, although unconnected posteriorly with a dorsal carina, the disk of the elytra being always even. The ovipositor is not exserted in the females, nor is the apical segment of the abdomen produced. The thighs are thickly and abruptly clavate, and the tarsi very moderate in length.

1. *Lophopœum carinatulum*, n. sp.

L. curtulum, minus depressum, postice rotundato-attenuatum, fusco-ferrugineum, nigro-fusco maculatum: elytris lateribus haud carinatis, carina centrobasali parum elevata nigro setosa, disco plagis tomentosis ochraceis variegato. Long. $3\frac{3}{4}$ lin.

Head rusty brown. Antennæ rust-coloured, base of each joint (from the third) paler; the basal joint somewhat evenly clavate, the upper side being convex, and the lower scarcely flexuous, but tubercled at the apex. Thorax rusty brown, varied with dingy ochreous; the lateral spine quite central and acute. Elytra less depressed than in allied species, and attenuated curvilinearly to the apex, which is briefly and obliquely truncated, and without acute angles to the truncation: there is no lateral carina, and the centro-basal ridge is only moderately raised, but is crested with black hairs; the surface is thickly punctured, except near the apex, and is without raised lines or inequalities, the colour being rusty brown, sprinkled over with darker spots, and varied behind the middle with two or three linear patches of decumbent hairs of an ochreous hue. The legs are rusty brown, with paler rings; the posterior tarsi, with their basal joints, are almost as short relatively as in the genus *Leptostylus*.

One example; Ega, Upper Amazons.

2. *Lophopœum fuliginosum*, n. sp.

L. oblongum, depressum, postice angustatum, fuliginosum, cano nigroque parce variegatum: elytris apice breviter truncatis, lateribus obtuse carinatis, carina centrobasali valde elevata et nuda. Long. $3\frac{3}{4}$ lin.

Head dingy brown. Antennæ (in ♂) greatly elongated and, towards the apex, fine as a hair, sooty brown, the extreme base of each joint (from the third) pallid; basal joint strongly flexuous beneath. Thorax dingy brown, punctured on the disk, which also is marked with four indistinct black spots. Elytra depressed, sides nearly straight, apex briefly truncated, angles of the truncation obtuse; humeral angles moderately prominent, the lateral carina extending thence towards the apex, obtuse, but the centrobasal ridges are strongly elevated, acute, and naked; the surface is somewhat evenly punctured throughout, and of a sooty hue, like the rest of the body, but the apical half has a few whitish specks, and on the disk behind the middle on each side is a short oblique black line. Body beneath and legs olive-brown, base of thighs pallid; tibiæ and basal joint of tarsi also each with a pale ring. The basal joint of the posterior tarsi is longer than the two following taken together.

Neighbourhood of Santarem, Lower Amazons.

3. *Lophopœum circumflexum*, n. sp.

L. curtulum, depressum, postice valde attenuatum, ferrugineo-fuscum: elytris singulis pone medium linea abbreviata cinerea maculaque laterali notatis, apice breviter transverse truncatis, carina centrobasali magna acutissima. Long. $3\frac{1}{2}$ lin.

Head dull brown. Antennæ greatly elongated, fine as a hair, most of the joints furnished with a short bristle at the apex beneath; rust-coloured. Thorax with the lateral tubercles spiniform, disk punctured, rusty brown, the middle with two broad dusky stripes, flanked by spots of the same colour. Elytra trigonal, shoulders prominent; lateral carina obtuse, apex briefly truncated, with the angles rounded; surface thickly punctured towards the base; centrobasal ridges strongly raised and acute, naked, or nearly so; ashy or rusty brown, spotted with darker brown, the disk behind the middle having on each side a short, oblique pale ashy line, accompanied on the side nearer the base with a smaller line of the same hue, lying at right angles to it, the pale lines margined with dark brown. Body beneath and legs rusty brown.

Ega; on dried twigs.

4. *Lophopœum bituberculatum,* White.

Leiopus bituberculatus, White, Cat. Long. Col. Brit. Mus. ii. p. 382.

"*L.* punctulatus, cinereo-fuscus: antennis subferrugineis: oculis supra approximatis: elytris supra subplanis, arcu postmediano cinereo, singulis ad basin medio tuberculo parvo uncinato, ad mediam et posticam partes cinereo variegatis; femoribus basi pallidis; tibiis pallido uniannulatis; tarsorum articulo primo pallido. Long. $3\frac{1}{4}$ lines. Ega." (White, *l. c.*)

This species very closely resembles *L. circumflexum* in shape and colours; but the centro-basal ridges are reduced to a tubercle. The lateral thoracic spines are placed near the middle of the thorax—the position they occupy in the genus *Lophopœum*; but the sides behind them are deeply sinuated, which gives the thorax a similar shape to that possessed by the typical *Leiopi.*

5. *Lophopœum acutispine,* n. sp.

L. latiusculum, depressum, brunneum, postice cano marmoratum: thoracis disco obtuse tuberculato: elytris apice sinuato truncatis, angulo interno acuto, externo longe mucronato. Long. $5\frac{1}{4}$ lin.

Head and antennæ dingy brown, basal joint of the latter flexuous beneath. Thorax wide; disk obtusely tuberculated, sides with the lateral tubercle very prominent and acute; colour dingy olivaceous brown, silky. Elytra rather broad; shoulders prominent, lateral carina proceeding thence, strongly marked and acute, apex rather broadly and transversely sinuate-truncate, the internal angle acute, the external produced into a long tooth or spine; the centro-basal ridge not much raised, but surmounted by a very high crest of hairs; the surface is coarsely punctured only near the base; the colour is the same as that of the thorax, but the posterior half is marbled with light grey. Body beneath silky brownish; legs the same, varied with grey. The basal joint of the tarsi is a little longer than the two following taken together.

Pará; on dead branches in the forest.

6. *Lophopœum cultrifer,* White.

Ægomorphus cultrifer, White, Cat. Long. Col. Brit. Mus. ii. p. 374.

"*Æ.* griseus, fusco variegatus: thorace supra subtuberculato, dorso medio maculis duabus subtriangularibus fuscis, lateribus tuberculo apice acuminato et elevato: scutello fusco-griseo subcincto: elytris singulis basi subtuberculatis, medio tuberculo supra acuto et apice postice producto: elytris singulis apice fasciis duabus fuscis: abdominis segmentis subtus lateribus fusco maculatis: pedibus griseis; femoribus intus fusco punctulatis; tibiis apice late fusco. Long. 6 lin." (White, *l. c.*)

The elongated form and grey colour of this species give it some resemblance to *Ægomorphus*, in which genus Mr. White placed it; but its depressed body would seem to suggest rather a relationship with the *Oreoderæ*. The great length and flexuous shape of the basal joint of the antennæ show, however, that its true place is amongst the Acanthocinitæ; and its strongly raised centro-basal ridges and acute lateral thoracic tubercles point out an affinity with the species I have grouped under the genus *Lophopœum*. Its form is elongate-oblong and depressed; the elytra have not very prominent shoulders, and do not taper to the apex; they therefore have not the trigonal shape which is usual in *Lophopœum* and *Alcidion*: as the species of these genera, however, vary in general shape, this is of less importance. The elytra are sinuate-truncate at the apex, and have both angles of the truncation slightly produced; there is no lateral carina, and the dorsal surface, with the exception of the strongly raised and naked centro-basal ridge, is free from raised lines. The thighs are strongly clavate, and the basal joint of the tarsi elongated.

Taken at Pará, and also at Ega on the Upper Amazons; the species has therefore a wide range.

Genus OZINEUS, nov. gen.

Body small, slender, depressed, and posteriorly attenuated. Antennæ as in *Alcidion* and the allied genera. Thorax with the lateral spines short, placed much behind the middle—in some species close to the hind angles, and in others coincident with them, but remaining always distinct. Elytra narrowed to the tips, which are truncated and toothed or spined; the centro-basal ridges prominent, but generally much smaller than in *Lophopœum* and *Alcidion*. Legs moderate in length; thighs abruptly clavate; tarsi slender, with the basal joint elongated.

This genus seems to form a connecting link between *Lophopœum* and the well-known group *Anisopodus*. Some of the species are almost as much flattened as the Anisopodi, but their hind legs are never elongated as in *Anisopodus*; the possession of prominent centro-basal ridges on the elytra is also a good distinctive character.

The species are all small and fragile; they are found, like most of those of the allied genera, on the bark of broken and decaying branches of trees in the forest, undergoing their transformations beneath the bark.

1. *Ozineus elongatus*, n. sp.

O. angustatus, elongatus, postice parum attenuatus, carneo-cinereus, ferrugineo-fusco maculatus: thoracis spinis lateralibus pone medium positis. Long. $3\frac{1}{4}$ lin.

Head dusky: eyes large, nearly touching above; labrum yellow. Antennæ much elongated, capilliform, rusty brown, base of joints pallid. Thorax rather elongated, the lateral spines placed behind the middle, but leaving a considerable space between them and the hind angles; surface punctured, pinkish ashy, with dark-brown spots. Elytra narrow and elongate, tapering posteriorly to the apex, which is briefly truncate, the angles not produced; sides and disk without raised lines, the centro-basal ridges rising in the form of small tubercles crested with hairs; the surface (except the apical part) is punctured, and is of a pinkish-ashy hue, with numerous darker-coloured spots, some of which are collected into a transverse belt a little beyond the middle. Body beneath and legs pale testaceous; thighs with a large dusky spot; base and apex of tibiæ and tips of tarsi also dusky.

Ega. The position of the lateral thoracic spines is almost the same as in *Lophopœum bituberculatum*; the species would therefore seem to belong to the last genus rather than to the present one; but in the general shape of the body it agrees better with the species placed in the group *Ozineus*, the distance of the thoracic spines from the hind angles being probably due to the general elongation of the thorax and the rest of the body.

2. *Ozineus mysticus*, n. sp.

O. subelongatus, depressus, cinereo-fuscus, lineis angulatis canis ornatus: thoracis spinis lateralibus ab angulis posticis paulo distantibus: elytris postice modice attenuatis, apice peroblique sinuato-truncatis, angulis externis productis, carina centrobasali paulo elevata, elongata, pilis nigris cristata. Long. 3 lin.

Head ashy brown; eyes distant above. Antennæ greatly elongated and hair-like, rusty brown; tips of joints (from the third) blackish. Thorax with the lateral spines placed at a short distance from the hind angles; surface rusty brown, with several curved ashy lines. Elytra depressed, curvilinearly narrowed to the apex; sides with an obtuse carina; tips very obliquely sinuate-truncate, with the outer angles produced; the centro-basal ridge is elongated, very slightly raised, but fringed with black hairs; the surface is moderately punctured in some parts, and is of an ashy-brown hue, with whitish ashy markings, which are in the form of lines near the base, but united in a very oblique angulated belt near the middle, two curved letters remaining close to the suture near the apex. Body beneath and legs pallid; thighs and tibiæ dusky near their apices.

Ega, Upper Amazons.

3. *Ozineus doctus*, n. sp.

O. oblongus, modice depressus, postice rotundato-angustatus, fuliginosus, lineis curvatis albo-cinereis notatus: elytris apice oblique sinuato-truncatis et dentatis, carina centrobasali modice elevata, nigro penicillata. Long. 3 lin.

Head sooty black. Antennæ the same, with the bases of the joints (from the third) pallid. Thorax with the lateral spines placed near the hind angles, sooty brown, with a few whitish specks. Elytra oblong, curvilinearly narrowed to the apex, which is very obliquely truncated, both angles pointed; sides with an obtuse lateral carina; centro-basal ridges slightly raised, fringed with black hairs; the surface thickly punctured nearly to the apex, sooty brown, with a number of ashy-white letter-like marks, some of which are united near the middle of the disk of each elytron so as to form the letter V. Body beneath rust-coloured: legs dusky, base of thighs pale testaceous, the tibiæ in the middle and the basal and claw-joints of the tarsi ringed with pale testaceous.

On dried twigs in the forest at Obydos, on the Guiana side of the Lower Amazons; also at Pará. A closely allied species, having, however, different markings on the elytra, is found at Cayenne, and exists in several collections*.

4. *Ozineus cinerascens*, n. sp.

O. subellipticus, olivaceo-cinereus fusco variegatus: thoracis spinis lateralibus prope angulos posteriores sitis: elytris oblique sinuato-truncatis; carinis centrobasalibus parvis, convexis, penicillatis: antennis pallide annulatis. Long. $3\frac{1}{2}$ lin.

Head and thorax olivaceous ashy. Antennæ brown, the third, fourth, sixth, and eighth joints with their basal halves pale testaceous. Thorax partially punctured, its small acute lateral tubercles placed very near the posterior angles, a minute notch only appearing between them and the hind margins. Elytra

* *O. strigosus.*—Oblongus, modice depressus, postice rotundato-angustatus. Caput fuliginosum. Antennæ obscure rufescentes, articulis apice nigricantibus. Thorax spinis lateralibus prope angulos posticos sitis, dorso fuliginoso-cinereo notato. Elytra apice peroblique sinuato-truncata, angulis acutis, lateribus obtuse carinatis; carina centrobasali modice elevata, pilis nigris cristata, punctata, fuliginosa, singulis lineis quinque fusco-cinereis basin haud attingentibus et plus minusve confluentibus ornatis. Corpus subtus obscure rufescente. Pedes fuliginosi, femoribus basi rufescentibus, tibiis tarsisque rufescenti annulatis. Long. 3 lin. *Hab.* Cayenna.

subelliptical and depressed, the tips obliquely sinuate-truncate; the centro-basal ridge slightly elevated and crowned with blackish hairs; the basal half of the surface is punctured, and the colour is the same as that of the head and thorax, but varied with small olive-brown specks placed partly in rows, and an undulated fascia of the same behind the middle interrupted at the suture. Body beneath and legs yellowish testaceous, thinly clothed with ashy pile; apex of femora and tibiæ and middle part of the tarsi blackish.

Taken on dead slender branches at Santarem and on the banks of the Tapajos. At Villa Nova, on the banks of the Lower Amazons, I obtained one example, which differs considerably in colour from the Tapajos form. This may be called

Local var. *O. pallipes.* Same size and shape as the type. General colour tawny ashy. Antennæ with the basal joint reddish, the remaining joints dusky, with the basal portions of the third, fourth, sixth, eighth, and following joints clear pale testaceous. The disk of the thorax has several olive-brown spots. The elytra are of a reddish-tawny hue, with tawny-ashy pile; they are spotted as in the typical *O. cinerascens,* but instead of a waved fascia behind the middle, they have simply a short oblique stripe on the disk of each. Body beneath and legs pale testaceous; knees, tips of tibiæ, and middle of the tarsi dusky.

O. cinerascens resembles much in markings a small allied species from Rio Janeiro, which is as yet unnamed in collections*.

* *O. ignobilis,* n. sp.—Parvus, subellipticus, olivaceo-cinereus fusco variegatus. Caput fuscum. Antennæ rufo-piceæ, articulis (duobus basalibus exceptis) apice nigris. Thorax olivaceus, spinis lateralibus longioribus acutissimis, prope angulos posteriores sitis. Elytra subdepressa, apice peroblique sinuato-truncata, angulis externis longe mucronatis, carinis centrobasalibus longe nigro penicillatis; dorso punctata, cinereo-olivacea, maculis minutis fasciaque lata pone medium fuscis. Corpus subtus nigrum. Pedes nigricantes; femoribus, tibiis tarsisque dimidiis basalibus testaceis. Long. 2 lin. *Hab.* Rio Janeiro. Coll. Bakewell, Bates.

A very pretty species of this genus, captured near Rio Janeiro, by Squires, in some number, is

O. rotundicollis.—Oblongus, latiusculus, depressus, cinereus, griseus vel fulvus, cano fuscoque variegatus. Antennæ rufescentes, articulis (duobus basalibus exceptis) apice nigris. Thorax brevis, latus, lateribus ante medium dilatato-rotundatis, utrinque spina minuta distincta ab angulo postico distante; dorso punctato, nigro bimaculato, lateribus (infra spinam) plaga fusca cum vitta basali elytrorum conjuncta notatis. Elytra subtrigona, depressa, apice peroblique sinuato-truncata, angulis externis longe mucronatis, carinis centrobasalibus brevibus, carinis lateralibus acutis; dorso punctato, griseo vel fulvo,

Genus Anisopodus, White.

White, Cat. Long. Col. Brit. Mus. ii. p. 349.

Syn. *Anisopus*, Serville, Ann. Soc. Ent. Fr. iv. p. 30 (name preoccupied).
Leptoscelis, Erichson, Consp. Ins. Peruana, p. 145 (name preoccupied).

Char. emend. Body elongated and extremely flattened. Prothorax even on its upper surface, its lateral spines placed near the hind angles. Elytra oblong-oval, flattened, *without centro-basal ridges*; their apices sinuate-truncate and mucronate, their sides each furnished with a sharp lateral carina extending from the humeral angle to the tip. Thighs abruptly clubbed; the hind legs elongated, in the males of some species excessively so. Ovipositor of the female not apparent.

The last genus (*Ozineus*) seems to form the connecting link between the groups allied to *Alcidion* and the present genus, some of the species of *Ozineus* (e. g. *O. mysticus* and *O. rotundicollis*) having very much the general appearance of *Anisopodi*. The absence of the centro-basal ridges of the elytra, and the elongation of the hind legs, however, amply distinguish *Anisopodus* from the four preceding genera.

1. *Anisopodus phalangodes*, Erichs.

Leptoscelis phalangodes, Erichson, Consp. Ins. Col. Peruana, p. 145.

A. "oblongus, planus, badius, dense cinereo pubescens, infra lateribus nigro vittatis: elytris seriatim fusco punctatis, apice mucronatis: pedibus posticis fortiter elongatis, femoribus abrupte clavatis. Long. 5½ lin." (Erichs. *l. c.*) Eastern Peru.

This species is distinguished from its congeners, to some of which (*A. arachnoides*, *A. cognatus*) it is very closely allied, by the sides of the breast and the abdomen being marked each with a streak of a sooty-brown hue (extending to the deflexed margin of the elytra), which, from the silky nature of the pile that clothes the under surface of the body, is fainter in some lights than in others, and in small examples is scarcely perceptible. The site of the centro-basal ridges of the elytra is marked by a small rounded tubercle coloured black. The male is much larger than the female, reaching 5½ lines in length, the female being seldom longer than 4½ lines. The hind legs in the male are sometimes 10 lines long. Besides the black spot on the elytra over the centro-basal tubercle, there is, in the males, a larger and irre-

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medio late cano fasciato, fascia fusco maculata, postice sinuata et fusco marginata. Corpus subtus testaceum. Pedes rufescentes, tibiis apice tarsisque nigro maculatis; tibiis anticis medio intus tuberculo conico instructis. Long. 3½ lin. *Hab.* Rio Janeiro. Coll. Bakewell, Bates, &c.

gular spot on the disk of each towards the apex, and in most specimens a small lateral streak on the edge of the lateral carina a little behind the middle; this latter, however, never extends towards the disk of the elytra, as does the similarly placed spot in *A. arachnoides*, *A. cognatus*, and *A. sparsus*. *A. phalangodes* also differs from its relatives in the shape and direction of the lateral thoracic spine, this being large, robust, and prominent, directed obliquely towards the edge of the humeral angle of the elytra, and not standing at right angles to the side of the thorax, as in *A. arachnoides*, or having its point directed in continuation of the thoracic outline, as in *A. cognatus*. Both angles of the truncation of the elytra are mucronate.

The species occurred, sometimes abundantly, on the boughs of fallen trees, in moist hollows of the forest at Ega, Upper Amazons. I could not ascertain the special use of the elongated hind legs of the male. Like all the species of this and the allied genera, the insects pass their lives on the bark, their larvæ feeding and undergoing their transformations between the bark and the wood, and the perfect insects rambling on the outside of the fallen boughs, on which, after copulation, the females deposit their eggs.

In the collection of Mr. Bakewell there is a specimen of this species from Cayenne, differing from Upper-Amazons examples only in the dark-brown points of the elytra being a little more distinct and encircled with grey.

2. *Anisopodus arachnoides*, Serv.

Anisopus arachnoides, Serville, Ann. Soc. Ent. Fr. iv. p. 31.

A. oblongus, griseus, sericeus, fusco punctatus: thoracis spinis lateralibus distinctis porrectis: elytris apice modice spinosis; tuberculis centrobasalibus hirsutis; lateribus atro-fuscis, maculis tribus adjacentibus, una pone medium, irregulari, majore: pedibus posticis vix elongatis. Long. $4\frac{1}{2}$–6 lin.

Head brown. Antennæ pitchy red, tips of joints (from the third) dusky. Thorax greyish, with two black spots on the fore part of the disk; sparsely punctate; the lateral spines standing out at right angles from the sides. Elytra transversely sinuate-truncate at the apex, the inner angle of the truncation pointed, the outer moderately prolonged as a spine; the surface is grey, with scattered black points and a black pencil of hairs over the centro-basal tubercles: the deflexed sides are dark brown and silky, and, above, this colour extends in three irregular spots—one near the base, one after the middle reaching to the disk of the elytron, and one smaller near the apex. The underside of the body is silky ashy. The legs are dusky, ringed with grey. The hind legs of the male are only slightly elongated.

The above description applies to a species which I have seen in collections at Paris under the name of *A. arachnoides* of Serville, and to which the description of Serville applies, as far as it goes. I found it on the same trees with *A. phalangodes* at Ega, and also met with it at Pará.

3. *Anisopodus cognatus*, n. sp.

A. subellipticus, carneo-griseus, sericeus, nigro punctatus: thoracis spinis lateralibus unciformibus: elytris absque tuberculis centro-basalibus, apice breviter mucronatis, pone medium macula laterali nigra obliqua notatis: pedibus posticis maris elongatis, fortiter clavatis. Long. 4 lin.

Head brownish. Antennæ pitchy red, tips of the joints dusky. Thorax greyish, fore part of the disk with two black spots, punctured; the lateral spines pointing to the hind angles, their anterior sides (nearest the head) being continuous with the lateral outline of the thorax, and therefore giving them a hooked shape. Elytra sinuate-truncate at the apex, both angles of the truncation pointed, but neither prolonged into a spine; the surface is grey with a pinkish shade, irregularly spotted with blackish, and having each, behind the middle, an oblique spot or fascia extending from the side to the middle; the deflexed margins are of a light silky-brown hue, like the under surface of the body. Legs dusky, base of thighs and tarsi pale testaceous. The hind legs of the male considerably elongated; the thighs in both sexes abruptly clavate.

Ega and S. Paulo, Upper Amazons, in the same situations as, and sometimes in company with *A. phalangodes*.

4. *Anisopodus sparsus*, n. sp.

A. subellipticus, carneo-griseus, sericeus, nigro punctatus: thoracis spinis lateralibus brevissimis, antice a lateribus vix distinctis: elytris apice oblique sinuato-truncatis, angulis vix productis, absque tuberculis centrobasalibus, pone medium atro-fusco fasciatis. Long. $4\frac{1}{2}$–$5\frac{1}{2}$ lin.

Head greyish silky. Antennæ reddish, tips of joints dusky. Thorax pinkish grey, punctured, bimaculate; lateral spines on their anterior sides scarcely distinct from the sides of the thorax, their minute points only being directed outwards; they have, therefore, not the hook-like shape of those of *A. cognatus*. Elytra with the angles of their truncation scarcely produced; their surface is grey, with a pinkish tinge, finely spotted with blackish, and with a largish black spot marking the site of the centro-basal tubercles (which are quite absent), besides an angled fascia of the same hue crossing behind the middle. The deflexed sides and under surface of the body are light brown and silky.

The legs are reddish, with the tips of the thighs, tibiæ, and tarsi dusky. The hind legs of the males are greatly elongated, but their thighs are not very abruptly clubbed.

Santarem and Obydos; generally on severed and hanging sipós, or woody climbers, near the borders of clearings. It appears to be not uncommon in Cayenne, examples from which country have been sent to me from Paris as *A. sparsus* of Dejean's catalogue.

5. *Anisopodus pusillus*, n. sp.

A. oblongus, griseus, fusco maculatus: thoracis spinis lateralibus antice a lateribus vix distinctis, retrorsum spectantibus: elytris apice breviter sinuato-truncatis; angulis internis acutis, externis productis; carinis lateralibus obtusis: femoribus modice clavatis. Long. 3 lin.

Head brown. Antennæ reddish, tips of joints dusky. Thorax thinly clothed with grey pile, sides with rufous-brown patches, and disk with two large rounded blackish spots; lateral spines large and acute, scarcely distinct anteriorly from the sides of the thorax, and pointing obliquely towards the humeral angles of the elytra. Elytra oblong, the lateral keels not sharp, and hence the surface apparently less flattened than in the preceding species; apex moderately mucronated; surface greyish, with a moderate number of rather large round brownish spots more or less confluent, one on the site of the centro-basal tubercles (which are quite absent), and another, lateral, near the middle of the elytra, being larger than the others. Body beneath and legs reddish. The legs are rather slender, and the thighs not abruptly, although distinctly clubbed.

This small and delicate species was found only at Pará.

6. *Anisopodus elongatus*, n. sp.

A. elongatus, ellipticus, fulvo-griseus, cano fuscoque punctatus: thoracis spinis lateralibus acutissimis, retrorsum curvatis, basi tumidis: elytris apice utrinque bimucronatis: pedibus posticis femoribus modice clavatis. Long. 5½ lin. ♀.

Head clothed with shining tawny pile. Antennæ reddish, tips of joints dusky. Thorax with the sides rather dilated and tumid at the base (on the fore side) of the lateral spines, which appear curved posteriorly, and have very acute points; disk punctured, tawny brown, with a short polished dorsal line and two discal black spots edged with light grey. Elytra narrow and greatly elongated, both angles of the truncation produced into spines; lateral carinæ rather obtuse, surface punctured, except near the apex, and of a tawny-brown hue, with three rows of alternate whitish and brownish spots, besides a sutural row of brown and grey specks. Body beneath and legs pale brown; hind thighs moderately clubbed in the female.

Found only at Ega, Upper Amazons.

7. *Anisopodus macropus*, n. sp.

A. elongatus, planus, griseus, fusco punctatus: elytris dimidio apicali nigro, cano notato, apicibus utrinque bispinosis: pedibus posticis maris maxime elongatis, tenuibus, femoribus abrupte clavatis. Long. $4\frac{1}{4}$ lin.

Head dusky. Antennæ rust-coloured. Thorax rather long, narrow in front, sinuated on each side, and then abruptly dilated, the dilatation terminating at the apex of the spine, which is obtuse, and points towards the hind angle; the surface is punctured, and has an impressed dorsal line, the colour being obscure greyish, with four indistinct oblong sooty spots not reaching the hind margin. Elytra elongate, narrow, flattened, although having the lateral keels obtuse; the apex transversely sinuate-truncate, with both angles spiniform; their surface is covered with equidistant punctures, and is, on the basal half, of a dull pinkish-grey hue, spotted with dark brown, whilst the apical half is dull black, with a few greyish marks. Body beneath clothed with silvery ashy pile. Legs slender; all thighs abruptly clubbed, the fore and middle pair having on their under side near the base a small tooth; they are of a dusky hue, with the base of the femora pallid. The hind legs in the male (the only sex known) are extremely long and slender.

Of this elegant species I found only a single example at S. Paulo, Upper Amazons.

8. *Anisopodus gracillimus*, n. sp.

A. oblongus, gracilis, olivaceus, nigro punctatus: thoracis spinis lateralibus retrorsum curvatis, basi tumidis: elytris apice utrinque bidentatis, pone medium nigro undulato-fasciatis: pedibus posticis (♂) fortiter elongatis, femoribus abrupte incrassatis. Long. $2\frac{3}{4}$–4 lin.

Head olive-green. Antennæ blackish, base of joints reddish. Thorax with the sides dilated and tumid before the spines, which latter consequently appear curved, and are placed close to the hind angles; the pile of the surface has an olive-green hue, leaving three blackish streaks in the middle—two touching the front margin, and one, lying between the anterior two, the hind margin. Elytra with both angles of the truncation produced, but not to a notable length, the external one longest; lateral keels obtuse; surface olive-green, spotted with blackish, an undulated fascia of the same colour crossing the middle, and two small patches lying on the sides, namely, one near the base, and one near the apex. Body beneath of an olive-ashy tinge. Legs dusky, base of thighs pale. Hind legs of the male greatly elongated; the thighs much more thickly clubbed in the male than in the female.

Taken once abundantly on dried twigs in the forest at Ega.

9. *Anisopodus ligneus*, n. sp.

A. oblongo-ovatus, fulvus, strigosus: thoracis spinis lateralibus conicis, prope angulum posticum sitis: elytris postice valde attenuatis, apice peroblique truncatis, angulis externis mucronatis; femoribus abrupte clavatis. Long. 4½–5 lin.

Head tawny brown, vertex spotted with dark brown. Antennæ reddish, tips of joints dusky. Thorax rather short, coarsely punctured, the lateral spines conical, and placed very close to the hind angles; colour tawny brown. Elytra rather oval in shape, rapidly attenuated from three-fourths their length to the tip; the tip is consequently pointed, and the truncation so short that each elytron may be said to end in a spine notched on the inner side, instead of being obliquely sinuate-truncate; the lateral keel is sharply marked, the surface is marked with several (seven or eight) slightly raised lines extending from the base to near the apex, but most of them bent near the base, and with as many corresponding depressed lines between them, the latter of which are thickly punctured, whilst the raised lines are impunctate; the colour is of a tawny-brownish hue, the base being dusky, and the apical third of a deeper tawny hue—the whole giving to the insect a striking resemblance to a chip of wood. Body beneath and legs reddish. Thighs abruptly clubbed; hind legs of the male greatly elongated.

Taken in the forests of the Tapajos and at Ega. Rare.

10. *Anisopodus lignicola*, n. sp.

A. oblongo-ovatus, cinereo-ochraceus, humeris fulvescentibus: thoracis spinis lateralibus magnis, acutis, obliquis: elytris postice valde attenuatis, apice peroblique sinuato-truncatis, subplanis, punctatis. Long. 3 lin.

Head reddish. Antennæ reddish, tips of joints dusky. Thorax ochraceous or yellowish ashy, with two obscure dusky lines on the disk; the lateral spines large, thick, directed obliquely rearwards, the thorax behind the spines being much narrowed. Elytra narrowed to the tips, which are obliquely sinuate-truncate, the inner angles pointed, the outer spiniform; the lateral keels are obtuse, but distinct; the surface is plane, but not notably depressed, minutely punctured, ashy-ochraceous in hue, with obscure spots and oblique fasciæ (on the sides) of a darker colour, a triangular spot on each shoulder, extending over the scutellum, being of a ruddier ochreous tinge. Body beneath and legs of a tawny colour; thighs moderately clavate.

Pará and the banks of the Tapajos.

11. *Anisopodus humeralis*, n. sp.

A. oblongo-ovatus, niger: thoracis lateribus humerisque fulvescentibus; spinis lateralibus magnis, acutis, obliquis. Long. 3 lin.

Head dusky, with the sides bright tawny. Antennæ pitchy red, tips of joints dusky. Thorax with the sides shining tawny, the middle portion dusky, with two more distinct black dorsal stripes; the spines as in *A. lignicola*—namely, large, acute, obliquely directed rearwards, and followed by a narrowing of the thorax to the base. Elytra oval, narrowed to the tips, which are obliquely sinuate-truncate, the inner angles pointed, and the outer spiniform; the lateral keels are indistinct; the surface is closely punctured, the colour sooty black, varied with a few ashy marks, the shoulders having each a triangular tawny spot, which does not cover the scutellum. Body beneath and legs dusky; hind femora (in the ♀) but slightly clavate.

One example, S. Paulo, Upper Amazons. It is possible, notwithstanding the great difference in colour, that it may be but a local variety of *A. lignicola*.

Two other species of *Anisopodus*, in addition to the eleven here enumerated, have been described, namely, *A. curvilineatus* (White, Brit. Mus. Cat. ii. p. 350, pl. 9. f. 1) of South Brazil, and *L. prolixus* (Erichson, Consp. Ins. Peruana, p. 145) of Eastern Peru. The latter is the largest species at present known, and seems to be closely allied to *A. arachnoides*. I add a description, at the foot, of a fourteenth species*.

XXVIII.—*On the Raphides of Onagraceæ.* By George Gulliver, F.R.S.

We have already seen ('Annals' for April and July 1863) how well this order is characterized by raphides, so that not only can a plant belonging to it be henceforth truly distinguished from others of nearly allied orders by these acicular crystals alone, but a minute fragment of the leaf or its modifications may be

* *A. canus.*—Oblongus, planus, tomento denso canescente vestitus. Antennæ rufescentes, articulis apice nigris. Thorax punctatus, antice nigro bivittatus, spinis lateralibus tenuibus porrectis. Elytra lateribus parallelis, prope apicem subito attenuata, dorso inæqualia, medio fortiter depressa, carinis lateralibus acutissimis, apicibus longe mucronatis; canescentia, maculis minutis nigris sparsa, quarum duabus distinctioribus prope apicem. Pedes nigricantes, femoribus tibiisque dimidiis basalibus rufis. Femora postica (maris?) elongata, subito clavata. Long. $2\frac{1}{2}$ lin. *Hab.* Brasilia meridionalis. Coll. Bakewell.

sufficient for the diagnosis; nay, that even a seed-leaf would be so was proved in *Œnothera* and *Epilobium.*

This last fact appeared so remarkable, that I have lately made it the subject of experiments with other plants, when a careful examination of numerous species showed that those belonging to orders previously ascertained to be regularly destitute of raphides in the adult leaves, are also equally devoid of them in the seed-leaves. Then the seeds of such Onagraceæ as were easily procurable (to wit, *Circæa lutetiana, Eucharidium grandiflorum, Clarkia elegans, C. pulchella,* and *Godetia vinosa*) were sown in pots; and as soon as the seed-leaves were well developed above the soil, they were all examined, and found in every instance to contain raphides. These could be seen both scattered in bundles throughout the parenchyma, and floating freely and singly in the water wherein the part had been broken by pressure and friction between the glass object-plate and cover. The raphides in the green cotyledons were somewhat smaller and less plentiful than in the plumule and in the fully developed stem and leaves.

The difference in question between Onagraceæ and their nearest allies of other orders is not only very curious, but is one of those numerous phenomena which remind us how little we know of the recondite operations of vegetation. Take, for example, two plants, as *Epilobium hirsutum* and *Lythrum Salicaria,* similar in habit and growing closely together in the same soil of the river-bank, and observe the signal difference of their products,—the one plant, as a regular part of its healthy structure, abounding during its whole existence in raphides; the other as regularly destitute of them, and affording sphæraphides instead, differing as much in form as they probably do in chemical composition from raphides. Supposing, then, as there is some reason to do, that these crystals respectively are phosphate and oxalate or some other salt of lime, a leading and constant function of the Onagraceæ would be the formation of the phosphate, while the Lythraceæ would be a laboratory of a different salt,—the performance of each of these diverse operations being a regular and special design of the plant-life in such cases.

But though we know so little of this subject that its significance remains a mystery to us, we may now make good use of the facts already revealed as botanical characters, provided we distinguish truly, as proposed in the last Number of the 'Annals,' raphides from sphæraphides, so as not to confound such different things under one and the same term,—taking care also to observe how far the sphæraphid-tissue (of which an engraving* was

* The outlines of the crystals are often more or less rounded or granular, not so sharp and distinct as there represented. In that Number of the 'Annals,' p. 228, for *Cucurbitaceæ* read *Dioscoreaceæ.*

given in the same Number of the 'Annals') may be characteristic of certain orders. If we confine the word raphides to the needle-like crystals commonly occurring in bundles, it may be the expression of a more universal diagnosis between such orders as Onagraceæ and their next allies, and yet not less simple and sure, than any single character hitherto employed. Thus, too, we could determine the affinities and contrasts of certain plants by a method at once easy, novel, and practical, and all this in the absence of those parts heretofore exclusively used for the descriptive distinctions. And there would be another advantage in enlisting these crystals into the service of systematic botany; for we should not be thus employing merely an empirical formula, but methodically recognizing some really fundamental results of plant-life, well fitted to keep before us such interesting and important phenomena in the economy of vegetation as must be especially valuable in a natural system of classification.

Still these observations are only offered suggestively, and not dogmatically, in the hope of exciting such further research as may yet be required either to extend, confine, or correct them, —since I have had so little opportunity of examining numerous species, that it is desirable that other botanists who may be more favourably situated will continue the inquiry, especially as regards exotic plants.

Edenbridge, August 17, 1863.

XXIX.—*On the Part played by Deciduous Plants in the Tertiary Floras previous to the Miocene properly so called, and especially in that of the Gypsum of Aix.* By the COUNT GASTON DE SAPORTA*.

THE part played by deciduous plants, congeneric with those of Europe in the present day, in the Tertiary floras of a far-distant age is one of the most singular questions raised by the still modern study of the fossil plants of this period. The very existence of these plants, or, rather, the contrast resulting from their association with perfectly tropical forms, constitutes of itself a very remarkable phenomenon. We should in vain attempt to explain it by a cause analogous to those which are still in action. It is true that the supposition of an alpine region situated in the vicinity of the ancient deposits, sufficiently elevated and cold to cause the presence of these species, presents itself immediately to the mind as a natural hypothesis; and yet, when we consider that it is not only upon an isolated point, but constantly and in

* Translated from the Bibliothèque Universelle, March 1863, p. 186, by W. S. Dallas, F.L.S.

all the floras, starting from the *Upper Eocene,* that we meet with European forms (limited in number, it is true, but with remarkable fixity), we are compelled to see in them, not the result of an accident of locality, but one of the elements of the vegetation of that period—an element which must be taken into consideration in analyzing the totality from which it depends. The regular development of this same element, at first very slowly, constitutes the most salient feature of the Tertiary vegetation in its course towards modern times. We have not here to appreciate this progress, but to seize the true character of this group of species at its origin, when, far from predominating, it is, so to speak, lost in the midst of the most varied exotic forms. As they remove from their starting-point, the organisms (*essences*) with deciduous leaves tend progressively to become what they are at present; but, notwithstanding the chain which binds their present to their former state, it does not necessarily follow that their *mode of being* was the same at all times. It would be to draw a forced conclusion from what they are under our eyes if we pass beyond a simple analogy of form. The mere fact of their association with plants the presence and preponderance of which announce an order of things different from that which exists in our days is an important indication that these species were far from being then adapted to the external conditions to which their congeners are now subjected, and consequently that some difference must distinguish them from the similar organisms of the present day.

The existence of an annual temperature attaining an average of 68°–77° F. (20°–25° Cent.) at the time of the gypsum of Aix follows from all the indications furnished by the plants of the period. Nor is the successive diminution of the temperature less evident from the gradual disappearance of all the tropical forms—a disappearance which need not have taken place if these forms had originally been adapted to a ruder climate than that which is now necessary to them. In fact, if there is nothing in opposition to the assumption that the types which have since continued to be European were at first adapted to a hotter climate, the contrary supposition (that is to say, that of tropical types conformed to a colder climate) appears to be by no means admissible, not only because these types, from their organization, do not appear to be susceptible of such a deviation, but also because (leaving the possibility of this out of the question) their association, their mode of grouping, their preponderance, and their analogy with the most characteristic forms of tropical regions sufficiently indicate that the general vegetation of this epoch is the expression of a temperature sufficiently high, or at least sufficiently uniform, to give rise to the external conditions which are now characteristic of the countries near the tropics.

We might, indeed, suppose that the *Flabellariæ* of the gypsum of Aix, like the *Chamærops excelsa* lately planted in our gardens, were capable of bearing several degrees of cold without perishing, if these trees occurred isolated in the midst of a multitude of organisms of European physiognomy; but it would be contrary to all the data furnished by the study of the laws of nature to extend gratuitously the same supposition to the assemblage formed along with the Palms by the species of *Dracæna, Musaceæ, Myrica, Andromeda, Zizyphus,* and *Rhus,* of tropical physiognomy, the *Laurineæ, Bombacia, Anacardiaceæ, Cæsalpinieæ,* and *Mimoseæ,* of which the mass encumbers the vegetation of Aix, whilst the species with deciduous leaves, isolated and lost in the midst of the others, would hardly attract attention, if their analogy with their European congeners of the present epoch did not lead us, justly, to attach a very peculiar significance to their presence.

In any case, these plants were then only a very limited accessory; it is therefore more simple to inquire how these plants accommodated themselves to a climate which favoured the growth of all tropical forms than to assume that the climatic conditions were established for the smallest portion of the total vegetation.

Thus, therefore, if we accord to the period of the deposition of the gypsum of Aix and the beds immediately subsequent to it a climate hot enough to cause the presence of the tropical forms, this hypothesis, which is justified by the general facts, is at the same time the negation of a cold season sufficiently severe to produce, by this alone, the stripping of the organisms with deciduous leaves.

It is nevertheless easy to see that the Tertiary species analogous to those which now bear deciduous leaves present no difference from the latter in their consistence, aspect, or any other circumstance; so that we are justified in concluding, from the examination of this category of Tertiary plants, that they lost their leaves periodically in the same manner as the existing plants which reproduce the same model. To cite only the most striking examples, *Betula gypsicola, Populus Heerii, Cratægus nobilis,* and *Cercis antiqua,* in the flora of Aix, and *Betula ulnacea, Alnus prisca, Carpinus cuspidata,* and *Acer primævum* in that of Saint-Zacharie, are in this case; and if there be anything in the texture of their leaves to distinguish these ancient plants, it is a greater delicacy of tissue; so that it becomes probable that they bore leaves of a finer texture, traversed by nervures of much greater tenuity, than any of the modern species with which they are most nearly allied.

If the ancient temperature was sufficiently high to exclude the possibility of a cold season, and if, on the other hand, the

Tertiary plants congeneric with those of modern Europe lost their leaves, like the latter, at a certain period of the year, it is evident that we must seek for this periodical fall an original determining cause other than that of a diminution of temperature. It is true that we may, and that we even must, assume the existence of a season, not cold, but fresher and moister, succeeding to the hot season, reanimating vegetation instead of extinguishing it, and bringing on the flowering of the plants—a season rather of life than of sleep and death, and therefore very different from our winter. What might be the effects of such a season upon the plants which we believe to have had deciduous leaves is the problem which is now before us; but it is necessary, in the very first place, to ascertain whether cold—that is to say, the sinking of the thermometer below the degree of heat necessary to the vegetation of each species—is the actual cause of the interruption of this vegetation during winter, or whether this cold only serves to render this interruption longer, more complete, and more radical, by coinciding with the period at which it is naturally manifested.

Now, when set in these terms, the question is easily solved. It is evident that all trees suffer from thermometric cold. For those of our continent this cold is a crisis which they pass through at a moment when their organs are in a condition to offer it the most resistance. The sleep in which they are sunk, at the same time that it favours the internal elaboration of their organs, allows them to undergo the crisis of cold without inconvenience; but this crisis, it must be said, is neither the reason for the existence nor the true cause of their physiological condition, as may easily be proved. We may, in fact, lay down as a principle, that, in the very great majority of cases, the trees with deciduous leaves lose their leaves at a higher temperature than that which subsequently causes the evolution of new leaves. This phenomenon may be easily proved in southern countries, and even in Provence; it becomes very striking in the hot regions which permit the growth of tropical organisms side by side with those which are peculiar to the northern parts of our hemisphere. In Madeira, for example*, where, in consequence of a very great uniformity of temperature, there is scarcely any winter, the vegetation, taken in its totality, is never interrupted. A multitude of plants, and especially the *Laurineæ*, *Myrtaceæ*, *Passifloræ*, *Bignoniaceæ*, &c., both indigenous and exotic, blossom during this season, which is that in which the gardens present the most ravishing spectacle. Nevertheless this continuous mildness of the temperature is no obstacle to the progress of

* This observation is due to M. Heer, who resided for a considerable time in Madeira.

European plants; the poplars, willows, alders, and maples behave just as they do in Europe; and the contrast between the verdure and the flowers of the indigenous or tropical plants and the naked aspect of the European trees is not one of the least astonishing spectacles presented by the flora of this island. We may say, with justice, that the cold which, in northern countries, hastens the fall of the leaf, instead of being the true cause of this phenomenon, rather disturbs it in its regular course by accelerating it and rendering it sudden; whilst in temperate climates (and even in the south of France), where, in consequence of an almost insensible diminution of temperature, the physiological action is the only one manifested, the denudation of the trees with deciduous leaves takes place with a regularity which clearly shows the real tendencies of each species—so that, instead of assisting in that shower of leaves which denudes the branches in so short a time in central and northern Europe, each species parts with its leaves in its turn with more or less rapidity, in obedience to aptitudes equally diverse with the specific differences themselves.

Thus, the absence of thermometric cold, far from depriving plants with deciduous leaves of their true character, really restores it to them. It leads us to recognize in them what they really are—namely, trees whose leaves, being limited to a duration of a few months, tend to separate from the branch as soon as the latter possesses formed buds, organs into which the sap flows, abandoning the leaves to elaborate the rudiments of new organs destined to become developed after an interruption of variable length according to the species.

In fact, the fall of the leaves in plants in which they are deciduous is not always the sign of a complete sleep, but rather the occasion of an intermittence of vegetation; and for many genera, such as *Alnus*, *Betula*, *Corylus*, *Ulmus*, *Populus*, &c., of which we have to note the characteristic presence during the Tertiary epoch, this state is only, so to speak, the signal of the floral evolution which is accomplished in the absence of the leaves. The cold of our countries only opposes, retards, or even interrupts the flowering of those trees which, when transported into a milder climate, expand their flowers towards the end, or even in the depth, of winter. Here, again, the thermometric cold, far from coinciding with the phenomenon, arrests or confuses its phases by its occurrence, and especially by its irregular return.

The plants of which we are speaking are in reality in the same circumstances as many tropical organisms the flowering of which constantly takes place in the absence of the leaves, one portion of the year being devoted exclusively to the evolution of leaves, and the other to that of flowers. It is thus that we must conceive the position of the deciduous plants at an epoch when the seasons were far from being regulated as they are at present. Their existence only apparently contrasts with that of the exotic plants with which they are associated; this disparity is effaced when we take into account, as we have just tried to do, what are these vegetable forms considered in themselves, abstracted from the changes to which they subsequently yielded more readily than the others. Their subsequent development and actual preponderance lead us to exaggerate their original importance, which in reality was very small. If afterwards it was otherwise—if the changes of temperature brought about by the lapse of time have contributed to increase the importance of these plants, this result (the effect of causes which were not yet in action at the epoch when we see them for the first time) must not lead us into error as to what they originally were. It is this first stage that we propose to analyze; and its knowledge will allow us to appreciate more justly the circumstances which subsequently brought about their multiplication correlatively with the exclusion of the forms which had previously predominated.

The frutescent plants with deciduous leaves and a European physiognomy, in the flora of the gypsum of Aix, amount to 15 at most, out of 118 dicotyledons. If from this number we deduct the more doubtful forms (those which present some analogy with living forms with persistent leaves, and those of which the leaves are still unknown), the number is reduced to 8 species only, that is to say, the insignificant proportion of 6·77 per cent. These species are the following:—

Betula gypsicola, Sap.	*Acer ampelophyllum,* Sap.
Ulmus plurinervia, Ung.	*Paliurus tenuifolius,* Heer.
Populus Heerii, Sap.	*Cratægus nobilis,* Sap.
Ribes Celtorum, Sap.	*Cercis antiqua,* Sap.

Nearly all these species belong to genera in which the flowers are often developed in the absence of the leaves, as in most of the *Betulaceæ, Ulmus,* many species of *Populus, Acer, Ribes, Cercis,* &c. It is probable that this was the case with the Tertiary species, and that their flowering coincided with the cool season, or that which took the place of winter, and during a portion of which these plants remained denuded of leaves as at present.

The most abundant of all these trees is the *Cercis antiqua*; all the others are excessively rare, or even unique. The *Cercis,* notwithstanding its identity with a genus now represented in Southern Europe, North America, and Japan, is not a characteristic type of the boreal zone. The living species of this genus appear to be a last vestige of an ancient type on the point of disappearing, rather than an essential element of the vegetation of the north of the two hemispheres, as are the *Betulaceæ, Salicineæ, Cupuliferæ,* and *Ulmaceæ.* If we limit our remarks to these last groups, adding to the species above cited those which enter into the same category, such as *Alnus antiquorum,* Sap., and *Ostrya humilis,* Sap. (although the leaves of the former were no doubt persistent, like those of *Alnus nitida,* Spach, its Nepaulese analogue, and the involucra alone of the latter are known), we shall obtain a total of ten species actually representing the boreal element of the flora of the gypsum of Aix,—all these species, as has been said, being extremely rare in individuals. This rarity is the more remarkable because, if we consider the present importance of these organisms, and even that which devolved upon them in the latter half of the Tertiary period, they are amongst the most generally distributed species, for the natural reason that most of them, and especially the species of *Alnus, Populus,* and *Acer,* frequent the margins or the vicinity of water—a circumstance which must have favoured the preservation of their shed leaves.

To be convinced of this, all that is necessary is to glance through the principal fossil floras, starting from the true Miocene. *Betula Dryadum,* Brongn., in company with an *Acer,* has filled with its fruits and leaves the strata of Armissan (Aude). The two, no doubt, covered the Secondary slopes in the neighbourhood of the lacustrine basin in which are deposited the flags with impressions which are quarried in that locality. At Manosque *Alnus nostratum,* Ung., and *Carpinus grandis,* Ung., are amongst the commonest species. In the Swiss Mollasse deposits this is the case with the species of *Alnus* and *Carpinus,* and next with those of *Populus, Salix, Platanus,* and *Liquidambar*; at Œningen, *Populus latior,* A. Braun, and *Acer trilobatum,* A. Braun, are seen on every slab, in company with several species of *Salix.* Nothing is more natural than the abundance of these forms in reference to the present condition of things; but nothing is better established than their rarity as soon as we descend the series of beds and approach the Tongrian. At Saint-Zacharie* *Alnus prisca,* Sap., *Betula ulmacea,* Sap., and *Ostrya tenerrima,* Sap., are very thinly scattered; *Acer primævum,* Sap., and *Carpinus cuspidata,* Sap., are more abundant, but still much less so

* The actual age of this flora, at one time referred back by us, with doubt, to the Bartonian (see 'Recherches sur le Climat et la Végétation du Pays Tertiaire,' par O. Heer, traduit par C. T. Gaudin, p. 135), has since been found, after fresh explorations, to be less ancient than the gypsum of Aix, and not very distant from that of Hœring in the Tyrol, a Tongrian locality.

than the *Myriceæ*, *Proteaceæ*, and *Araliaceæ*, which abound in this deposit. The same rarity of European forms occurs also at Hœring, at Sotska, and at Mt.-Promina: the fact which we remark at Aix is therefore not isolated; it is related to circumstances which were uniformly repeated at the same epoch in all parts of Europe.

We are therefore led to this conclusion,—that the frutescent genera of European physiognomy, and particularly the *Betulaceæ*, *Ulmaceæ*, *Salicineæ*, and *Acerineæ*, were not then distributed as at the present day, and that they were destined neither to play the same part nor to mark in the same way the masses of the landscape.

What, then, was really the place occupied by these plants? On this subject there are but few suppositions to be made; and amongst these, one, no doubt, must express the truth.

It is nearly certain that, at the epoch of the gypsum of Aix, the species of *Alnus*, *Betula*, *Populus*, *Ulmus*, *Acer*, &c., did not inhabit the immediate vicinity of the ancient lacustrine shores. This part was reserved for species of Palms, *Coniferæ*, *Proteaceæ*, and *Laurineæ*; but we may, strictly speaking, remove the station devoted to the European forms of plants beyond the immediate margins, without by this excluding them from the neighbourhood of the waters. In fact, they may have adorned the banks of small streams, or the damp bottoms of the woods, or, lastly, cool and northern exposures, at a sufficient distance apart to prevent their shed leaves, &c., from being carried otherwise than exceptionally into the deposits in course of formation.

Nevertheless, if we admit this hypothesis as the true one, it brings with it many difficulties.

If the genera in question did really haunt the places which we should ascribe to them as their habitation, it is difficult to believe that they there formed great masses; for in that case their leaves, being transported by the winds or streams of water, would have reached the lake in comparative abundance, at least at certain times, although, no doubt, they would have left more scattered traces than the other species. It will be seen, in fact, that it is to a sort of chance alone that is due the preservation of an isolated species lost in the midst of others, whilst strong and numerous groups, notwithstanding distance, must have their leaves and fruits carried away with a certain regularity, and in such a way as to leave their impressions, perhaps not abundantly, but more or less repeated. Now we have seen that this is not the case with the species of European physiognomy belonging to the flora of Aix. The remarkable preservation of the impressions belonging to this category of plants is also opposed to our full adoption of this opinion. These impressions are very rare, or even unique, in most cases, but they belong to very different organs. The fruit of the *Betula* occurs in a different stratum from that which contains the leaf. The fruit of the *Populus* has been found isolated from its leaf, and the latter separate from a ciliated bract, probably forming part of the same species. The involucra of *Ostrya* are not yet accompanied by their leaves; there exist a leaf of *Ulmus,* but hitherto no trace of its fruit, and leaves of *Acer* without any fruit. We must therefore notice a very great irregularity in the mode of transmission of the organs; and all that we can conclude from the state in which they have come down to us is, that no obstacle difficult to get over has stood in the way of their reaching the waters of the lake, that they did not get there from any great distance, and that small and delicate organs, especially those of fructification, have been preserved pretty frequently in a state of perfect integrity; whilst, on the other hand, winged fruits, easily carried by the wind, are sometimes wanting, in cases where the leaves have, on the contrary, passed into the fossil state.

What are we to conclude from these various observations, if not that the hypothesis first put forward as the most natural in appearance is at least contestable from the side of the facts? that these facts do not tend to confirm it, and would, on the contrary, rather lead one to think that the plants with a European physiognomy and deciduous leaves, although evidently excluded from the vegetable masses of the epoch, and forming arborescent groups of considerable size neither on the immediate margin of the waters nor in the vicinity of the ancient lake, do not appear nevertheless to have occupied a very distant station? and lastly, that their organs have reached the sediments in course of formation with complete irregularity, and without the aid of the wind having contributed to augment the proportion of such organs as the winged fruits, by assisting them to get over greater distances? It remains for us, therefore, to seek another series of hypotheses more in accordance with the facts.

Perhaps the plants in question, not possessing originally the appearance, size, and habits which they subsequently acquired, isolated in the midst of the robust plants of the period, only occupied a secondary place among them, which would explain at once their rarity as individuals and the limited proportional quantity of their organs, of which only a very small number could reach us.

On this hypothesis we should have to establish three points with regard to the plants under consideration:—(1) a sensible difference in their habitual station; (2) a peculiar mode of grouping, a natural consequence of the preceding, producing a greater rarity of individuals; (3) lastly, a comparatively small stature,—

circumstances all of which would have concurred to limit the quantity of organs fitted to pass into the fossil state.

The difference of station can only be proved by means of indirect negative evidence. It appears to be certain, however, that, as we have stated above, the plants nearest to the ancient lacustrine shores were not forms with a European physiognomy, but Palms, *Coniferæ, Proteaceæ, Zizyphi, Diospyri,* &c.—genera the impressions of which are met with in all the beds; and next to these, *Laurineæ, Ericaceæ, Leguminosæ,* &c., which usually make their appearance after the former. If the *Betulaceæ, Salicineæ, Ulmaceæ,* and *Acerineæ,* even in limited numbers, had inhabited the immediate margin of the ancient waters, their remains would have been buried annually, either at the period of the fall of the leaf or at that of the maturity of the fruit. Moreover it is the nature of plants inhabiting moist localities to multiply in colonies, in consequence of the uniformity of conditions, which uniformly favours the propagation of the same organisms; there is therefore, we repeat, but little probability (although nothing can be stated with absolute certainty) that the group of species of which we are speaking inhabited the zone immediately contiguous to the ancient shores; it is more natural to suppose that they were a little thrown back upon the second plane; but we remain of necessity in ignorance of their true aptitudes, not knowing the exact configuration of the ancient land. From stratigraphical observations, it appears that on one side (towards the north-east of the town) it was, if not commanded by escarpments, at least considerably elevated and broken. The repeated occurrence of *Coniferæ* (*Callitris, Juniperites, Widdringtinia, Pinus*) and of trees which, like *Cercis* and the *Proteaceæ* (*Grevillea, Lomatia*), haunted undulating ground rather than low and moist spots, must lead us to this opinion. On the other hand, the abundance of species of *Andromeda* and *Vaccinium* appears to indicate turfy and inundated ground, occupying probably a great extent. It is difficult to decide whether the organisms with deciduous leaves of the flora of Aix inhabited one or other of these two zones, and dwelt consequently upon the broken slopes or in moist, low, and marshy ground; the nature of the sediment in which their impressions are observed, and the kind of species with which they are associated in the beds, are the only indications which can be consulted in a question of this kind. The following are the notions which may be obtained upon this point.

There exist in the stratum of Aix two kinds of beds with vegetable impressions, indicating two modes of sedimentation, of different nature. The first includes schistose and especially marly limestones, in very thin laminæ, denoting a deposit formed in calm waters, very feebly charged with a few particles of very fine mud. The vegetable impressions observed in these beds are due to organs which have either fallen in naturally, or been carried by the wind, or, lastly, transported into the lake by a very weak current of very clear water.

Other beds, on the contrary, are composed of deposits or strata of some thickness, either purely calcareous or composed of a whitish marly limestone, the body of which denotes an abundant mud, arising from the freshets which at certain periods exerted their action with more or less force upon certain points of the lake. They present vegetable impressions belonging to species which, in many cases, may have been carried for a considerable distance, or have arrived from other parts of the country, or at least have been entombed under different circumstances from the former.

It is therefore probable that the flora of the schistose beds is composed chiefly of the species living nearest to the ancient shore, or within a certain distance of it, and that it contains but few species brought from a distance, except perhaps seeds or light fruits. The flora of the marly beds, on the contrary, presents at once the littoral species and those brought by the muddy waters even from the interior of the country.

It may also be observed that the forest-trees of the genera *Quercus* and *Cinnamomum* and most of the *Anacardiaceæ* occur in those beds which also contain numerous *Andromedæ*. The leaf of *Ulmus plurinervia*, Ung., has likewise been met with in a marly bed.

The schistose beds contain rather the remains of the littoral plants, or of those which inhabited the neighbouring slopes and served as a cincture to the ancient lacustrine sheet on the eastern side. These are Palms, *Gramineæ*, *Coniferæ*, *Myricaceæ*, *Proteaceæ*, and a few *Laurineæ*, and, lastly, some *Rhamneæ* and *Leguminosæ*. The most abundant species are common to both sorts of beds.

It is also in the schistose limestones, or in the laminated marly limestones, that all the scattered fragments of fruits or leaves belonging to deciduous plants of European physiognomy have been met with, with the exception of *Ulmus plurinervia* and of a strobile of *Alnus antiquorum* (the leaves of the latter species were probably persistent). It is therefore probable that most of these plants (that is to say, the genera *Betula, Populus, Ribes, Acer, Paliurus*, and *Cratægus*), without inhabiting the margin of the water, occurred in a station within easy access of the ancient shore, and that they were associated rather with the *Coniferæ*, *Proteaceæ*, and *Leguminosæ*, than with the *Quercus*, *Andromedæ*, *Cinnamoma*, and *Anacardiaceæ*, which occur more frequently in the marly beds. It is true that we only advance this opinion as a conjecture; there exists, however, if we attend to the preceding indications, a certain probability for the belief that the species with deciduous leaves, at the epoch of the gypsum of Aix, inhabited a station intermediate between the immediate margin of the waters and the more distant parts of the interior of the country.

With regard to the mode of grouping, that is to say, the manner in which the individuals of this series of plants was distributed, the same reasons which have inclined us to think that they were not situated on the margin of the waters, or in the inundated and marshy parts, lead us equally to believe that they did not form colonies of individuals or numerous and frequently repeated associations; the rarity of the impressions must rather lead us to assume that these organisms were then scattered here and there, and occurred only in certain situations the precise nature of which it is impossible to indicate. In a word, these organisms nowhere formed a wood, or even a group of considerable extent, but we should have met with them from time to time as isolated plants growing under the influence of some particular exposure which protected and favoured their development.

There are not wanting examples of a similar mode of existence for trees or shrubs which, not living in society, make their appearance here and there isolatedly or in very small groups, without ever multiplying greatly.

Another circumstance may have assisted in limiting the number of impressions of trees with deciduous leaves in the flora of the Gypsum of Aix—namely, the small size of the species, which were probably reduced to the proportions of mere bushes.

It sometimes seems that the gigantic must necessarily have been the appanage of the ancient creations: one is led to see it everywhere, even in species really inferior in dimensions to their living analogues. The large size of certain Cryptogamic plants of the Palæozoic epoch, the enormous Saurians of the Secondary strata, and the no less astonishing Pachydermata of the last Tertiary epoch may have led to the notion that magnitude was, as it were, a general character of extinct organisms; but this is by no means the case. On quitting animals for plants, we quickly see that in these at least the proportions have varied according to the age and classes. There are even times in which the size of species seems to diminish in comparison to that which now exists; and this phenomenon is particularly distinct in the Gypsum of Aix. Nothing in the fragments of stems and branches, nor in the aspect of the fruits and appendicular organs, indicates anything but plants of middling size;

the ancient organs, when compared with those which correspond with them in the present day, almost always appear considerably smaller, and sometimes even very much so. The silicified trunks of Palm-trees indicate the existence of small species, of which the stem, even in the largest forms, scarcely equals that of *Chamærops excelsa* in diameter. The Pines only present slender and sparingly divided branches. The leaves of Dicotyledonous plants are almost always small, narrow, oval, elliptical, or linear; and although very large trees may have small leaves, the persistence and generality of this character cannot but raise great doubts as to the size of the individuals to which they belonged. This doubt has the more foundation as most of the *Proteaceæ* most nearly allied to species of Aix in the present order of things only form shrubs of middle size or even mere bushes.

These data may be applied to the series of species with deciduous leaves in the flora of Aix; but for them there are further reasons which would lead to the belief that they were still smaller in their dimensions than the preceding. These plants, not numerous as species, and very rare as individuals, are subordinated to organisms in which the variety of combinations and the profusion of forms indicated a development arrived at its climax; it is among these that we must of course find the strongest species of the epoch. It appears to us more probable, in fact, that we should find the arborescent organisms of that period amongst the groups as to the preponderance of which there is no question, such as the Palms, *Proteaceæ, Laurineæ, Anacardiaceæ,* and *Leguminosæ,* than amongst the scarce plants with deciduous leaves, which had so inconsiderable a part to play. Considered in themselves, these species, by the knowledge we possess of their organs, confirm the supposition that they only attained to small dimensions. If we except *Alnus antiquorum,* the leaves of which were probably persistent, like those of *A. nitida* and *A. Nepalensis,* and *Cercis antiqua,* which only differs from its living congener in the outline of its leaves, the appendicular organs of the other species with a European physiognomy, either by their comparative smallness or by the analogy of the forms which correspond with them at present, indicate rather shrubs than true trees. There can be no doubt in this respect with regard to the *Ribes, Cratægus,* and *Paliurus,* which are only bushes. But, among others, *Betula gypsicola* belongs to a section of the genus which contains species of very small size, and which is characterized by Regel, the author of the Monograph of the Betulaceæ, as "Frutices plerumque humiles;" *Populus Heerii* is remarkable for the smallness of its narrow saliciform leaf, beyond any existing *Populus* of the section *Balsamea,* to which it seems to belong; the *Acer ampelophyllum,* as to the true nature of which there is still much doubt, especially in the absence of its fruit, would take its place, judging from its leaf, among the smallest species of the genus.

Thus there would remain only *Ulmus plurinervia,* the leaf of which is of tolerable size, and which, even without this indication, might have constituted an actual tree. For this, its probably distant station may sufficiently explain the rarity of its impressions.

To sum up,—in spite of obscurities which it is impossible entirely to elucidate, it is certain that nearly the whole of the organisms with deciduous leaves in the flora of Aix indicate limited dimensions, denoting mere shrubs; and if there were trees among them, this denomination could only be applied to the smallest number, and, so to speak, to a single species.

We terminate these considerations, which have been perhaps treated at rather too great a length, but in which the novelty of the subject necessitated more development than in ordinary cases, by formulating our conclusions as follows:—In accordance with all the indications, it is extremely probable that the plants with deciduous leaves of the flora of Aix only played in it a secondary part; and if their impressions are very rare in the beds formed at that epoch, their station at a little distance from the ancient shores, their distribution as isolated individuals, and the small size of most of them have concurred to produce that result. We affirm, lastly, that the periodical fall of the leaves in these species, far from implying the existence of a cold season, is a phenomenon very reconcilable with the high temperature which is indicated by the profusion of tropical forms in the flora of the Gypsum of Aix.

XXX.—*Remarks on the Rev. S. Haughton's Paper on the Bee's Cell, and on the Origin of Species.* By Alfred R. Wallace.

My attention has been called to the paper in the 'Annals' for June last on the above subjects, the author of which seems to me to have quite misunderstood and much misrepresented the facts and reasonings of Mr. Darwin on the question. As some of your readers may conclude, if it remains unanswered, that it is therefore unanswerable, I ask permission to make a few remarks on what seem to me its chief errors.

Mr. Haughton combats the views not only of those who believe that the regular structure of the Bee's comb can be accounted for through the agency of "natural selection" and variation, but also of the opposite school, who impute to the Bee a supernatural or divinely inspired instinct, by which it is enabled to construct its cells on true mechanical and mathematical principles, so as to combine the requisite accommodation for rearing its brood and storing its honey, with the greatest amount of strength and the utmost economy of material. In his opinion of this last school I quite agree with him, but think he has not pointed out its weakest points. If we consider the cell as adapted to the size of the grub and young bee, and in its relations to the cells immediately surrounding it, there can be no doubt that the form of the cell itself, with its pyramidal base and arrangement in double tiers, gives the greatest economy of space and material possible. But if we look at the whole comb suspended vertically by its upper side only, we shall immediately perceive that the strain upon its uppermost rows of cells is many times greater than that upon its lower ones; so that, if economy of material was the main object of this beautiful structure, and the attainment of such economy was secured by unerring wisdom, the walls of the cells should regularly decrease in thickness from the upper to the lower part of the comb. The same mathematical knowledge that enables us to see the beauty and economy of the form of the individual cells, as surely points out the great waste of material in building the upper and lower portions of the comb of the same thickness and strength. We have here, I think, a conclusive argument against the notion that the bees are guided by any supernatural impulse to construct their cells on the best mathematical principles, so as to economize, in the highest degree, labour, space, and material.

When Mr. Haughton attempts to overthrow the theory of Mr. Darwin on this subject, we are compelled to demur to many of his statements, which, indeed, are often so deficient in clearness as to suggest the idea that 'The Origin of Species' has been but superficially studied by him. In his first paragraph, for example, he speaks of a class of writers by whom "the geometrical properties of the cells are alleged as a sufficient cause for the production of the insects that make them, from the advantage which these forms of cells are supposed to possess over other forms—advantages said to be so important as to decide the battle of life in favour of the insects that adopt the geometrical plan of making their cells." This is surely a most unfair statement of the doctrine that simultaneous favourable variations in structure and habits, accumulated by natural selection, may act and react on each other, and thus ultimately lead to such a modification of the insect as may better adapt it for constructing the most advantageous form of cell. Mr. Haughton's statement of the case is, that the cell made by the bee is a sufficient cause for the production of the bee; and he would have his readers believe that this absurdity is maintained by the writers he alludes to.

The author then describes the following three forms of cells which he has observed, but does not always express his meaning with sufficient accuracy:—1. Hexagonal cells, somewhat pyramidal, with a rounded extremity. The British tree-wasp and the genus *Polistes* make cells of this form, in small groups, and often of a very fragile papery material. 2. "Hexagonal cells formed of adjoining prismatic figures, with rectilinear axes, terminated by a truncated plane, at right angles to the axes of the prisms." I have quoted this elaborate description literally, because I am quite unable to understand what the author means by a "truncated plane," which renders his meaning somewhat obscure. The cells of this form are said to occur in wasps' nests from the West Indies and South Africa. 3. The bee's hexagonal cell terminated by three faces of a rhombic dodecahedron, each of which forms one-third of the base of one of the cells of the opposite layer. It is not stated, but may be inferred, that the first two forms of cells are in a single layer only; and all these varieties of cells, it is said, may be accounted for "simply by the mechanical pressure of the insects against each other during the formation of the cell." Again, at page 428, "The true cause of the shape of the cell is the crowding together of the bees at work, as was first shown by Buffon. From this crowding together they cannot help making cells with the dihedral angles of 120° of the rhombic dodecahedron; and the economy of wax has nothing to do with the origin of the cell, but is a geometrical property of the figure named." There are, however, several important objections to this pressure-theory. Many exotic tree-wasps construct little groups of three or four hexagonal cells, only one or two insects working at them together. Here is no crowding, yet they are hexagonal. Again, a Mexican bee (*Melipona domestica*) makes a comb of cylindrical cells, only partially hexagonal; and in the Malay Islands there is a domesticated bee which makes oval cells, and though the insects are kept in hollow bamboos for hives, yet the crowding together does not make their cells hexagonal. The wild bee of Borneo, on the other hand, suspends its comb from the arms of lofty trees in the free air; and if crowding had *all* and economy *nothing* to do with it, one would think that here the cells should retain their normal cylindrical form; instead of which, they are as beautifully geometrical as those of our own hive-bee. But, what is still more important, Mr. Darwin states (Origin of Species, ed. 3, p. 251) that our bees build the cell-wall at first rough and ten times as thick as it is to remain when finished, it being afterwards gnawed down to the proper thinness. Here is a complete proof of economy of wax rather than economy of labour, and a complete disproof of the theory of circular walls pressed into hexagons by the crowds of struggling bees, which is given us as a new theory of the formation of the bee's cell, unsupported by a single original observation.

To finish this subject of the bees, we will now pass to page 427, where Mr. Haughton produces his most crushing argument. He seems to suppose that it is necessary to the theory of Mr. Darwin that there should have been a number of species of bees, now extinct, filling up the gap between the single round cell of the humble-bee and the perfect geometrical structure of the hive-bee, each of them using a little less wax than the preceding one, and that, to effect this, it is necessary that there should have been a bee building a *triangular* cell, and after that, one building a *square* cell, before arriving at the *hexagonal* cell of the hive-bee. But in this view there is a misconception of the conditions of the problem. It is true that, to fill up a given space with cells of a given *area* and walls of equal thickness, the triangle will be more economical of material than the circle (with solid intervals), and the square more economical than the triangle. The primary use of the cell, however, is not the storing of honey—but the accommodation of the larva and pupa; for this it must have a certain *diameter*, and the triangular cell must therefore circumscribe the circular one, and will then be found to require more materials even than the circular cell with solid intervals, without taking into account the fact that the sides of the triangular cells, being without support in their whole length, would have to be thicker than those of any other form, if of equal strength. The same argument will apply in a less degree to the walls of a square cell.

A still more serious error exists, however, in supposing any such extravagantly shaped cells requisite to form the gradual passage from the circle to the hexagon, in order that every step of the process may give its proportionate saving of material. Let the reader draw a number of equal circles in contact, and he will at once perceive how very simple it is (considering that the bees build the cell-wall of a uniform thickness, and reduce it to the smallest serviceable dimensions by gnawing down the growing walls) to suppose them, when material was scanty, to gnaw out a little of the solid triangles left between the circles. The amount of intelligence perceptible in the habits of most insects renders such an act by no means beyond their capacities; and as every step in this direction would tend to the well-being of the community, what was at first done under the pressure of necessity would at length become a regular practice, and finally settle into that class of hereditary habits which we call instinct.

Some of these steps do actually occur in the *Melipona domestica* and other bees; and the immense quantity of honey consumed by the hive-bee to make a small quantity of wax, as well as its curious habit of cutting down the walls of its cells to a uniform thickness, are certainly very strong arguments in favour of this view.

Exactly the same arguments will apply to the origin, step by step, of the lozenge-formed planes forming the pyramidal base of the cell as to the hexagonal form of its wall; for these planes are the simple result of gnawing away the superfluous wax in the angles between the alternate spherical bases of the opposite layer of cells; and when this wax is so much gnawed away as to reduce all the walls of the cells to an equal thickness, the true geometrical figure which we see is the necessary result. (Origin of Species, p. 247.) Itis evident, therefore, that all the minute calculations of geometers respecting the amount of saving in this pyramidal base over a *flat* base to the cell is altogether beside the question, because a flat base could not arise out of spherical alternate bases in contact, by any such simple successive steps as are shown to result in the existing form.

On the question of the "origin of species" Mr. Haughton enlarges considerably; but his chief arguments are reduced to the setting-up of "three unwarrantable assumptions," which he imputes to the Lamarckians and Darwinians, and then, to use his own words, "brings to the ground like a child's house of cards." The first of these is "*the indefinite variation of species continuously in the one direction.*" Now this is certainly never assumed by Mr. Darwin, whose argument is mainly grounded on the fact that variations occur in *every direction*. This is so obvious that it hardly needs insisting on. In every large family there is almost always one child taller, one darker, one thinner than the rest; one will have a larger nose, another a larger eye: they vary morally as well; some are more poetical, others more morose; one has a genius for numbers, another for painting. It is the same in animals: the puppies, or kittens, or rabbits of one litter differ in many ways from each other—in colour, in size, in disposition; so that, though they do not "*vary continuously in one direction,*" they do vary continuously in many directions; and thus there is always material for natural selection to act upon in *some* direction that may be advantageous.

In his remarks upon this "unwarrantable assumption" (which is altogether his own), Mr. Haughton has the following passage:—"In the writings of Darwin there is this singular inconsistency, that, while he shows the utmost effects of human breeding on domestic animals to be capable of production in ten or twenty years, he denies the right of his adversaries to appeal to the unaltered condition of the ass, the ostrich, and the cat for 3000 years," &c. The first part of this sentence is so completely out of the pale of grammatical construction, that I must conclude Mr. Haughton writes a very bad hand, and did not correct the proofs. But, so far from Mr. Darwin denying his opponents the use of the facts above alluded to, he himself offers them far stronger ones, in the many species of shells which have lived unchanged since the middle tertiary epochs, and of mammals whose remains are found in beds which testify that they have survived important changes of the earth's surface. No one who understands the theory of natural selection will imagine that these facts are in any way opposed to it.

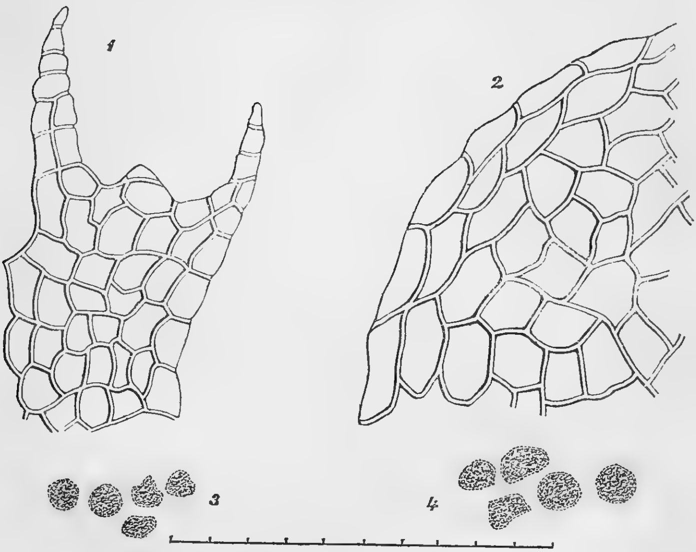
The second supposed "unwarrantable assumption" is, "*That the causes of variation,* viz. natural advantage in the struggle for existence (Darwin), *are sufficient to account for the effects asserted to be produced.*" There certainly never was a more unwarrantable assertion made, than that Darwin assigned "natural advantage in the struggle for existence" as "the cause of variation." Darwin over and over again declares that the *cause* of variation is unknown (Origin of Species, pp. 8, 38), though the *fact* is certain and undeniable. Natural selection, acting through advantage in the struggle for existence, *accumulates* favourable variations, but in no sense *causes* them. This is the very foundation of Mr. Darwin's theory; yet even this is misunderstood or misrepresented by Mr. Haughton.

The third "unwarrantable assumption" charged upon Mr. Darwin is, "*That succession implies causation,*" "that the Palæozoic Cephalopoda produced the Red-Sandstone fishes," "that these in turn gave birth to the Liassic reptiles," &c. &c. Now those who have read the 'Origin of Species' know that such absurd doctrines as these are nowhere taught there; and I can only say to those who have not read it that I challenge them or Mr. Haughton to produce any passages which will bear such a meaning.

In conclusion, it is asserted "that naturalists who have accepted by multitudes the new theory of the origin of species are, as a class, untrained in the use of the logical faculties, which, however, they may be charitably supposed to possess in common with other men." This is the judgment of the Rev. S. Haughton on such men as Lyell, Hooker, Lubbock, Huxley, and Asa Gray. A perusal of his paper, with the remarks I have now made upon it, will enable any one to judge how far Mr. Haughton himself possesses those "logical faculties" which he is half inclined to deny to the mass of British naturalists. There are several other minor points in his paper which might be alluded to; but it has already occupied as much space as it deserves, and I will only, in conclusion, quote from it a short paragraph which contains an important truth, but which may very fairly be applied in other quarters than those for which the author intended it:—"No progress in natural science is possible as long as men will take their rude guesses at truth for facts, and substitute the fancies of their imagination for the sober rules of reasoning."

XXXI.—*On the Tissue-cells of the Involucres of* Hymenophyllum. By George Gulliver, F.R.S.

Since the publication, in the August Number of the 'Annals,' of my comparison of the leaf-cells of the British species of *Hymenophyllum*, which was done from poor specimens of these plants, Mr. F. Clowes has kindly given me some better-grown leaves of them; and, as he mentioned, I find that they will freshen in water like mosses. Accordingly, after these dried ferns had been put for an hour or two therein, the cells were



Scale, $\frac{1}{500}$ths of an inch.

Fig. 1. Tissue-cells of involucre of *Hymenophyllum Tunbridgense*.
Fig. 2. Ditto of *H. Wilsoni*.
Fig. 3. Spores of *Hymenophyllum Tunbridgense*.
Fig. 4. Ditto of *H. Wilsoni*.

found as perfect as in the growing plants; and many examinations confirmed the accuracy of the fact before stated, that the leaf-cells of *H. Wilsoni* are more elongated and larger than those of *H. Tunbridgense.* In the perfect specimens from Mr. Clowes the cells are generally polygonal, often hexangular, whereas they are frequently quite round or oval in my more stunted plants. This variation is such as might be expected from the more or less distention of the cells, as the round and oval forms are well known to become angular from mutual pressure in luxuriant growth.

And now, from an examination of the tissue-cells of the involucres of these plants, it results that in them also there is a difference of size, similar to that in the leaf-cells. After repeated comparisons of the involucre-cells of the two plants, it was found that these cells are regularly the largest in *H. Wilsoni*, and that the two species could be easily distinguished by this character alone, as may be seen in figures 1 & 2.

The spores also were larger in these plants of *H. Wilsoni* than in *H. Tunbridgense.* But as the spores were mostly misshapen, though some of them seemed perfect, they should be carefully compared in fresh and mature plants before we conclude that this difference of size is regular and constant. Figures 3 & 4 will show the comparative sizes as I saw them in the plants from Mr. Clowes.

Probably sufficient evidence has now been adduced to show that the cells both of the involucres and leaves may be available as specific characters in Hymenophyllaceæ. In *Trichomanes radicans* the leaf-cells are nearly like those of *Hymenophyllum Wilsoni*, and consequently larger than those of *H. Tunbridgense.*

Edenbridge, Sept. 17, 1863.

BIBLIOGRAPHICAL NOTICES.

The Angler-Naturalist: a Popular History of British Freshwater Fish; with a plain Explanation of the Rudiments of Ichthyology. By H. Cholmondeley Pennell. London: Van Voorst. 1863. 12mo.

When old Izaak Walton published his 'Complete Angler,' it was his endeavour to bring together all the scientific knowledge of his time connected with Fish and fishing; and, absurd as many of his tales appear to us, they were undoubtedly vouched for in his day by naturalists of high authority. But even these erroneous statements have often a charm, partly from the quaintness with which they are related, and partly from the perfect good faith with which they are woven into the narrative; and Walton's book was certainly, at the time of its publication, a mine of information upon natural history, in the angling point of view, such as has never since been equalled. Indeed in most of our angling-books the descriptions of the habits of Fish are borrowed more or less directly from Walton; and some of those authors who have endeavoured to write with more originality have been misled, by the continued popularity of Walton's charming work, into attempting an imitation of it, though generally destitute either of the imagination, poetic and literary power, or talent for the observation of nature, the combination of which enabled the old hosier of Fleet Street to produce his prose-pastoral. In the 'Salmonia' of the great Sir Humphry, to choose one of the highest examples, the conversation resembles that of a set of priggish pretenders to learning, talking to show off the greatness of their attainments; and the sporting dialogues of some other writers are offensive in a different way. Under these circumstances, it was no small gratification to us to find, on opening Mr. Pennell's little book, of which the title stands at the head of this article, that, although a sportsman, he had avoided making his work a conversation-piece, and been content to tell "a plain unvarnished tale."

Mr. Pennell appears to have been induced to undertake the preparation of his book by the perception of the general ignorance on all ichthyological matters pervading the generality of anglers, and by the desire to indicate to them the greatly increased gratification that will accrue to them from the practice of their art by learning to understand a little of the life-history of the objects of their pursuit, and thus qualifying themselves for the observation of many phenomena which would otherwise take place before their eyes unnoticed. With this view he has commenced with a general outline of the structure and physiology of Fish, which is written in a clear and plain manner, and, notwithstanding one or two little defects, will undoubtedly furnish the reader with a very good notion of the mode in which life is carried on in the denizens of our waters.

In the second part of the work, which treats of the natural history of our Freshwater Fishes, Mr. Pennell has adopted the Cuvierian classification, which is no doubt the best course he could have taken in order to render his subject readily intelligible to those for whose use the book is specially intended. In order to enable the readers to determine the species of fish which may come in their way (a branch of knowledge in which many anglers even are wofully deficient), careful descriptions are given of all the known species, which amount, according to the author's enumeration, to fifty-three. He has, however, omitted all notice of the Smelt and the Flounder, which nevertheless may fairly be reckoned among river-fish, the latter especially being often met with far above the influence of the tide. The most important sections of this part of the work are those treating of the Pike and the numerous species of Salmonidæ, the difficult natural history of the Salmon especially being admirably described. Of the Charrs, Mr. Pennell, following Dr. Günther, makes three species; but of this group, as also of that of the true Trouts, it seems probable that further researches will prove the existence in our waters of a larger number of species than is now known; and Mr. Pennell's book will do much to call the attention of anglers and others who may have the opportunity of investigating the productions of our rivers to this important point in British ichthyology. Indeed, as a manual of our Freshwater Fishes, this little work will be welcome to many a naturalist who may be desirous of working upon this branch of zoology.

It seems to us, however, to be rather a defect in the book, that it is too exclusively zoological. The infusion of a little more angling information into it would have rendered it a far better angler's handbook than any that we possess; and this information might easily have been given in the space which is at present occupied by considerable digressions, such as that at pp. 223–232, in which numerous examples of fishes making terrestrial excursions are detailed. In one of these little digressions, which happens to be peculiarly *à propos de bottes*, the author falls into a curious muddle, describing the *Pinna* under the name of "Nacre," as the source of mother-of-pearl, and giving Oppian's account of the relation between the Mollusk and the *Pinnotheres*. It would, however, be an invidious task to point out the two or three little errors of this description which have crept into a book otherwise excellent, and which we can highly recommend to all who are desirous of investigating the fishes of our fresh waters; and in taking leave of Mr. Pennell, we can only hope that we may speedily see a second edition of his book, containing some additional species, to the discovery of which it may have contributed.

Introduction to Zoology; for the Use of Schools. By Robert Patterson, F.R.S. Twenty-eighth Thousand. Belfast: Simms & M'Intyre. London: Longmans & Simpkins. 1863. 12mo.

Mr. Patterson's 'Zoology for Schools' has been too long and favourably known to need much notice at our hands. We are glad to see that it has attained so large a circulation, as, from the character of the information contained in it, and the clearness and attractiveness of its style, it cannot fail to communicate to the young readers for whose benefit it is intended sound views of the general subject of zoology.

In the present edition, we find that Mr. Patterson has introduced many changes rendered necessary by the recent progress of zoological science. Amongst these we may mention especially the adoption of the subkingdom Protozoa, the transfer of the Polyzoa to the Mollusca, and of the Entozoa and Rotifera to the Annulose series, and the separation of the Batrachia from the Reptiles as a distinct class. Mr. Patterson still retains the subkingdom Radiata, although indicating the existence of the great group of Cœlenterata; it seems to us that he would have done better to have adopted the latter division, with its subdivisions, as giving a far clearer insight into the somewhat difficult subject of the diversity of generations in the Hydrozoa. This, however, is a small matter; and in other respects this little book is deserving of the highest praise, the author having succeeded in giving a remarkably uniform picture of the whole animal kingdom, well illustrated by references to examples, and enlivened by a number of interesting anecdotes told in a lively manner.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Jan. 13, 1863.—George Busk, Esq., F.R.S., in the Chair.

Descriptions of Five New Species of Fishes obtained at Madeira. By James Yate Johnson, Corr. Mem. Z. S.

Fam. Scombridæ.

Brama princeps, sp. n.

D. 5.27–33. P. 20. V. 1.5. A. 3.26. C. iv. 15. iv. M. B. 7.

Body oval, compressed, and elevated, the height compared with the length being as 1 to $2\frac{1}{2}$ or $2\frac{2}{3}$. It is of a blackish-grey colour, beautifully reflecting white and iridescent hues. A coppery lustre is reflected in certain lights from the sides of the body and the head. The hinder portion (black) of the body is covered with large striated scales; those on the head have finely pectinated edges, those on the body have simple borders. Between and in front of the eyes the head is scaleless.

The head is short and abrupt; its length to that of the whole fish is as 1 to $2\frac{2}{3}$. The *eye* is vertically oval; the pupil a pale grey, the iris a dark brown. It is contained about $4\frac{1}{2}$ times in the head, and is removed from the muzzle by a space equal to about $1\frac{1}{3}$ times its longer axis. Above it there is a space equal to $1\frac{1}{2}$ times its longer axis, and below it a space equal to twice that axis. There is only one opening on each side to the pituitary sac, and that is small and transversely oval. The mouth-cleft is small and subvertical; the under jaw rather longer than the upper. The superior border of the mouth is formed by the narrow premaxillary, much of which, when the mouth is closed, passes underneath the maxillary. The latter is much dilated below, and its exposed portion is triangular. It reaches back to the vertical from the middle of the eye. There are small scales on the premaxillary, and large ones on the maxillary. There is a broad band of small, conical, slightly curved teeth, narrowing backwards in each jaw, the innermost row being slightly longer. There is also a narrow band of small teeth on the palatines; but the vomer and tongue are unarmed. The tongue is broad, fleshy, and black. Inside the teeth in each jaw there is a black flap extending from one side of the mouth to the other. The opercular pieces are clothed with scales, and their margins are unarmed and rounded.

The long *dorsal* fin is very high and falcate in front, this portion being covered with small scales. The fin is low behind, and near its termination the broadly expanded apices of the rays project beyond the membrane. The length of the fin, compared with the total length of the fish, is as 1 to $2\frac{1}{7}$. The *pectoral* fins are long, pointed, and subfalcate, and they reach back as far as the middle of the dorsal fin. The base is clothed with small scales; and in the axil there is a membrane bearing eight or nine scales, which connects the upper side of the base with the side of the body. When the fin is pulled away from the body, these scales spread out and cover up the hollow of the axil. The *ventral* fins are inserted under the bases of the pectorals; they are short, and their apices are truncate. The spine is very short, and there is a scale-like appendage in the axil. The long *anal* fin resembles the dorsal in shape, being high and falcate in front; the falcate portion scaly; the hinder portion low, with the rays projecting beyond the membrane. It terminates on the vertical of the termination of the dorsal. The *vent* is placed a little before the commencement of the anal fin. The *caudal* fin is lunate, and has a wide spread; its base is scaly.

The middle portion of the tail is raised or thickened longitudinally, so as to form a kind of flat, broad keel. Near the base of the caudal fin there are some transverse grooves above and below.

Forty-five rows of scales may be counted between the border of the opercle and the base of the caudal fin, and on the fin itself there are nine or ten rows of small scales. There are about twenty-five series of scales in the height of the body. The scales are very broad, and their surfaces are radiate-striate, *without the slightest trace of an umbo or spine.*

One of the examples, measuring 32½ inches in length, proved on being opened to be a female, and had an egg-sac 3½ inches long and 1¾ inch across. There were five stout pyloric cæca, four of which were 3 inches long, the fifth only half as long. The intestine was convoluted, and 22 inches in length. The stomach was small; the liver of moderate size; the gall-bladder large.

The fishermen call this handsome fish "Freira do alto," *Brama Raii* being called "Freira." Several specimens have been taken in the months of February and March, the lengths of which ranged from 27 to 33 inches.

In form it bears a close general resemblance to *Brama Raii*, which, however, is less thick in proportion, has much smaller scales, and is without the broad ridge at each side of the tail and the white borders of the vertical fins. Moreover in that species the anterior portions of the dorsal and anal fins are much less developed. If admitted into the genus *Brama*, the definition of that genus given in Dr. Günther's Catalogue will require modification in regard to the size of the scales, the number of the dorsal spines, and the jaw-teeth, which are there said to have an outer series of stronger teeth. No such series is discoverable in the species now described.

The following measurements were taken from two examples of nearly the same length:—

	A. inches.	B. inches.
Total length	32½	33
Height	13	13
Thickness under anterior part of dorsal	4	4
Length of body without caudal	..	25
Head	6½	7½
Eye, diameter	..	1¾

	A. inches.	B. inches.
Teeth, width of band in jaws	$\frac{9}{20}$	
Rictus	..	$2\frac{7}{10}$
Dorsal, distance from muzzle	$8\frac{3}{4}$	$10\frac{1}{4}$
——, length of base	14	
——, height in front	6	$7\frac{1}{2}$
Pectorals, distance from muzzle........	$7\frac{1}{2}$	
——, length	..	$8\frac{7}{8}$
Ventrals, length....................	$1\frac{1}{4}$	$1\frac{1}{2}$
Anal, length	$10\frac{1}{2}$	
——, height in front................	6	
——, distance from muzzle	..	$14\frac{1}{2}$
Caudal, expanse....................	12	12
Scales of body, width................	$1\frac{1}{2}$	

Fam. Tæniodeæ (Lophotidæ, Günther).

Lophotes cristatus, sp. n.

D. about 255. P. 13. V. 5. A. 19. C. 15. M. B. 6.

Elongated, compressed, blade-like; the line of the unarmed belly nearly straight; the back curving upwards slightly for the first third, then falling gently to the tail. The height of the body, compared with the length, is as 1 to $5\frac{1}{4}$. The colour is uniformly a silvery grey, without spots. The body is clothed with simple scales, which are buried in the skin, and set obliquely so as to give a reticulated appearance. They are rather large and very delicate.

The head is short and unarmed; it bears a high fleshy crest, the horizontal line of which is straight with the back. This crest carries the anterior portion of the dorsal fin, and it projects, at an acute angle, beyond the vertical of the snout. At the angle rises a single bony ray, which is equal in length to one-fourth of the total length of the fish. A fringe of red membrane connects it with the dorsal fin, of which it appears to be the first ray. The edges of the gill-covers are simple, the bones radiate-striate. The round *eye* is large, its diameter being contained three times in the head; the iris is silvery white, the pupil oval. The space intervening between it and the front of the head above the jaw is much less than a diameter; but the space between the edge of the capital crest and the superior part of the orbit is considerably more than a diameter. The space between the eye and the snout is reddish and scaleless. The *mouth* is oblique and rather small; the rictus about two-thirds the diameter of the eye, and its width almost equal to a diameter. There are about four rows of small conical-pointed *teeth*, which curve backwards, at the front of the premaxillary; and about two rows of similar teeth at the sides of the lower jaw, whilst in front they are crowded four or five deep. Small teeth, very few in number, are planted on the vomer and on the anterior extremities of the palatine bones; but there are none on the tongue. Inside the mouth, above and below, there is stretched a black membrane from side to side. The maxillary is toothless, and is much dilated below. It covers the premaxillary at the sides, and reaches back to the vertical through the middle of the eye.

The single *dorsal* fin extends from the capital crest to the caudal fin, from which it is not easily distinguished. Behind the long bony ray, already mentioned, it is low, the middle portion being higher than the rest. The base is sheathed in transparent membrane, an extension of the skin. The *pectoral* fins are of moderate size, placed low down, and at a distance from the top of the lower jaw equal to about an eighth of the total length of the fish. The first ray is bony and very strong, but not longer than the rest, which are branched. The *ventral* fins are very short, and are inserted a little behind the pectoral fins, and only slightly below them. Only five, slender, simple rays were counted in the specimen. The *anal* fin is low, it is placed far behind, near the caudal fin, and its first three or four rays are short. The *vent* is placed just before the fin. The tail, behind the anal fin, has parallel margins, and is much compressed. It is low, and its lower edge is finless; whilst its upper edge carries the posterior portion of the dorsal fin. The *caudal* fin is short, and is not well distinguished from the dorsal fin; but there seem to be fifteen rays, viz. ten below the lateral line and five above. The lower angle only projects. This fin is not set on obliquely, as in some of the genera of the family.

The unarmed *lateral line* descends at an angle of 45° from the angle of the capital crest to behind the eye; it is then straight along the body to the base of the caudal fin.

The *stomach* is cæcal, narrow, and tapers downwards. Numerous cæca are attached to the intestine. The intestinal canal is long and straight; the egg-sac long and forked; the liver of moderate size. The stomach of the specimen examined contained the much-digested remains of a small fish and a Cephalopod.

Only a single individual of this curious fish has occurred. The single species of the genus hitherto known, a Mediterranean fish (*Lophotes Cepedianus*, Giorna), appears to be likewise very rare; for M. Valenciennes (Hist. Nat. des Poiss. x. 401) says that only three specimens had been examined by naturalists, two of which had been deposited in the Museum at Turin, and the third in the Museum at Paris. In the British Museum are two stuffed specimens and one preserved in spirits. The differences between the Madeiran fish and the Mediterranean fish (as described in the Hist. Nat. des Poiss.), which seem to justify the formation of a new species, are these :—In the latter the height, compared with the length, is said to be as 1 to 7; and the thickness, compared with the height, as 1 to 3; whereas in the Madeiran fish the height is to the length as 1 to $5\frac{1}{4}$, and the thickness to the height as 1 to 6. Moreover, Valenciennes says the skin is without scales, that its silvery-grey colour is relieved with round spots of pure white, and that all the fins are of a lively rose. Now the skin of the fish here described possesses scales, and the colouring of the body and fins is a uniform grey. I may add that I have examined the fish preserved in spirits at the British

Museum, but I could not detect any scales in the skin. The dimensions of the specimen, which will hereafter find its way to the British Museum, are given in the following table:—

	inches.
Total length	50
Height (14 inches from snout)	$9\frac{1}{2}$
Height of head through the eye	$7\frac{3}{8}$
Thickness for the greater part of body	$1\frac{1}{2}$
Head	$6\frac{1}{2}$
Eye, diameter	$2\frac{1}{8}$
——, distance from front of head	$1\frac{1}{2}$
——, distance from edge of crest	$3\frac{8}{10}$
Mouth, rictus	$1\frac{1}{2}$
——, width	2
Teeth, length	$\frac{1}{10}$
Maxillary, width below	$\frac{3}{4}$
Dorsal, length of first ray	$12\frac{1}{3}$
——, height of middle portion	2
Pectorals, length	$3\frac{1}{5}$
———, distance from tip of lower jaw	$6\frac{3}{4}$
———, distance from lower edge of body	$1\frac{1}{4}$
———, width of base	$\frac{8}{10}$
Ventrals, length	$\frac{1}{2}$
———, distance from root of pectorals	$\frac{7}{10}$
Anal, height	$\frac{8}{10}$
——, distance from caudal	$1\frac{1}{2}$
Tail, height	$\frac{7}{10}$
Caudal, length at lower angle	$1\frac{1}{10}$

Fam. Scopelidæ.

Saurus atlanticus, sp. n.

1st D. 13. 2nd D. adipose. P. 11. V. 8. A. 9. C. 18. M. B. 16.

Form of *Saurus Lacerta*, i.e. elongate and cylindrical. The height, compared with the length, is as 1 to 7 nearly. The head, cheeks, and back are of a dull red colour, with irregular patches of bluish purple. The belly is white, as well as the sides, which, however, are variegated with irregular patches of dull red and brownish yellow, arranged alternately and longitudinally. The rays of the first dorsal fin are spotted with red. The anal fin is blotched with reddish marks in transverse lines, and with some opaque white marks. The cycloid scales are of moderate size.

The long, depressed, unarmed *head* is contained in the total length about $4\frac{1}{4}$ times. The space between the eyes is hollowed, and the head behind the eyes is flat and marked with radiating striæ. Near the tip of the muzzle there is a shield-shaped depression. There are scales on the cheeks, and the opercle is bordered with a transparent membrane. The *eye* is nearly round; its diameter is equal to one-seventh of the head, and it is distant about two diameters from the tip of the muzzle. It is placed rather before the middle of the upper jaw, and the upper part of the orbit forms part of the profile. The space between the eyes is rather less than a diameter. The lower jaw is more pointed than the upper, the upper rather longer than the lower. The rictus is long, being equal to the height of the fish, and extending much beyond the eyes. The upper border of the mouth is formed entirely of the strong and thick dentiferous premaxillary, the much weaker maxillary lying behind. Both bones are covered, like the bones of the lower jaw, with a thick scaleless skin. In the lower jaw there are two rows of small slender teeth with hastoid apices; those of the inner row are larger, they are rather distant from each other; and in the intervals are set some very much shorter teeth of the same shape. All these teeth are directed inwards. In the upper jaw there are also two rows of similarly shaped teeth, which are about equal in size to those of the inner row in the lower jaw. The teeth of the inner row are moveable. On the tongue are several irregular rows of slender teeth, directed backwards. On the palatines are about three rows of acicular moveable teeth, which are more slender than those of the jaws. There are also teeth on the pharyngeal arches, but none on the vomer.

The gill-openings are large, and the branchiostegal membrane is supported by sixteen rays on each side.

The *first dorsal* fin has a trapezoidal shape, and rises from a shallow groove posterior to the base of the ventral fins. It is short, and terminates over the middle of the body. The two first rays are unbranched; the longest rays are the second and third, which neither equal the height of the trunk nor the base of the fin. The minute *second dorsal* fin is adipose, without rays, and is placed over the middle of the anal fin. The *pectoral* fins are about one-eleventh of the total length of the fish, and about half as long as the ventral fins; the first ray is shorter than the succeeding three, but longer than the last. The *ventral* fins are inserted about halfway between the pectoral and first dorsal fins. Their length is about one-fifth of the total length of the fish. The lower rays are longer, the last but one being the longest in the fin. The *vent* is far behind, being three-fourths of the length of the fish, minus the caudal fin, from the muzzle. The *anal* fin is short, and rises out of a shallow groove. The *caudal* fin has eighteen rays, besides short external rays. On each face of this fin there are two scale-like appendages, such as are seen in *Saurus Lacerta* ("un appendice écailleux prolongé en une petite palette."—*Valenciennes*).

The *lateral line* is straight, and is placed rather above the middle of the body.

This description has been drawn up from a single specimen, obtained in the month of April, which has been sent to the British Museum. Another example, taken in May, only a trifle more than 3 inches long, had fourteen rays in the first dorsal fin, and ten rays in the anal fin. There was a distinct dark spot at the tip of the muzzle.

The fish described by Mr. Lowe, in the 'Trans. Zool. Soc.' vol. ii. p. 183, under the name of *Saurus griseus*, is not to be distinguished from *S. Lacerta*, as defined by Valenciennes (Hist. Nat. des Poiss.

vol. xxii. p. 463); and to the same species is to be assigned the fish described by Valenciennes, in his 'Ichthyologie Canarienne,' under the name of *S. trivirgatus.* Both these forms have been obtained by me at Madeira.

The following are the dimensions of the larger of the two specimens of *S. atlanticus*:—

	inches.
Total length	11
Height	$1\frac{6}{10}$
Head	$2\frac{6}{10}$
Eye, diameter	$\frac{7}{10}$
First dorsal, distance from muzzle	4
—— ——, longest rays	$1\frac{1}{10}$
Second dorsal, height	$\frac{3}{10}$
—— ——, width	$\frac{3}{20}$
Pectorals, length	1
Ventrals, length	2
———, distance of their vertical from muzzle	$3\frac{1}{4}$
Vent, distance from muzzle	$7\frac{1}{2}$
Anal, height	$\frac{8}{10}$
——, length of base	$\frac{9}{10}$
——, distance from base of ventrals	$4\frac{1}{4}$
Caudal, length	$1\frac{1}{10}$

Scopelus caudispinosus, sp. n.

1st D. 26. 2nd D. adipose. P. 12. V. 9. A. 19. C. viii. 10+11. vii. M.B. 10.

Body slender, with the head of a peculiar aspect, from the steep profile, the forward eye, and the deep mouth-cleft. The height is to the total length as 1 to 7, and the thickness about one-twelfth of the total length. The scales are cycloid.

The *head* curves rapidly downwards in front of the eyes, forming a quadrantic profile. Compared with the total length, it is as 1 to $4\frac{1}{2}$. It is scaleless, unarmed, and arched above. The *eye* has a diameter equal to about one-fifth of the length of the head, and is placed less than half a diameter distant from the muzzle, which is short, blunt, and truncate. The oral cleft is oblique, and reaches much beyond the eyes. The upper border of the mouth is formed by the premaxillary, the slender maxillary lying behind. There are villiform bands of *teeth* in each jaw, on the palatines, and on the pharyngeals, as well as three longitudinal bands on the tongue, the middle one widening backwards. There are also patches of similar teeth on the entopterygoids; but the vomer is unarmed. The rakers of the branchial arches carry small teeth. The gill-openings are large, and the gill-covers are of a dark blue colour inside; the opercle has an angular form near the root of the pectoral fin.

The *pectoral* fin is small, being to the total length as 1 to $11\frac{1}{2}$. It is inserted low down, and reaches nearly to the root of the ventral fins. The *first dorsal* fin is placed at the middle of the back. It is higher in front, but its height does not equal that of the fish. The abdominal *ventral* fins are inserted under the anterior part of the first dorsal; they do not reach quite so far back as the commencement of the anal fin. The *anal* fin is of moderate length; it commences under the middle of the first dorsal fin. On the upper edge of the tail there are eight small sharp spines, followed by two larger spines; on the lower edge are nine small spines, followed by two larger ones.

The single example of this fish that has occurred (taken in the month of February) was so much damaged that little can be said about the scales or colour. It appeared, however, to have been nearly black; but there were no traces of silvery spots on the sides. The muscles abounded with oil.

It appears to be nearly allied to *Scopelus Crocodilus,* Valenciennes, who assigns twenty rays to the first dorsal and eighteen rays to the anal fins of that species (H. N. Poiss. xxii. 447). Of that fish it is stated that the eye is contained $3\frac{1}{2}$ times in the head, and that the pectoral fins do not reach to the ventral fins. No dark blotch at the base of the caudal fin was observed in my fish. It would seem to fall into Rafinesque's subgenus *Myctophum*; but it is distinguishable from all the four species described and figured in the 'Fauna Italica,' by the greater length of the first dorsal fin, and by the larger number of rays in that fin, which, in the four species referred to, range from twelve to seventeen.

The following are the dimensions of the example which has been sent to the British Museum:—

	inches.
Total length	$6\frac{1}{3}$
Height under first dorsal	$\frac{9}{10}$
Thickness	$\frac{1}{2}$
Head	$1\frac{4}{10}$
Eye, diameter	$\frac{3}{10}$
Mouth-cleft, length	$\frac{9}{10}$
First dorsal, distance from muzzle	2
—— ——, height	$\frac{9}{10}$
—— ——, length of base	$1\frac{8}{10}$
Pectorals, length	$\frac{6}{10}$
Ventrals, length	$\frac{7}{10}$
——, distance from tip of mandible	2
Anal, length of base	$1\frac{1}{5}$
——, distance from tip of mandible	$2\frac{9}{10}$
Caudal, length	$1\frac{1}{10}$

NEOSCOPELUS, gen. nov.

Oblong, compressed, covered with large caducous scales. First dorsal fin placed over the abdominal ventral fins. The pectoral fins long; their inferior rays not thicker than the rest. Mouth-cleft not extending beyond the eyes. The maxillary dilated below, and furnished with a small supplementary piece. The upper border of the mouth formed entirely of the premaxillary. Scobinate bands of teeth in both jaws, on the palatine bones, and on the vomer; scobinate patches of teeth on the entopterygoids. Branchiostegal membrane with nine rays.

This new genus is allied to both *Aulopus* and *Scopelus*. In its moderate number of branchiostegal rays and scopeloid form of body it approaches the latter genus; the shape of the teeth and the dentiferous vomer ally it to the former. From *Odontostomus* it is distinguished by the moderate size of the eye and the immobility of the teeth; from *Lampanyctus* by the greater height of the body and by the comparatively short rictus, which, in that genus, extends much beyond the eye.

Neoscopelus macrolepidotus, sp. n.

1st D. 4.9. 2nd adipose. P. 18. V. 8. A. 13. C. iv. 10+9. iii. B. M. 9. Scales of lateral line 30.

Oblong, compressed, the height contained $4\frac{1}{2}$ times, and the thickness 10 times in the total length. Back and sides dark red, becoming uniformly fuscous in spirit; cheeks silvery; throat and belly black; the scales on the belly having a pearly iridescent centre, and forming about five longitudinal rows of spots; all the fins a pinky red, approaching scarlet. None of the fins, except the caudal, are scaly.

The *head* is contained rather less than four times in the total length. It is somewhat compressed, and the cheeks are flat. On the vertex, above the posterior margin of the eyes, are two small spines. The opercular pieces, the head between the eyes, and the jaws are scaleless. The upper part of the opercle is marked by a low longitudinal ridge. The neck and shoulder are rather high. Between the eyes are two broad, shallow, longitudinal grooves, with two low ridges between them. This part has an adipose or gelatinous appearance, and it is marked with some twenty or more transverse beaded lines, and in the neighbourhood of the eyes with numerous gelatinous papillæ. The round *eye*, the iris of which has a golden-greenish colour, is contained about five times in the head, and is placed at a distance of not quite a diameter and a half from the tip of the muzzle. It is surrounded by an adipose border, which intrudes upon it at the antero-superior side, and which has a small notch at the posterior side. The distance from eye to eye is nearly equal to a diameter and a half. The nostrils are close together, and placed halfway between the eye and the jaw; the hinder one of each pair is large. The muzzle is rounded, and short but not abrupt. There is a protuberance on the premaxillary, behind the symphysis of the jaw. The under jaw projects slightly beyond the upper. The upper border of the mouth is formed entirely of the premaxillary, behind which is the toothless maxillary, having a length one-half that of the head. The latter is dilated below, is furnished with a very small and narrow supplementary piece, and extends back to the vertical from the posterior border of the eye. There is a scobinate band of teeth on each jaw, the inner rows being rather larger and almost cardiform. A portion of these dental bands is seen outside the mouth when it is closed. A narrow band of similar teeth is found on the palatines, and a chevron-shaped patch on the vomer. The thick tongue is toothless in front; but behind there is a narrow band of small teeth along the middle as far as the branchiæ extend. On the entopterygoids there are large oval patches of minute teeth. On the outermost free branchial arch are long rakers, of which one edge is set with a band of minute teeth; and on its hinder surface is a series of short rakers, the apices of which bear numerous minute teeth. The other branchial arches bear short stout rakers, which have teeth at their ends; and the hinder faces of these arches have similar processes to those of the first arch.

The tongue, the mouth, and the insides of the gill-covers are bluish black. The gill-openings are large. The delicate branchiostegal membrane is supported by nine rays, of which the first is hair-like, and the last very broad, with a raised posterior edge. The *first dorsal* fin has a trapezoidal shape, and is placed well forward over the ventral fins. The four first rays are unbranched, and the first of these is very short. The longest ray is the fifth, and this is about two-thirds the length of the head. The *second dorsal* fin is adipose and scaleless; it is placed over the hinder part of the anal fin. The *pectoral* fins are longer than the ventral fins. They have about two-thirds of the height of the fish above their bases, and they reach back beyond the end of the first dorsal fin, but not quite so far as the vent. Their inferior rays are not thicker than the rest. The abdominal *ventral* fins have stout rays, and the first one is unbranched and shorter than the next three, which are about equal to each other. The abdomen is flat between the roots of these fins. The *vent* is immediately in front of the trapezoidal *anal* fin, the first ray of which is unbranched and very short; the fourth ray is the longest. The *tail* is much compressed. The *caudal* fin is deeply furcate, spotted with minute black spots, and covered with small scales.

The distinct *lateral line* descends rather rapidly from the shoulder; but from the pectoral region it is straight along the middle of the body. The caducous scales which clothe the body are large and remarkably broad, with the exposed margins armed with several rows of small spines. Those of the lateral line are about thirty in number, and in the height of the body ten rows may be counted, viz. four above, and five below the lateral line, which is itself formed of the tenth row.

Of this species only a single example (now in the British Museum) has occurred, and this was taken in the month of January. Its dimensions are given below:—

	inches.
Total length	$10\frac{5}{10}$
Height, a little in front of first dorsal	$2\frac{3}{10}$
Thickness	$1\frac{1}{8}$
Head	$2\frac{3}{4}$
Eyes, diameter	$\frac{1}{2}$
——, distance apart	$\frac{7}{10}$
Mouth, width behind when open	1
———, length of upper jaw	$1\frac{3}{8}$

	inches.
First dorsal, distance from muzzle	$3\frac{3}{4}$
——— ———, length of base	$1\frac{3}{8}$
——— ———, length of first branched ray	$1\frac{5}{8}$
——— ———, length of last ray	$\frac{3}{4}$
Second dorsal, height	$\frac{1}{2}$
——— ———, distance from first dorsal	$1\frac{3}{4}$
Pectorals, length	$2\frac{1}{2}$
———, distance from muzzle	$2\frac{5}{8}$
———, width of base	$\frac{4}{10}$
Ventrals, length	$1\frac{1}{2}$
———, distance behind pectorals	1
Vent, distance of vertical from muzzle	$5\frac{8}{10}$
Anal, length of fourth ray	$1\frac{1}{4}$
———, length of base	$1\frac{1}{8}$
———, distance from ventrals	$2\frac{3}{8}$
Tail, height	$\frac{7}{8}$
Caudal, length	2

Jan. 27, 1863.—G. R. Waterhouse, Esq., V.P., in the Chair.

On the Ophidians of the Province of Bahia, Brazil. By Dr. Otho Wucherer, Corr. Memb. (Part III.*)

The Dryadidæ which I have here been able to obtain belong to two genera—*Herpetodryas* and *Philodryas*†. The specimens of *Herpetodryas* were in very considerable number, but I am disposed to consider them all belonging to *H. carinatus*. They showed many varieties as regards their scales; some appeared to possess no keels at all, indeed the keel was almost effaced, and barely perceptible, on very close inspection, in a few only of the scales. But these specimens agreed in every other respect so much with undoubted specimens of *H. carinatus* that I could not help considering them specifically the same, and supposing Schlegel was right in not regarding *H. fuscus* as a species. *H. carinatus* is one of the few Snakes possessing the peculiarity pointed out by Reinhardt, that, though they have keeled scales, these have but one groove at the tip. The groove is often very indistinct in *H. carinatus*, and to be found only on some of the scales of the neck.

Of the genus *Philodryas* I have seen two species—*Philodryas Reinhardtii* and *P. Olfersii*. Of these, the former is by far the most common in our neighbourhood. Soon after my attention was drawn to the small grooves on the scales, I found that all my specimens of *P. viridissimus* had but one groove on each scale. I therefore thought Reinhardt was wrong in stating this Snake to have two grooves, until Dr. Günther showed that there were two species comprehended under the name *P. viridissimus*, to the one of which with two grooves he has left the name *viridissimus* (Surinam), establishing the other with one groove as a new species—*P. Reinhardtii* (Brazil).

* See 'Annals,' 1861, vol. viii. p. 179; 1862, vol. ix. p. 251.

† [To these we may now add the genus *Dromicus*; see page 325.—A. G.]

Of *P. Olfersii* I have seen about half-a-dozen specimens. One was sent to me lately from Rio de Janeiro, the rest were from this province.

Of the family Dendrophidæ a single species, *Ahætulla liocerca*, has come to my notice, but in few specimens. One was sent to me from Rio de Janeiro; when alive, it is a very beautiful animal.

The family of Dryiophidæ is represented in this province by two species of the genus *Dryiophis*—*D. argentea* and *D. acuminata*, of which the former seems to be very scarce, whereas the latter is exceedingly common. I have nothing to add to what is already known of these animals. I have repeatedly tried to keep live specimens in confinement, but they all soon perished, after incessant disquietude, without ever taking food of any kind.

The Brazilian Dipsadidæ are all, as far as I have been able to ascertain, of nocturnal habits. During the day, specimens are found only in dark, sheltered places; at night they are frequently met with abroad. A specimen of *Leptodeira annulata*, which I kept for a long time in confinement, was never visible during the day, being hid in a crevice of its cage, but soon after sunset it became very lively. I never saw it take any food; and it died after several months' confinement, probably from inanition. This species is very frequently found close to dwellings and in the thatch of houses.

Of *Thamnodynastes Nattereri* I have obtained a great many specimens; but of *T. punctatissimus* only a few from Cañavieras.

My statement to Dr. Günther, that I had seen a specimen of *Eudipsas leucocephalus*, was founded on a mistake; no specimen of this species has yet come to my notice.

Leptognathus Catesbyi is not very scarce. Of *L. Mikanii* I have only lately received specimens from Caravellas.

The Brazilian species belonging to the family Scytalidæ are numerous. Of *Scytale coronata* I have seen only the variety B. of Dr. Günther's Catalogue. It is exceedingly common, and very remarkable for the different changes of coloration it undergoes by age. Young specimens are of a pale pink colour; adults are of an almost uniform black colour above, and white beneath. It lives, like all the members of this family, on lizards, chiefly on our most common species, *Trachycyclus marmoratus*. I have frequently had specimens of *Scytale* and *Oxyrhopus* alive for months; they are all of seminocturnal habits, and pursue their prey, not during the night, but at beginning of dusk, or a short time before sunset. On seizing they seldom crush their victims, unless these offer strong resistance; and considering how vigorous and tenacious of life lizards are, I have often been surprised at the little resistance they offer when caught even only by a leg. They seem paralyzed. If they struggle, the snake quickly throws a coil or two over them; if not, they allow their pursuer, after a little while, to relinquish its hold and to seize them deliberately by the head. Is it that the Snakes with grooved teeth are, after all, not quite innocuous, at least for cold-blooded animals? I was once severely bitten by a *Philodryas Reinhardtii* without feeling the slightest subsequent inconvenience.

Of the genus *Oxyrhopus* I have seen the following species:—*O. Clœlia, O. formosus, O. petolarius, O. immaculatus,* and *O. trigeminus.* The last-named one and *O. petolarius* are the most common. Of *O. immaculatus* I have seen a single specimen.

Of the family Elapidæ two species are very common—*Elaps lemniscatus* and *E. corallinus.* The variety of the latter with white-edged black rings never attains but a small size; it differs also in coloration from the others, being brick-red. I am therefore inclined to consider it as a distinct species—the *E. circinalis* of Dum. and Bibron.

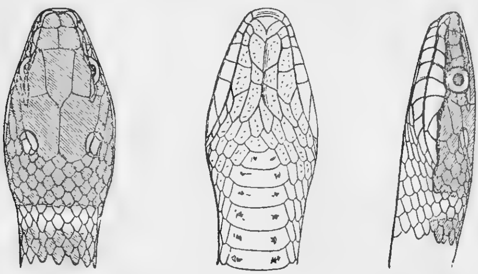
Addition to Dr. Wucherer's Article on the Ophidians of Bahia. By Dr. A. Günther, F.Z.S., etc.

Almost simultaneously with the concluding part of Dr. Wucherer's paper "On the Ophidians of Bahia," I received from him a small Snake, which on examination proved to be a new species of the genus *Dromicus.*

Mr. Cope has lately* pointed out the complete gradation existing between the most slender species of *Dromicus* and the stout forms of the genus *Liophis,* dividing them into six divisions, characterized by the structure of the scales and by the relative length of the tail†. This new species would enter the division *Lygophis* of his arrangement, having the scales without grooves, and a tail the length of which is one-fourth of the total.

Dromicus (Lygophis) Wuchereri, sp. nov.

Scales in fifteen rows. Loreal square; one præorbital, reaching to the upper surface of the head, but not touching the vertical; two



postorbitals; eight upper labials, the third, fourth, and fifth entering the orbit (the third with its posterior angle only); the seventh labial forms only a small portion of the lip, and on one side it is

* Proc. Acad. Nat. Sc. Philad. 1862, p. 75.

† Mr. Cope's general observations on the species of these genera are perfectly correct, and the divisions proposed by him are most convenient for the determination of the species, but they do not appear to me to be more natural groups than those which we had before; for instance, *Liophis Reginæ* is certainly more closely allied to *L. Merremii* and to *L. Cobella* than to *Dromicus Temminckii*; yet *L. Reginæ* and *D. Temminckii* are united into one group, and the two others into another. *L. conirostris* cannot be separated from *L. Reginæ.* And if *Liophis* and *Dromicus* be brought into so close a proximity as they are by Mr. Cope, *Zamenis* and certain species of *Coronella, Leptodira,* &c., cannot be kept at a distance.

even somewhat remote from the labial edge, the sixth and eighth labials being in contact with each other (as in *Diemennia,* where this shield is generally described as a temporal). An elongate temporal shield is in contact with both oculars; five scale-like temporals behind, in two transverse series. Five pairs of the lower labials are in contact with the chin-shields. 160 ventral shields; anal bifid; 66 subcaudals.

The posterior maxillary tooth is the strongest, and somewhat remote from the preceding.

Light brownish olive, minutely dotted with brown. Anterior part of the trunk with twelve pairs of brown spots, which are arranged in a zigzag series; the spots of the two anterior pairs are confluent. Head brown, with a pair of rounded, well-defined, yellowish spots; a yellow line from above the eye, along the canthus rostralis, round the snout; upper lip yellow, separated from the brown colour by a black line; anterior ventral shields with an irregular series of black dots on each side; belly yellow.

The typical specimen is an adult male, 16 inches long. I name the species after my friend Dr. O. Wucherer of Bahia, its discoverer, who informs me that he has seen only three specimens of it, alike in size and colour. The species, therefore, appears to be scarce.

MISCELLANEOUS.

On the Acanthocephali. By Rudolph Leuckart.

The *Acanthocephali* are the only group of Entozoa the development of which has hitherto eluded the investigations of naturalists. Dujardin and Siebold have indicated that the ova of the *Echinorhynchi* contain embryos very different from their parents; but this constitutes the whole of our knowledge, and the attribution to these animals of a simple metamorphosis by Van Beneden and G. Wagner is a pure hypothesis.

Prof. Leuckart was struck more than once by the presence of an imperfectly developed *Echinorhynchus* in the freshwater *Gammarus* (*G. Pulex*), and he thought that he recognized a certain resemblance between this parasite and the *Echinorhynchus Proteus* of the Carps. He therefore scattered the ova of six or eight *Echinorhynchi* of this species in a bottle containing *Gammari,* and in a few days found a great number of these ova in the intestine of the *Gammari.* He also found that the embryos quitted their envelopes, pierced the wall of the intestine, and passed into the abdominal cavity of these Crustaceans. These young worms are truncated anteriorly, and the truncated surface bears a double bundle of chitinous spines. In the interior of the body there is an accumulation of oval granules, previously indicated by Siebold as a constant organ of the embryos of *Echinorhynchi*: Siebold regarded this organ as an unassimilated residue of the vitellus. To avoid prejudging, it may be called the nucleus.

The young embryo increases in size for about three weeks, after which it undergoes a singular metamorphosis. Its nucleus is elongated, organized, and gradually converted into a true *Echinorhynchus.* The latter is therefore formed within the primitive embryo like an Echinoderm in its *Pluteus,* or a *Nemertes* in its *Pilidium.* It rapidly increases in size, becoming twice or three times its former length, and finally fills the body of the embryo completely. The latter is not destroyed, but persists and becomes transformed to constitute the envelopes external to the muscular tube of the worm—envelopes which are distinguished, as has long been known, by the existence of a proper vascular system. The primitive cuticle and the bundles of spines disappear; but this slight moulting is a phenomenon of far less importance than the casting of the *Pilidium* by the young *Nemertes.*

When the cephalic armature of the *Echinorhynchus* is formed, it draws back into the posterior part of its body like a *Cysticercus* in its vesicle.

The number of these parasites is sometimes very considerable. Prof. Leuckart has counted as many as fifty or sixty in a single *Gammarus*; but in this case they often destroy their host.—*Nachrichten der kön. Ges. der Wiss. zu Göttingen,* Oct. 1862; *Bibl. Univ.* March 20, 1863, *Bull. Scient.* p. 245.

Note on the Animal of Lithotis rupicola. By William T. Blanford, A.R.S.M., F.G.S.

Since sending the descriptions of *Lithotis* and *Cremnobates* (see p. 184) I have obtained much finer specimens of the former shell from the same locality—the rocks of the Bhore Ghat. The animals being in full vigour, I had a better opportunity of observing them: those previously captured were æstivating and very sluggish. One or two of the characters previously noted require correction, and I have observed some additional particulars of interest.

The foot, during the monsoon, is rather longer than the shell, and oval, the head-lobe being separated by a groove. There is no trace of the lower pair of (true) tentacles; the upper pair, or eye-pedicels, are much swollen and mammiform towards the base. The upper jaw is horny and arcuate; the lower lip deeply cleft. Mantle closed, with the exception of a circular orifice at the end of the siphonal ridge in the shell.

The largest specimen I now possess measures $10\frac{1}{2}$ millimetres by 7, and is $3\frac{1}{2}$ mill. high.

Lithotis abounded upon the surface of the damp rocks. *Cremnobates* occurred only where water ran down the face of the cliff, thus confirming my expectation of the latter proving to be an amphibious rather than a terrestrial form.

Poona, Aug. 6, 1863.

Habits of the King-Crab (Polyphemus). By Dr. J. E. Gray, F.R.S. &c.

Several uses have been suggested for the elongated spine-like tail of this genus of Crustacea. They have several specimens alive in a shallow tank in the Liverpool Museum; and Mr. Moore showed me one use these crabs make of this appendage. If they are turned over on their backs, they bend down the tail until they can reach some point of resistance, and then use it to elevate the body and regain their normal position; and they did this repeatedly and quickly. They have never been seen to use this tail for the purpose which has often been assigned to it—that is, for leaping from place to place by bending it under their body, like the toy called a "spring-jack" or "leaping-frog."

Delphinus crassidens.

This Cetacean, which was described by Professor Owen, in his work on Fossil Mammalia, from a skull found in the bottom of a fen in Lincolnshire, has lately been discovered as a recent species, which occurs in great shoals in the North Sea. The animal and its anatomy have been described by Professor Reinhardt of Copenhagen, under the name of *Pseudorca crassidens*, as forming a genus intermediate between *Grampus* and *Orca*.

Distribution of Bos Taurus *and* Bos Dante *in Africa.*

To Dr. J. E. Gray, F.R.S. &c.

Kăno, Central Africa, July 25, 1862.

Dear Sir,—I am desirous, through you, of correcting a slight error in Barth's 'Travels,' into which he has apparently been led from want of acquaintance with zoological divisions. In Appendix to vol. iii. p. 574, in speaking of a place named 'Wárji' (but which ought to be 'Wárzhi'), he says, "Cattle of a peculiar kind called Múturú are frequent here, much smaller than the ox," &c. Now this 'Múturú' is the *Bos Taurus*, which is the ox of the south and south-west countries to the Gulf of Guinea, and which, from being abundant in Gbári or Gwári, is often called the Gbári ox. I have seen numbers of them, and, about two months ago, while among a wild tribe dwelling on rocks, I saw cattle which I could not have told from small Highland cattle or from our old Orkney cattle; but all are *B. Taurus*. The cattle of Háusa, again, and of Bórnu and the countries on the Great Desert, and westward to Firta Tóro, are all *B. Dante*; and when in his writings Dr. Barth speaks of cattle or oxen, he always means this species. If not noticed, Dr. Barth's remark might lead to the belief that there is here a new species of *Bos*.

B. Dante has not always a hump: three days ago I bought one, a pack-ox, with enormous horns, but no hump. Old bulls have a regular falx-shaped hump. The prevailing colour is white, with black muzzle, eyes, and inside of ears, like some wild cattle in England; but in some places red and brown are also frequent. In Núpe and other places, the species are crossed, and the offspring has no hump, and approaches more to *B. Taurus*. I have had several opportunities of comparing the two, and will, when I am able, send you my remarks. *B. Taurus* is the prettier of the two. Excuse these few hurried lines, and believe me, dear Sir,

Very truly yours,

Wm. Balfour Baikie.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 71. NOVEMBER 1863.

XXXII.—*Further Observations on the Distinctive Characters and Reproductive Phenomena of the Amœban Rhizopods.* By G. C. Wallich, M.D., F.L.S., &c.

Although certain changes have taken place in the aspect of the specimens of *Amœba villosa* still met with in the remaining portion of the Hampstead material in which they were originally discovered, these neither involve the loss of any essential characters, nor can they justly be regarded as anything more than mere changes in degree. As now seen, the individuals have become somewhat reduced in size; they contain less fresh-looking organic food-particles; their movements are more sluggish; the nucleated corpuscles and sarcoblasts are not so frequently met with; the crystalloids, although not less numerous, are smaller; the nucleus is shrunk somewhat, but still retains its very marked membranous capsule; the contractile vesicle performs its diastole and systole at longer intervals; and, lastly, the villi are not so densely studded over the surface of the villous region. But inasmuch as these evidences of impaired vitality are equally manifest in very recently procured specimens, it is probable that they are due to the operation of identical causes—namely, failure of proper nutriment incidental on the season, or temporary stagnation, without absolute drying-up, of the water in which they live.

In the August Number of the 'Annals' (p. 124) I expressed my doubts as to the "reproductive cells" of Mr. Carter (assuming these to be the same bodies to which I had given the name of sarcoblasts) being the product of repeated binary division of the nucleus, and I gave reasons for inclining to an opposite conclusion. My late observations show that these doubts were not unfounded; for whilst I am able to confirm Mr. Carter's statement regarding the recurrence of nuclear division up to a certain limit, I still experience the same difficulty in reconciling the presence, sometimes of a single, sometimes of multiple encapsuled nuclei, which I have frequently witnessed, with the occurrence in the same individual of a large number of sarcoblasts of nearly uniform average size, but which size differs very materially from the also uniform size of these multiple nuclei. In short, I believe that whilst duplicative division does take place in the nucleus and the nuclear capsule up to a certain point, it stops there—and that the sarcoblasts are formed within the body of the nucleus, and are not segments of it and its capsule combined. This view is strengthened, moreover, by some curious facts which have been observed by me only within the past few days—facts which would seem to indicate that the office of the true nuclei is not identical with that of the sarcoblasts, although in both cases a new brood is the result. How the sarcoblasts escape though the apparently imperforate capsule of the nucleus I am ignorant; but I would remark that in *Acanthometra* and *Thalassicolla* they occur within the nuclear body, as well as externally to its capsule (that is to say, throughout the endosarc generally), whereas amongst a multitude of the last-named organisms examined by me I have not met with a divided or a dividing nucleus in a single instance; and in the Foraminifera and Polycystina, which possess no true nucleus at all, the sarcoblasts ("yellow cells" of authors) are present in great number. It is possible, however, that I may be in error in regarding my sarcoblasts as identical with the "reproductive cells" of Mr. Carter, more particularly as he describes the latter as invariably exhibiting a distinct capsule in their mature state, whereas I have entirely failed to detect any endogenously formed bodies, besides the nucleus or few multiple nuclei, which possess a definite capsular covering. It only remains for me to point out that the sarcoblasts in their early stage present a pale-yellow tint, and are somewhat oily-looking, which is not the case with the multiple nuclear bodies. Additional evidence, however, must be produced before these questions can be regarded as definitively answered.

Recent examples also enable me to corroborate the statement advanced in my previous papers respecting the occasional occurrence of a simultaneous tripartite division of the nucleus. When this happens, it is brought about by the inversion of two folds of the nuclear capsule nearly at right angles to each other, one fold passing completely across so as to isolate a segment, whilst the other bisects the remaining portion. In this manner the three divisions, although originally differing in shape, may each contain equal quantities of nuclear matter, and by the gradual rounding of their outline ultimately assume isometrical proportions. In these instances, and indeed in the case of the multiple nuclei generally, I have detected no nucleolus, and the granular mass of the nucleus has invariably filled up its own capsule. In no example, whether amongst the youngest or most mature specimens, have I observed the nucleus (that is, the entire nuclear cell and contents) attached to the ectosarc, or the granular mass of the nucleus itself attached at one point to the interior of the capsule containing it,—the granular mass being free, and its component granules merely sustained within a matrix of viscid protoplasm, although frequently these granules cling, as it were, to the interior of the cell, just as the chlorophyll-granules of the vegetable cell, generally speaking, form a layer immediately within the denser granular protoplasm which lines and circulates within its interior.

It will be seen, on reference to Mr. Carter's last paper in the 'Annals' (October 1863, p. 254), that he now entirely relinquishes the character derived from the supposed anomaly in the configuration of the nucleus, on which he so strongly insisted in his reconstruction of the typical characters of *Amœba princeps*, and accepts, as the distinctive feature of that form, the villous appendage and, as a matter of course, the novel phenomena involved in the discovery of its presence in *Amœba villosa*. Further comment upon this is accordingly unnecessary.

Another point on which my previous views have been materially strengthened by recent experience is the nature of the circulation in *Amœba*. I am more than ever convinced that this is not a vital act, but a secondary and mere mechanical effect consequent on the inherent vital contractility of the sarcode. It is only necessary to watch a specimen of *Amœba* carefully, to become convinced that the appearance of a returning as well as an advancing stream of granules is illusory. The stream, it will be observed, is invariably in the direction of the preponderating pseudopodial projections. The particles simply flow along with the advancing rush of protoplasm. There is no return stream; but the semblance of one is engendered by one layer of particles remaining at rest whilst another is moving past them. In short, the effect is similar to that which would be produced were an empty and transparent bladder or caoutchouc sac, containing granular bodies of greater specific gravity than the viscid fluid within which they were sustained, to be rolled along a plane surface. In such a case it is obvious that only those granules on the upper or free aspect of the sac would be carried onwards —that, having arrived at the most advanced point, they would be deposited, as it were, and remain stationary, as would also that portion of the sac on which they rested, until the rest of the mass should have flowed over them again, causing them now to appear at the posterior extremity, when they would once more be urged onwards as before. The same explanation will, I think, be found to hold good even in the attenuated pseudopodia of some families, as, for instance, the Foraminifera. The essential attributes of sarcode (namely, extensibility and contractility), coupled with the polymorphism evident in every example in which definite form is not partially maintained by the presence of a shell or test, necessarily involve the power of retracting as well as projecting these processes, whereas the tenacity of the substance is not such that a pseudopodium once projected can be retracted towards the body in the same way that a piece of rope thrown forwards from a given point can be hauled in again inch by inch. In the broad pseudopodium of *Amœba*, as also in the attenuated filament of the Foraminifera, or the still more subtle filament of *Acanthometra* or *Euglypha*, the process is the same, and is brought about by a reciprocal outward and inward flow of the sarcode-substance; and thus the granular particles are merely the passive exponents of a vital force which exists quite independently of them. Hence, with all deference to so high an authority as Professor Schultze, I would still regard the circulation of granules in the Rhizopods as a pseudocyclosis, analogous, I grant, in appearance, but not in origin, to the cyclosis observable in certain vegetable cells, as for example *Tradescantia*.

Whilst recently endeavouring to establish the relation between the phenomena of the circulation seen in *Amœba* and the cell of *Vallisneria*, the following very singular facts revealed themselves. As is well known, within each cell of *Vallisneria* is to be found—in addition to the more watery portion (or, as Mr. Carter has appropriately termed it, the "axial fluid"), the layer of very finely granular protoplasm which seems to hug and flow round the interior of the wall, and the chlorophyll-granules—a single colourless mass of protoplasm (of considerable size) which, generally speaking, is only partially affected by the cyclosis, but nevertheless sometimes flows round with the chlorophyll-granules and occasionally adheres to the peripheral protoplasm so as to form a nodule on its internal aspect. This mass of protoplasm, which has been termed the nucleus or cytoblast, presents at its centre a nucleolus which may be rendered very palpable by the ordinary chemical reagents, but especially so by solution of magenta. Occasionally also some of the chlorophyll-granules form an investing layer over the surface of the nucleus, remaining adherent to it in such a manner as to prove that their presence is not accidental. This association of chlorophyll-granules and nucleus is very constant in the mature leaf, but, together with the cyclosis and other phenomena now about to be mentioned, is most distinctly visible in the perianth. On examining a delicate longitudinal section taken from the free margin of the perianth, the gradational changes which take place in the cytoblast, from the free state first described to that in which it is embraced by the green chlorophyll-granules, and, after divesting itself of these bodies, becomes differentiated into a distinct anterior and posterior portion, the former throwing out the flagelliform proboscis of *Astasia*, whereas a regularly pulsating contractile vesicle invariably occupies a position in the latter, are most strikingly manifested. Of the purely endogenous origin of the *Astasia*-like bodies I feel perfectly satisfied, having, as already stated, not only detected the single cytoblast in *every* cell both of the leaf, the spiral flower-stem, and the perianth, but also assured myself by the most careful examination that no lesion had taken place in the cell-walls whereby the entrance of zoospores might have been effected. But the most wonderful feature remains yet to be noticed—namely, the multiplication of the *Astasia*-like bodies by longitudinal fission whilst still within the parent cell, until sometimes as many as ten have been congregated together. In several cases the entire process, which did not occupy more than half an hour, took place under my eyes—commencing at the ciliated extremity, and proceeding backwards until it reached the contractile vesicle, which, after sundry partitions and reunions, finally divided into two halves, one of which was apportioned to each of the new individuals.

Without entering at present into the subsequent history of these bodies, I am desirous of pointing out wherein they resemble and wherein they present marked differences from the characters described by me as pertaining to *Amœba*. Like the Amœban Rhizopods generally, without any exception, whether naked or testaceous, their protoplasmic substance is differentiated into an anterior and posterior portion. Their contractile vesicle discharges itself invariably in the latter region, but, unlike that of the *Amœbæ*, it is fixed in that position permanently. When supplementary contractile vesicles are given off from or near the primary one, they either coalesce with it or discharge themselves independently as in *Amœba*. The nucleus which is in the centre of the body never alters its position. And lastly, whereas the movements in *Amœba* are strictly polymorphous, those of the *Astasia*-like organisms have the power of altering their *outline* only, by extending and contracting the body round an imaginary axis; so that although it is conceivable that the reparation of lost parts may take place, such reparation would consist in the renewal of a determinate and not an indeterminate figure. Coupling this, then, with the absence of any digestive apparatus whatever, we are furnished with a clear line of demarcation between the animal and vegetable, whilst in the simpler forms of Infusoria the presence of a fixed and determinate aperture or apertures connected with a digestive system sufficiently separates them from the Amœban or highest type of Rhizopod structure.

But, to revert once more to the *Amœbæ*. Within the past fortnight my friend Mr. J. N. Tomkins, the able Inspector of the Government Vaccine Department, called my attention to his having unexpectedly detected a profusion of *Amœbæ*, possessing all the characters of *A. villosa*, in some damp confervoid material which had been scraped off a stone slab in his garden and consigned to a vessel containing water, about two months previously. I confess that, even putting out of the question the untenable theory of "spontaneous generation," the development of these *Amœbæ* from germs either constantly present in damp soil or deposited on it through the medium of wind or rain from distant localities was regarded by me with doubt, if not actual incredulity. For knowing how zealously my friend collects the various microscopic forms of life, it seemed far from improbable that these *Amœbæ* were derived from the refuse cast aside from his aquaria. The sequel, however, showed that my doubts were altogether groundless. But, leaving this point for the present, I may state that the question I was especially desirous of determining—namely, the possibility of a gelatinous organism like an *Amœba* being able to withstand the desiccation to which it must be subject during summer if it be the normal inhabitant of confervoid growth met with in similar positions—was deemed by me sufficiently important to merit immediate inquiry.

On examination of a portion of the material which had been kindly placed at my command, I found it contained an abundant stock of *Amœbæ*, both old and young, and that these exhibited (at a bird's-eye view, as it were) the collective characters of *Amœba radiosa, diffluens, globularis, Schultzii, limax, princeps, guttula, verrucosa, quadrilineata, actinophora,* and *villosa.* But whilst it would have been easy to select individual specimens presenting in a marked degree those purely external characters which have been held to distinguish all but the last-named of these forms, it would have been equally easy to demonstrate, by means of the infinite intermediate varieties, that all are the offspring of a common parent, and that the mere outward deviations in figure and degree of differentiation are dependent on those ever-varying physical conditions to which they are amenable, and which will probably for ever elude our scrutiny.

It is necessary to state explicitly that I lay no claim to the discovery that many Infusoria and some even more highly organized forms (as, for example, Rotifera) undergo desiccation without perishing. Professor Ehrenberg, Dr. B. Hicks, and more recently M. Balbiani in conjunction with Mr. Samuelson, have clearly established this fact. My object in dwelling on the observations now recorded is to show how inseparably most of the minor distinctions are connected with accidental changes of physical conditions, and how guarded we should be in assigning limits to variation before we have become acquainted with the extent to which such changes may operate.

In my previous papers it was stated that many incidental facts led me to believe in the narrow limitation of species in *Amœba,* if not in their absolute unity. The appearances presented by the specimens now under notice have served to confirm that belief, and I can hardly imagine it possible that any person, viewing them unbiasedly and witnessing the occurrence of extreme variability even in the earliest stage of the *Amœbæ,* when (as seen by me within the past few days) countless numbers of these minute organisms alternately assume the characters of the most "lobose" type and of *Actinophrys,* could arrive at any other conclusion.

But the history of these *Amœbæ* is not left in doubt; for not only did a fresh supply of confervoid material, scraped off and delivered to me as procured, present specimens after being immersed in water for a few days, but (in order to exclude those sources of error that might be supposed to attach to my observations had the supply been obtained from my own garden, where the refuse of aquaria is at times flung out) a portion of confervoid growth taken from another locality*, having been consigned to water for a few days, was found to furnish similar results. Lastly, with a view to put the matter to a still more severe test, a small quantity of the material first obtained from Mr. Tomkins was placed on a plate of glass and left to dry completely by evaporation. In three days it was again covered with water. Twenty-four hours afterwards no traces of life beyond a few young *Chilodontes* and monads were visible. In forty-eight hours *Amœbæ* were observed, although in much smaller number and more sluggish in their movements than was the case prior to this second desiccation; whilst after the lapse of four days the *Amœbæ,* although still less numerous, were as active as ever.

In the confervoid material recently obtained I detected numerous effete *cysts* of *Amœba,* some quite empty and crumpled up into angular folds, some enclosing the empty frustules of a diatom that occurs abundantly in a living condition in the damp soil associated with the confervoid layer—namely, *Nitzschia Amphioxys*; whilst others enclosed sarcoblasts, and in some examples coarsely granular nuclear bodies which I at once

* The spot selected was a gravel walk, at one part of which rain had lodged occasionally. It had, to my knowledge, been repeatedly raked over during the past three months.

recognized as analogous, if not identical in their origin, with the *naked* nuclear masses described and figured by me in a previous Number of the 'Annals' as occasionally resulting from the extra-capsular subdivision of the granular contents of the primary nuclear cell (Annals, May 1863, p. 368).

The presence of these dead and empty frustules of *Nitzschia* is well worthy of note, as yielding evidence, almost tantamount to proof, that their soft contents had undergone digestion, and hence that they had been received into the interior of the *Amœbæ* prior to encystation and desiccation; whilst the fact of their being commonly taken as food by the *Amœbæ* is manifest from the numbers of *Amœbæ* now living on the material, that contain within their endosarc frustules full, as also partially relieved, of their endochrome.

It may be recollected that, in the same Number (*loc. cit.*), I expressed doubts as to the normal investiture of any *Amœba* by a membranous ectosarc, and inclined to the view that the single example of such investiture which had fallen under my notice up to that period betokened encystation. The strongest confirmation of that opinion is hence afforded; for not only were empty and effete cysts now met with, but a few examples of cysts in which the sarcode-mass, although apparently in a deteriorated state, had recovered a sufficient degree of contractility to produce distinct changes in their form. Of the ultimate fate of these revivified cysts I have not as yet been able to satisfy myself. There are reasons, however, for supposing that they are only destined to afford protection to the reproductive elements until such period as the latter are in a fit condition to be set at liberty. It would also seem probable that the encystation of *Amœba* does not take place, as a matter of course, at certain seasons, but only when the normal conditions of the creature's existence become impaired or altogether deficient—the increased consolidation of the external layer being the exceptional result of prolonged contact with the vitiated medium around, and the cessation of that reciprocal interchange between endosarc and ectosarc, described by me under the name of Amœbasis, which is continually going on in the healthy state of the organisms. That such is the case may be reasonably inferred from the absence of anything like the encysted condition in the specimens of *Amœba villosa* which have now been seven months under close observation, and carefully protected from desiccation. Should encystation in the remaining Hampstead material follow on slow desiccation being permitted to take place, the proof required will be complete.

Want of time and space preclude me from entering into full details respecting the several modes in which, in addition to those previously described under the heads of "gemmation" and "viviparous parturition," a new brood of *Amœbæ* appears to be ushered into existence. For the present, therefore, I would merely state that one series of young individuals seems to be derived from the conversion of each free sarcoblast into a polymorphous body, devoid of cilia or flagelliform organ, but provided from the first with a nucleus, a contractile vesicle, and a rudimentary villous organ—that a second series, less frequent than the last, seems to result from the similar conversion of each encapsuled nucleus into a polymorphous body, in which, besides the organs just enumerated, may frequently be seen two or three spherical masses undistinguishable from the sarcoblasts; whilst a third and by far the most numerous brood appears to be derived from each separate granule of the naked mulberry-like nuclear masses which were described by me in the 'Annals' for May (p. 368) as being occasionally formed within the parent *Amœba*. The evidence of this last-mentioned mode of increase consists in the admixture of minute *Amœbæ* with some of the granules which are still quiescent, in their barely exceeding the latter in size, and especially in the gradual transition observable from the quiescent to the motile and polymorphous condition of the granules. Of course it would be futile to attempt an explanation of these processes in the present state of our knowledge; for, although satisfied of the occurrence of these varied methods of increase, I consider the questions they involve as too important to be solved without much additional information or on mere inferential reasoning.

Lastly, I would mention another interesting fact which has revealed itself within the past few days, but the details of which must be supplied hereafter. I allude to the transition observed to have taken place, in specimens of free *Amœbæ* preserved alive in shallow glass cells, from the naked to the testaceous condition—a form closely resembling, if not identical with, *A. radiosa* having first assumed a state of comparative rest, as if about to become encysted, and then gradually secreted the delicate hyaline outer wall which ultimately presented the unmistakable characters of the test of *Arcella vulgaris*.

Kensington, October 20, 1863.

Note.—I am permitted by Mr. Tomkins to state that, whilst looking over the same material, he has distinctly seen the animal of *Arcella vulgaris* evacuate its test, and move away in the garb of a naked Amœban. This occurrence has often been regarded as probable, but I am not aware that it had previously been actually witnessed by any trustworthy observer.

XXXIII.—*Description of two new Madeiran Land-Shells lately discovered by* the Baraõ do Castello de Paiva *and* S[r] J. M. Moniz. By R. T. Lowe, M.A.

The two following valuable additions to the Helicological Fauna of Madeira are at once proofs of the inexhaustibility of that singularly fertile region and of the acumen and activity of its present explorers. The discovery of a new semifossil *Helix* in the S. Deserta, belonging to a group so imperfectly represented in Madeira as *Euromphalus*, Beck, is scarcely less interesting than that of a fourth species of *Clausilia* in addition to the very small number of that genus, proportionately to the *Helices* and *Pupæ*, previously observed in Madeira. The fossil Desertan *Helix* is indeed so nearly allied to *H. Gueriniana* that it may reasonably be expected to reward future research, in the remoter sylvan districts of Madeira *proper*, in a living state. It is, at all events, a proof how closely the topographic and climatic conditions of even the Desertas must have formerly resembled those of the principal island of the group, from which they are now in all respects so widely separated.

1. *Helix calathoides*, Paiva, MSS.

Testa latissime et perspective concavo-umbilicata, subtus excavata, rotundata, utrinque *convexiuscula*, arctispira, *obsolete v. obtuse carinato-angulata, subsolidiuscula*; supra grosse crebricostata, costis prominulis ad angulum *abrupte desinentibus*; subtus obsolete vix striatula, lævigata; spira *convexiuscula*, subconoideo-depressa, apice obtusa, lævigata; sutura *distinctissima*, valde *impressa*; anfr. 7–8, *convexiusculis*, lente crescentibus, ult. antice recto, haud deflexo, supra carinam obsoletam crebricostato, convexiusculo, subplanato, infra ecostato, lævigato, *rotundato-convexo*; umbil. latissimo, infundibuliformi, pervio, patulo, profundo; apertura oblique ovali, altiore quam lata; peristomate simplici, recto, tenui, acuto.

Diam. maj. 7–8, min. $6\frac{1}{2}$–$7\frac{1}{2}$, alt. 3–4 mill.
Hab. semifossilis in insula Deserta australi "Bugio" dicta.

Very closely allied to the Madeiran recent *H. Gueriniana*, Lowe (*H. semiplicata*, Pf.), but assuredly a genuine species, and not a merely large fossil form of that shell. It is distinguished by its larger size, less discoidal shape, greater convexity beneath, more elevated spire, obsolete keel, deeply impressed suture, and much coarser, more abrupt, and prominent ribs above, resembling, in the latter respect and in the abrupt ending of the ribs at the obsolete keel or angle of the last volution, *H. Calathus** or *H. bifrons*, Lowe. Not much reliance can be placed on its greater thickness of substance as compared with *H. Güeriniana*, seeing

* According to Pfeiffer = *H. stephanophora*, Desh. in Fér.

that it is only known at present in a dead or semifossil state. The specimens, however, for three of which I am indebted to the liberality of the Baron de Paiva, are in excellent condition as to form and sculpture, though completely colourless. Two of them are even partially semitransparent or opake milky hyaline, like *H. coronata*, Desf. They were obtained last spring in the South Deserta (Bugio), by a person employed as a collector by the Baron, whose note upon them states, "in rupibus subinaccessis." It is perhaps more probable, however, that they were found in the fossil deposit at the top of the island, in which *H. coronula* occurs. They must, at any rate, be very rare or local to have escaped the observation of Mr. Leacock and myself in 1849, and again of Mr. Wollaston and myself in 1855.

2. *Clausilia obesiuscula.*

T. subrimata, fusiformis, tenuiuscula, subabbreviata, obesiuscula, obtusa, fusco-castanea, cinereo submaculata v. strigillata, nitidiuscula, tenuiter creberrimeque longitudinaliter striata; spira apice obtusa, sæpe decorticata, nec gracili producta; anfr. 8–8½, planulatis, ultimo ad basin v. cervicem unicanaliculato, varice columellari distincto, haud cristato; apertura ut in *C. deltostomate*, lamellis plicisque peristomateque tenuioribus.

Long. 10–11½, lat. 2½ mill.; apert. 2½ longa, 2 lata.

Hab. in Madera prope Caniço secus aquæductum "Levada Debaixo" dictum, supra "Rib. do Porto Novo," sub foliis *Sempervivi glandulosi* (Ait.), Maio 1863, invenit S^r. J. M. Moniz.

Intermediate between *C. deltostoma* and *C. exigua*, Lowe, with the fine close-crowded striæ of the latter. Size and shape more of the former, but shorter and more obese, with a blunt spire not slender or drawn out upwards, and one or two fewer, rather more flattened volutions, with the suture somewhat less depressed, the longitudinal striæ less prominent, distinct, and remote, than even in var. β, subvar. 1; the shell altogether more glossy and shining, not grey or ash-colour, but brighter chestnut-brown, speckled or blotched with grey; the two plaits of the mouth less developed, and the whole peristome thinner than in *C. deltostoma*, β, except in specimens of the latter from high elevations (2000–3000 feet) remote from the coast, *e.g.* in the Curral das Freiras.

Possibly a mere local form or variety of the extremely polymorphous common Madeiran *C. deltostoma*, though at present I am inclined to agree with its discoverer, S^r Moniz, in considering it distinct. Except in size and shape, it approaches nearest to var. β, subvar. 2, *depauperata*, of that variable species; but it is a much larger and more obese or ventricose shell, though agreeing with it in the number of its volutions and in the fineness and closeness of their striæ. And though specimens of *β*, subvar. 1, *normalis*, occur occasionally quite as obese, yet they are generally far more slender, being always, moreover, distinguished from the present shell by their uniform dull pale-grey cinereous colour without lustre, stronger, more distinct, and remote longitudinal striæ, more acute and drawn-out spire, with the volutions slightly more convex, and suture more impressed, having also at least one more volution. Thus, as a variety of *C. deltostoma*, its proper place would be between subvar. 1 and subvar. 2 of var. *β*; but, if admitted as a species, it must stand between *C. deltostoma* (*β*, subvar. 2) and *C. exigua*. In the former case, I would propose the following fresh arrangement of the varieties or subvarieties, instead of that given in "Catal. Moll. Mad.," in the 'Proc. Zool. Soc.' 1854, part 22. p. 215:—

C. deltostoma, Lowe.

* Striis longitudinalibus remotiusculis distinctis.

α. raricosta, subvarr. 1 (= *C. Lowei*, Alb.), 2, *l. c.* p. 215.
β. crebristriata, subvar. 1, *normalis*, *l. c.* p. 216.

** Striis longitudinalibus confertis tenuissimis.

γ. obesiuscula = *C. obesiuscula* suprà.
δ. depauperata = *C. deltostoma*, *β*, subvar. 2, *depauperata*, *l. c.* p. 216.

I have received also from the Baron de Paiva several examples of a minute Madeiran *Vitrina*, with only two volutions, collected between S[ta] Anna and S. Jorge, in April last, which, from its globose shape and aspect, seemed at first sight possibly distinct; but, on close and careful examination, I find it to be merely the very young (*pullus*) of *V. Lamarckii*, Fér., with the very minute, puncticulate, spiral striæ which characterize the young of that species and of *V. media*, and which are also visible on the *nuclei* or two primary volutions of most adult specimens of those two species, though wanting in *V. Teneriffæ*, Q. et G.

Lea Rectory, Oct. 15, 1863.

XXXIV.—*Third Communication on the Vasa Propria, Laticiferous Vessels, &c., of Plants.* By M. T. Lestiboudois*.

It has been shown in the two preceding communications that the coloured juices of plants are contained in reservoirs extremely diversified in structure, and that these are at times anastomosing vessels constituting a network, at others straight and rigid tubes or utricles, either in rows or collected into irregular

* Translated by Dr. Arlidge from the 'Comptes Rendus' for July, 1863.

masses or meati, or vasiform or irregular lacunæ. Consequently these reservoirs cannot be said to possess the characters of a vascular system; indeed, when they have unquestionably the form of vessels at their origin and during the greater portion of their course, they are not distributed in the manner of vessels in the organs in which they terminate. It must, moreover, be added that they are not met with in the generality of plants, nor in all portions of the plant in which they may occur. For instance, they cease to exist in the roots of *Asclepias Syriaca.*

A still more remarkable condition may be seen in the *Acer campestre.* In this tree the bark of the young stems and the young branches possesses an abundant lactescent fluid, contained within wide flexuous vessels difficult of detection in consequence of their being surrounded by cells filled with rather greenish granules, not coloured blue by iodine. On tearing, however, a fragment of bark, extremely slender threads are seen interposed among the cortical fibres, and to be very extensible; these are nothing else but the laticiferous fluid itself, coagulated into a solid substance, eminently elastic, which is drawn out into very delicate filaments having various bulgings here and there, and accurately corresponding in appearance to vessels when said to be in a "*state of contraction.*" In portions of the cortical tissue of sufficient transparency, the real vessels are visible, and are seen to be very different from these fibres, and, among other things, to possess walls, which are scarcely distinguishable from the liquid they enclose. Their appearance is so singular that there is little question that they are the structures which have been described (with little precision, indeed) as the laticiferous vessels of the *Acer platanoïdes.*

The existence of vasa propria in young stems cannot certainly be called in question; but those layers of the bark which are more than three or four years old are deficient of them, and they are not discoverable in the roots. Hence in old stems and in roots, the new tissues which belong to the same formation in regard to age as do the most recent branches exhibit no traces of laticiferous juices, although these are abundant in the tissues produced in the course of the same year.

The laticiferous juice, therefore, is not an essential element in the growth of plants. It is sometimes wanting in the most essential portions of plants. It, moreover, is found in certain species, and disappears in others closely allied: thus, the *Acer platanoïdes* has a perfectly milky juice, whilst the *Acer pseudo-platanus,* which is so closely related to it, possesses juices of a perfectly limpid character. The same observation may be repeated with respect to the Umbelliferæ. Consequently the coloured juices cannot be considered agents indispensable to life: they exist or are absent in the most intimately allied species; they are wanting in the most important organs; they are enclosed in reservoirs of entirely different structure. There are certainly some vessels which appear articulated, because the constrictions they present extend so as to constitute septa, or because, when they are observed, they are broken into several pieces—a circumstance which happens because the reservoirs are originally constituted of cells united end to end. There are some which occur in the form of irregular masses; such therefore cannot be regarded as having primitively formed vessels.

These facts being beyond dispute, the opinion has been put forward that it is necessary to distinguish the coloured liquids enclosed within vessels from those contained in cells, meati, and lacunæ, and that the former alone constitute the nutritive juice and have their analogues in all plants. This brings us to the examination of the fifth and sixth questions we have propounded, and leads us to inquire, in the first instance, whether, in fact, two distinct categories of coloured juices can be instituted.

At any rate, no character can be seized upon which will serve to establish a line of demarcation between them: often the juices which are contained in vessels differ more among themselves in composition than they do from those which are found in cells. Some juices contain fatty matters, others substances of a totally different nature, such as caoutchouc; some are bland and nutritious, others are acrid and poisonous; some possess alkaloids endowed with energetic properties, others contain no such compound principles. No greater differences are met with between the liquids contained in different reservoirs. If, therefore, no indication can be discovered sufficient to distinguish one from the other, on what grounds, it may be asked, can it be asserted that some are special, secreted, excrementitial juices, and others of the nature of vital and of alimentary fluids? Such a distinction is assuredly too arbitrary.

It can with still less reason be admitted in certain plants, such as *Chelidonium*, previously cited,—where the coloured juices of the stem are contained in vessels, whilst those of the root are enclosed in cells. These juices preserve their properties in their integrity, although their receptacles differ in form and may assume the numerous configurations which are peculiar to vegetable tissues.

We have now to inquire whether it is true that in all non-lactescent plants there are vessels which constitute a capillary network such as M. Schultz has described and figured, differing only from lactescent vessels by reason of their fluid contents being limpid instead of coloured. In instituting this inquiry we encounter the most important of the problems to be solved; for if we find in all plants a system of vessels of the like kind, occupied by liquids differing only by being either limpid or else coloured, then functions of a general importance must be attributed to this vascular system, and both forms must be regarded as canals permeated by the descending sap or the nutritive juice.

The numerous observations we have made place it beyond doubt that, in the generality of non-lactescent plants, tubes are to be found filled with an elaborated liquid, in which granules are frequently to be seen in great abundance and of variable magnitude. I have found such in almost every plant in which I have sought them; for example, their presence may be descried with great facility in the Cucurbitaceæ, the thin transparent tissues of which are of large size. If a vertical slice of a fibro-vascular bundle be removed from *Pepo* after the plant has been boiled, the cortical portion of these bundles may be seen to be almost entirely formed by tubes filled with a liquid holding numerous granules in suspension. These granules are small, unequal, ill-defined in form, and sometimes of a greenish hue.

But these liquids essentially differ from the coloured juices. The latter contain caoutchouc, fatty matters, organic principles possessing properties often of singular energy, and which stand in no sort of relation to the organs with which they are associated; moreover they do not turn blue under the action of iodine. The juices of the straight tubes are simple in composition. M. Trécul has shown (Institut, No. 1487, p. 215) that the granules of the cortical fibres become blue when permeated by an aqueous solution of iodine; they therefore contain starch—a principle isomeric with cellulose, the base of all the tissues.

In relation to physical properties, the juices compared together are not less distinct: the one sort is coloured, as already stated, and the other limpid; and although the fluids of the latter description may contain granules, the appearances they present when extravasated differ from those exhibited by the former. The difference is particularly striking when the milky and the limpid juices of the bark are examined in a plant in which they are readily separated—for example, in the *Acer campestre*. If a drop of the milky juice be placed on a glass slide, it is seen that, as it dries up, it becomes progressively capable of being drawn out into very long elastic threads: when dried, it has the appearance of a uniform semitransparent mass, in which the granules cannot be detected, and which remains completely undivided and homogeneous. But if a drop of the limpid fluid be placed on the glass, it rapidly dries and breaks up in the fashion of gummy substances. The meshes produced are of smaller or larger dimensions, and anastomoses occur in an irregular manner among them, whence a resemblance (sufficient to cause deception) to a group of reticulated fibres is set up. The appearance is that of the network of a leaf. It is one of the most singular illusions that can occur under the microscope. But it may be proved that the parts which give this image of anastomotic fibres are the fissures formed in the act of desiccation of the gummy fluid: some of these appear in an instantaneous manner; others elongate themselves by their extremity, much as fissures of glass do under the influence of slight pressure. It is at times difficult to trace this formation, so great is the rapidity with which the dried substance breaks up. But the formation of this network may be readily seen by placing under the lens of the microscope a particle of dried cortical juice, lightly breathing upon it without causing displacement, and then observing it as speedily as possible. At first everything is obscure, for the moisture of the breath has destroyed the transparency of the glasses; but ere long the objects come well into view: the moisture allows the gummy substance to combine in a single mass, and the subsequent desiccation reproduces a new network, altogether different from the first. If we examine the cortical juice of young shoots, or of the aged bark of the *Acer pseudoplatanus,* which contains no milky fluid, all the phenomena exhibited by the limpid juice of *Acer campestre* are clearly shown. It therefore cannot be asserted that the limpid juices of non-lactescent plants are the analogues of the coloured fluids; they have, indeed, their analogues in lactescent plants, but not in those juices possessing a special colour and peculiar qualities. We may add that the tubes which enclose them do not resemble reticulated vessels; they especially occur in parts recently formed; they are thin, transparent, and of variable diameter; further, they do not anastomose so as to form a network, but are straight, parallel, and terminate in more or less acute points placed in apposition with other similar tubes, or else unite end to end, along a transverse line, with the tubes following them. We have observed similar tubes in the Vine, *Antirrhinum majus, Nicotiana Tabacum, Mercurialis annua, Pelargonium zonale, Cheiranthus Cheiri, Brassica oleracea,* &c.

If the tissues possessing granuliferous tubes be macerated for several days, they may afterwards be easily separated, and their characters be well explored.

If they are submitted to prolonged maceration, they become extensible, and are constricted by traction in such a way that their cavity, at certain points, is almost completely effaced, and they assume the appearance of slender threads, of which the granuliferous liquid is reduced to the appearance of a feeble streak of little corpuscles ranged in a single line. Some of these tubes present oblique or transverse articulations derived from the union of the tubes with those which are continuous with them. These tubes, by reason of their transparency, of the tenuity of their walls, of the absence of fissures (clefts) and perforations, and of the presence of granules floating in their contained fluid, resemble in some respects the vessels filled with coloured liquids; but, on the other hand, they present differences of a very decided nature. The tubes filled with milky juices are flexuose, branching, and anastomotic, whereas these others are straight, parallel, placed in close juxtaposition, and closed at their extremities, as in the plants already enumerated, and in many others we have examined—as, for instance, *Arum Italicum, Impatiens balsamina, Menyanthes trifoliata, Cynara Scolymus,* &c. We have observed in certain plants (for instance, in *Brassica oleracea*) the commencement of divisions of the tubes, but no anastomoses, and no indications of a complex network.

How does it happen that so skilful an observer as M. Schultz has assumed the existence of, and figured, this reticulated arrangement? Is it owing to the influence of the hypothetical system he adopted? Is it on account of the partial divisions he may have noticed? Is it because that in certain cases, where the cells have been partially destroyed by maceration, they still offer resistance to separation along their lines of junction, and exhibit a sort of network, as we have seen them do in several instances? Or is it, lastly, on account of mycodermic filaments developed in the macerating fluid, and presenting themselves in the form of transparent, ramifying, and sometimes articulating tubes, having been mistaken for structures belonging to the plant on which they were produced? We cannot reply to these queries; but in the many observations we have made and often repeated, we have failed to encounter these reticulated tubes, which have been represented as the analogues of proper vessels.

With reference to the three states of articulation, expansion, and contraction admitted by M. Schultz, these appear to me to be the consequences either of the natural structure of the tubes, or of the modes of preparation to which they have been subjected. Naturally, indeed, tubes may be articulated, since they are more or less short, and unite at intervals end to end by their rectangular extremities; they may further appear to be articulated when the walls are broken through in consequence of maceration, and the continuity of the tube is maintained by the thickened juices of its interior; the tubes, again, may appear in a state of expansion or of contraction because their diameter varies considerably in their course—and they may be either full or empty, according to circumstances. Lastly, their walls lose consistence by maceration; they are then rendered extensible, and may assume the appearance of a simple filament; indeed it is possible to mistake a streak of granule-bearing liquid, more glutinous and resistant than the walls themselves, for a tube.

These tubes, moreover, exhibit transitions to the nature of fibres, so that we see intermediate forms in every variety between fibres with thick and porous walls and nearly obliterated cavity and those whose walls are of extreme tenuity. The fibres are firm and porous in completely formed tissues, whilst their walls are less and less thick in proportion as the tissues in which they occur are more recent; hence in tissues most lately produced they exhibit that conformation which has led to their being taken for laticiferous vessels: in all these instances their extremities are formed in the same manner. The fibres not only present transitional phases in the degree of thickness of their walls, but also in the quantity of granular matter contained in their interior: this substance grows scarcer in proportion as the tubes advance in age, and as their walls augment in thickness and their cavity contracts; yet, however reduced the diameter of their cavity may be, it is rare that a certain number of granules is not found in it.

When the cavity is very distinct, the granules are often seen in abundance; but when the tissues are incompletely formed, their walls are not very evident, and the granules within are in scanty proportion.

These tubes are met with in the fibro-vascular bundles, and are not distributed in the medulla or in the parenchyma of the bark, as are the proper vessels.

To further demonstrate that these granule-bearing tubes are not identical with vasa propria, it may be noticed that they occur as well in vegetables having coloured juices as in those which have not. Thus, *Asclepias Syriaca* and other species of this genus, *Acer platanoïdes*, &c., have fibrous bundles very distinct from the proper vessels, though erroneously assumed by Mirbel to be milk-vessels, and are perfectly like the ordinary cortical fibres, and pass through all those phases just described, presenting thick walls and punctiform cavities, or thin walls and very apparent cavities, containing few or many granules. This fibrous tissue, as we have stated, accompanies the spiral bundles in the leaves. The tubes which compose it taper and decrease in length as they follow the course of the nerves in their divisions, and concur in forming the network of the leaves.

Their walls having lost their thickness, they cannot be any longer so easily distinguished in the exterior zone of the cortical fibres of the stem. However, in certain plants, as the *Ficus* *elastica,* a semicircle of transparent small points may be seen beneath the inferior bundles of the petiole and above the superior ones.

In most plants the tissue enclosing the cortical tubes may be easily separated from the spiral vessels, and the proper vessels be readily and distinctly demonstrated. It must therefore be supposed that they represent an entirely different histological constituent, and the more so because we know that the liquids they contain are also of a different character.

We therefore conclude that the tubes met with in the greater number of plants, enclosing transparent and granular fluids, have not the structure of proper vessels: they are not ramified; they do not anastomose and form a network; they are, on the contrary, analogous to fibrous tubules, and shade off into them; they occupy the same position; their walls are proportionately thicker as they grow older; they are straight, simple, aggregated in bundles, and have acute or rectangular extremities placed in apposition with those of similar tubes so as to form filaments or fibres, but not a vascular system or network; lastly, they all contain the same sort of fluid. They occur not only in non-lactescent plants, but also in those possessing coloured juices and vessels. They must therefore be regarded as distinct from the last-named reservoirs. They constitute the commencement of fibrous tubes, shade off into them, and progressively assume all their characters.

We do not go so far as to assert that vessels anastomosing to form a network, and containing granular uncoloured juices, are never to be met with. The immense varieties of vegetable products justify the belief that the juices contained in the vessels need not necessarily be always coloured by the granules they hold in suspension; indeed it is a fact, remarked in the case of certain lactescent plants, natives of tropical climates, that the coloured juices are absent from them when grown in our climate; that is, they fail to secrete, under the influence of a lower temperature, those juices marked by a higher degree of elaboration. Nevertheless they retain the special apparatus belonging to them, and the only change is that the liquids they contain do not possess those properties that they would have acquired had their vital activity been sustained in full vigour. The circumstance we have sought to show is, that the tubes of plants normally devoid of coloured juices do not seem the analogues of proper vessels.

In our opinion, therefore, it is sufficiently demonstrated that a vascular system like that existing in animals, concerned in transporting and distributing the nutritive juices prepared by special organs, is not found in plants: the proper vessels themselves do not possess this character. If they do constitute capillary anastomotic tubes at their origin, this condition does not last.

The spiral vessels have closed extremities, and anastomose; if they communicate with each other, it is an accidental circumstance. They are adapted by their length to serve as channels for the rapid transmission of liquids to a great distance; but they do not disperse or diffuse them except so far as the permeability of their walls permits.

The cortical tubes and fibres, which are only modified conditions of the same structure, present a similar disposition: they are closed at their extremities, and by intermediate phases approximate in characters with cells; their walls are permeable only to liquid substances.

The appellation *latex* cannot advantageously be applied to the liquid they enclose, for the name has been given to juices essentially different: nor can the name *laticiferous vessels* be given to these tubes, for they are not vessels in the usual signification of the word; it has, moreover, been employed to designate channels of another description. The expressions *latex* and *laticiferous vessels* seem to me calculated only to cause confusion in science, and to be rightly rejected; they perpetuate an erroneous idea, by assigning to plants those centralized functions peculiar to animals. In plants, all the organic constituents possess an individual life, and concur in the maintenance of the common life; all, even to the cells which compose the simplest hairs, are organs of transmission and the seat of processes of elaboration; in all, the fluids undergo movements of cyclosis or of gyration, and the materials peculiar to nutrition are prepared by a process which combines the elementary principles, or separates those which are hurtful or useless. Every single cell or vessel thus creates the substances which are required for its growth; each allows the transudation of those materials which form, in contact with its walls, the new tissues which preserve unchanged the characters of the species, even when the mass of elaborated juices is derived from another species grafted on the plant; lastly, each one is able to supply juices to distant parts, just as it has itself received such from them.

XXXV.—*Third Account of new Species of Snakes in the Collection of the British Museum.* By Albert Günther, M.A., M.D., Ph.D.

[Plates V. & VI.]

The following species of Ophidians have been added to the Collection of the British Museum since the publication of two papers on the same subject in this Journal*. The total number of species in that Collection is now 745, and that of the typical specimens 260.

This considerable increase, within the period of less than a year, is partly caused by the particular attention which the author has paid to the herpetology of the East-Indian continent. The descriptions of the new species belonging to that fauna will be found in his forthcoming work on this subject, published by the Ray Society.

I. *List of Species which were formerly desiderata.*

Typhlops mirus, *Jan.* Ceylon. Purchased.
Silybura ocellata, *Bedd.* Nilgherries. Capt. R. H. Beddome.
Rhinophis sanguineus, *Bedd.* Wynand. ,, ,,
—— pulneyensis, *Bedd.* Pulney Hills. ,, ,,
Plectrurus Güntheri, *Bedd.* Nilgherries. ,, ,,
Melanophidium wynandense (Plectrurus wynandensis, *Bedd.*). Wynand. Capt. R. H. Beddome.
Calamaria Alkeni, *Blkr.* ——? J. Bowring, Esq.
Oxycalamus longiceps, *Cant.* Pinang. Dr. Cantor.
Aspidura trachyprocta, *Cope.* Ceylon. Purchased.
Elapomorphus lemniscatus, *Dum.* & *Bibr.* Paraguay. Prof. Grant.
Simotes venustus, *Jerdon.* Madras. J. C. Jerdon, Esq.
—— aphanospilus, *Cope.* Philippines. H. Cuming, Esq.
—— punctulatus, *Gray.* Himalayas.
—— anchoralis, *Jan.* East Indies. A. Günther.
Ablabes sagittarius, *Cant.* (=Enicognathus Grayi, *Jan*). Pinang. Dr. Cantor; and Himalayas. Messrs. von Schlagintweit.
—— Humberti, *Jan.* Ceylon. R. Templeton, Esq.
—— bicolor, *Blyth.* Khassia. East India Company.
—— tenuiceps, *Blyth.* Nepal. B. H. Hodgson, Esq.
Tomodon ocellatus, *Schleg.* Paraguay. Prof. Grant.
Salvadora Grahamii†, *Baird* & *Gir.* Mexico. Sallé.
Tropidonotus junceus, *Cant.* Pinang. Dr. Cantor.
Hypsirhina Jagorii, *Peters.* Siam. M. Mouhot.
Elaphis tæniurus, *Cope.* China. College of Surgeons.
Zamenis diadema, *Schleg.* Affghanistan. East India Company.
Zaocys nigromarginatus, *Blyth.* Sikkim. Messrs. von Schlagintweit.
Taphrometopon lineolatum, *Brandt.* Siberia. Prof. Peters.
Dromicus tæniatus, *Peters.* Mexico. Purchased.
—— perfuscus, *Cope.* ——? Royal College of Surgeons.
Ahætulla natalensis, *Smith.* Port Natal. Rev. H. Calloway.
—— heteroderma, *Hallowell.* Gold Coast. Purchased.

* Ann. & Mag. Nat. Hist. January 1862, p. 52; *ibid.* Jan. 1863, p. 20.

† Two species are known of this genus,—*Zamenis mexicanus*, Dum. & Bibr., and *Salvadora Grahamii*: the lateral shields in the head of the latter are subject to variation; and *S. Bairdii* of Jan is only an individual variety of *S. Grahamii*.

Dipsas colubrina, *Schleg.* Madagascar. A. Newton, Esq.
—— multifasciata, *Blyth.* East Indies. Purchased.
Lycodon striatus, *Shaw.* Anamallay Mountains. Capt. Beddome.
Ungalia melanura, *Schleg.* Cuba. Zoological Society.
Diemenia† Mülleri, *Schleg.* North Ceram. Purchased.
*Pseudechis australis, *Gray.* North-east Australia. Royal College of Surgeons.
*Tropidechis carinata, *Krefft.* Clarence River. G. Krefft, Esq.
Hydrophis fasciata, *Schneid.* East Indies. Capt. Beddome.
—— viperina, *Schmidt.* Madras. J. C. Jerdon, Esq.
Acalyptus superciliosus, *Dum. & Bibr.* ——? A. Günther.
Platurus Fischeri, *Jan.* New Guinea, &c. Purchased.
Aipysurus lævis, *Lacép.* New Guinea.
Craspedocephalus alternatus, *Schleg.* Paraguay. Prof. Grant.
Vipera confluenta, *Cope.* ——? Zoological Society‡.
Bothrops Lansbergii, *Schleg.* Vera Paz. Messrs. Godman and Salvin.
—— Schlegelii, *Berthold.* South America. A. Günther.
Trimesurus strigatus, *Gray.* Dekkan. Col. Sykes.
Atheris squamata, *Hallow.* West Africa. A. Günther.

II. *List of the new Species described and procured in the course of the Year* 1863.

Typhlops bothriorhynchus. Pinang. Dr. Cantor.
—— siamensis. Siam. M. Mouhot.
—— tenuis. Madras. Walter Elliott, Esq.
Silybura bicatenata. Dekkan. East India Company.
Calamaria siamensis. Siam. M. Mouhot.
—— nigro-alba. Pinang. East India Company.
Macrocalamus lateralis. India. Old Collection.
*Homalocranium mœstum. Peten. Messrs. Salvin & Godman.
Aspidura Copii. East Indies. Purchased.
Oligodon modestus. Philippines? Purchased.
—— Elliotti. Madras. Walter Elliott, Esq.
—— spilonotus. Coast of Malabar. Purchased.
—— fasciatus. Dekkan. East India Company.
Simotes cinereus. Gamboja. M. Mouhot.
—— albiventer. Kandy. Capt. Gascoigne.
—— fasciolatus. Siam. M. Mouhot.
—— Swinhonis. Amoy. Consul Swinhoe.
—— labuanensis. Borneo. Purchased.
—— signatus. Singapore. Old Collection.
—— cochinchinensis. Lao Mountains. M. Mouhot.

† This is the correct spelling of the word, which evidently has been derived from *Van Diemen('s Land)*. Originally written *Demansia* by Dr. Gray, it has since been altered into *Diemansia* by myself (Colubr. Snak. p. 254), and into *Diemennia* by the editor of the 'Proceedings of the Zoological Society' (1863).

‡ We possess now two specimens of this species, one being nearly 5 feet long. I suppose it is a native of Persia or Syria.

Simotes bicatenatus. East Indies. Royal College of Surgeons.
Nymphophidium maculatum. India. Old Collection.
Coronella orientalis. Dekkan. East India Company.
*Mizodon longicauda. Fernando Po. A. Günther.
*Xenodon Neuwiedii. Rio Janeiro. Purchased.
*—— irregularis. Para. Purchased.
*Tropidonotus ferox. Fernando Po. Purchased.
—— leucomelas. Singapore. Old Collection.
—— ceylonensis. Ceylon. Purchased.
—— himalayanus. Himalayas. Messrs. von Schlagintweit.
—— Beddomii. Anamallay Mountains. Capt. R. H. Beddome.
*Bothrophthalmus brunneus. Fernando Po. Purchased.
*Heterodon modestus. Madagascar. Leyden Museum.
*Xenurophis Cæsar. Fernando Po. Purchased.
Lielaphis holochrous. Ceram. Purchased.
Gonyosoma gramineum. Khassia? East India Company.
Phyllophis carinata. China. A. Günther.
Dromicus Wuchereri. Bahia. Dr. O. Wucherer.
Ahætulla heterolepidota. Africa. Purchased.
—— hoplogaster. Port Natal. Purchased.
—— nitida. Demerara. Purchased.
Tragops dispar. Anamallay Mountains. Capt. Beddome.
*Dipsas nigriceps. East Indies. Zoological Society.
Pareas nuchalis. Khassia? East India Company.
*Simocephalus Grantii. West Africa. Prof. Grant.
Lycodon laoënsis. Lao Mountains. M. Mouhot.
—— anamallensis. Anamallay Mountains. Capt. Beddome.
Odontonomus gracilis. Anamallay Mountains. Capt. Beddome.
*Enygrus superciliosus. Pelew Islands. G. L. King, Esq.
*Cacophis Krefftii. Port Macquarie. G. Krefft, Esq.
*Hoplocephalus nigriceps. Australia. A. Günther.
*—— minor. Swan River. Purchased.
Bungarus ceylonicus. Ceylon.
Callophis annularis. East Indies. J. Bowring, Esq.
*Atractaspis aterrima. West Africa. Prof. Grant.
*Bothriechis Godmanni. Guatemala. Messrs. Godman & Salvin.
*Causus rostratus. East Africa. Capt. Speke.
Hydrophis diadema. East Indies? Old Collection.
—— torquata. Pinang. Dr. Cantor.
—— Elliotti. Siam. Purchased.
—— stricticollis. East Indies. East India Company.
—— Cantoris. Pinang. East India Company.
—— latifasciata. Mergui. Prof. Oldham.
—— atriceps. Siam. Purchased.
—— coronata. Bengal. Old Collection.
—— robusta. ——? Purchased.
Trigonocephalus himalayanus. Gurval. Messrs. von Schlagintweit.
*Ancistrodon bilineatus. Guatemala. Messrs. Salvin & Godman.
Trimesurus monticola. Himalayas. B. H. Hodgson, Esq.
—— anamallensis. Anamallay Mountains. Capt. Beddome.

Homalocranium mœstum.

Entirely deep black, with a broad yellow collar extending over the hind part of the occipitals; laterally; to the eyes; and below, over the whole chin and throat.

Anterior frontals very broad, with the lateral portion produced backwards, about half as large as the posterior frontals. Vertical six-sided, much longer than broad, with an obtuse angle in front, and an acute one behind; occipitals rounded behind, as long as the vertical and posterior frontals together; posterior nasal low, elongate, in contact with the single præocular; two postoculars; upper labials seven, the third and fourth entering the orbit, the last being the largest and highest. The median lower labial is in contact with the chin-shields, which are twice as long as broad; there follow two or three other pairs of small scale-like chin-shields. Scales smooth, in 15 rows. Ventrals 150, anal bifid, subcaudals 32 + . . . (tail injured).

The posterior maxillary tooth is stout, and provided with a very shallow groove.

A single specimen has been found by Messrs. Salvin and Godman in the Province of Peten: its head and trunk are 10 inches long; probable length of the tail $2\frac{2}{3}$ inches.

Mizodon longicauda. Pl. V. fig. A.

Scales in seventeen rows; anal bifid. Length of the tail more than one-third of the total. A reddish-yellow, black-edged collar.

Habit like that of *Dromicus melanotus*, but with a longer tail. Snout rather short; rostral shield not extending on the upper surface of the crown; frontals small; loreal square; one præocular, just reaching to the upper surface of the head; three postoculars; eight upper labials, the fourth and fifth entering the orbit. Temporals 1 + 2: the anterior is elongate, in contact with the two lower postoculars; the upper of the two posterior temporals also is elongate, bordering the occipital. Two pairs of chin-shields, the posterior of which are much longer than the anterior; the anterior in contact with four labials. Ventrals 137, without any keels; subcaudals about 100*. Maxillary teeth gradually increasing in length behind, in one continuous series. Upper parts uniform brownish olive. A reddish-yellow band across the nape, broadly edged with black in front and behind; the hinder black edge is the more intense, and is again followed by an indistinct lighter band. Upper lip yellow, with some black spots; lower parts nearly uniform yellowish.

Fernando Po. Length of the cleft of the mouth $\frac{1}{2}$ inch, of the trunk $11\frac{1}{2}$ inches; probable length of the tail 8 inches, of which $5\frac{1}{2}$ inches are preserved.

* The tail is mutilated: 64 subcaudals on the preserved part.

I refer this species provisionally to *Mizodon*, although it differs in several points from the typical species of this genus, viz. in the length of the tail, and in the entire anal shield. West Africa appears to be inhabited by many Coronelline Snakes; and before other additions to our knowledge of them have been made (which we may shortly expect), it appears hazardous to propose further generic divisions.

XENODON, Boie.

This genus ought to be restricted to the South American species with smooth scales. Having lately received a form with twenty-one series of scales, from Rio Janeiro, and another with seven labial shields from Central America, I was induced to re-examine all our specimens, the number of which has been considerably increased since the publication of the 'Catalogue of Colubrine Snakes,' and I am now enabled to distinguish seven species. *Xenodon typhlus*, L., differs from the others in having the scales more uniformly rhombic and less imbricate. The remaining six species may be distinguished as follows:—

* None of the labial shields enter the orbit.
  Labials eight; anal entire .... *X. gigas*, D. & B.

** Only one labial enters the orbit.
  Labials seven; anal bifid .... *X. irregularis*, n. sp.

*** Two labials enter the orbit.
  Labials eight; anal bifid. Ventral shields 131–144. Coloration uniform, or with about eight very broad dark bands across the trunk .... *X. severus*, L.
  Labials eight; anal entire; ventrals 141–151. Eye large; crown of the head uniformly coloured. (This species appears to be confined to the province of Bahia). .. *X. colubrinus*, Gthr. (Pl. V. fig. E.)
  Labials eight; anal bifid; ventrals 163–174; scales in twenty-one series; trunk with about twenty dark cross bands .... *X. Neuwiedii*, n. sp.
  Labials seven; anal bifid or entire; ventrals 144–157; trunk with about fourteen dark-brown, black-edged cross bands, contracted in the vertebral line.................. *X. rhabdocephalus**. (Pl. V. fig. B.)

* Prince Maximilian of Neuwied has evidently represented two distinct species under the name of *X. rhabdocephalus*. We preserve this name for the more common species (Bahia, Pernambuco), figured on plate 4 of the 10th part of the 'Abbildungen,' whilst plate 3 appears to be intended either for *X. colubrinus* or *X. Neuwiedii*, probably for the former, although the physiognomy of the snake is not well represented.

Xenodon irregularis. Pl. V. fig. D.

Similar in habit to *X. severus.* Head broad, rather depressed, with the snout short; eye of moderate size. Rostral broader than high, reaching the upper surface of the snout; vertical nearly as broad anteriorly as long; occipitals small, somewhat longer than the vertical. Loreal quadrangular, as high as long. One elevated præocular, reaching the upper surface of the head; a second, minute one, below, excluding the third labial from the orbit; three or four postoculars. Seven upper labials, only the fourth of which enters the orbit. There are about seven temporals on each side, which are rather irregularly arranged; the foremost is the largest. Scales in nineteen rows, one-grooved: those of the vertebral line are somewhat larger than those on the sides; those of the six following series are narrow, the remainder rhombic. Ventrals (147–) 153; anal bifid; subcaudals 36.

An adult specimen from Para, 43 inches long (tail 5 inches), is uniform brownish grey above; *each scale has a white streak along its outer margin,* as in *Ahætulla irregularis*; the lower parts uniform whitish. Some very faint traces of ornamental markings on the head are still visible.

I consider a specimen from Demerara, 15 inches long (tail 2½ inches), as the young of this species, although it is differently coloured. The head has nearly the same markings as a young *X. rhabdocephalus.* Trunk with seventeen broad brown cross bands, each with a black-and-white edge; these bands are much contracted in the middle of the back, and the three anterior are entirely severed, forming three pairs of semicircular lateral spots; lower parts with scattered brown dots.

Xenodon Neuwiedii. Pl. V. fig. C.

Head but slightly depressed, rather broad behind, with the snout of moderate length; trunk not very stout. Eye of moderate size. Rostral shield broader than high, just reaching the upper surface of the snout; vertical longer than broad, scarcely shorter than the occipital; loreal rather higher than long; one præocular reaching to the upper surface of the head; two postoculars; eight upper labials, the fourth and fifth entering the orbit; temporals 1 + 2. Scales in twenty-one series, those of the vertebral line not larger than the others, those on the sides much narrower than the outer ones; most of the scales have a very indistinct single apical groove. Ventrals 163–174; anal bifid; subcaudals 56–67. Greenish or brownish olive, with twenty or more very broad brown cross bands on the trunk, each being about four times as broad as the interspaces. A more or less distinct brownish band across the snout, and another across the interorbital space, the latter sometimes confluent with a triangular occipital spot. A deep-brown black-edged band from the eye to the angle of the mouth. Belly with more or less distinct, marbled cross bands. The dorsal bands are sometimes very light in the middle, having the appearance of double bands. One variety is almost entirely brownish black above.

This species comes from Rio Janeiro: it is the most slender species of the genus, and has the body distinctly compressed and the ventral shields obtusely keeled.

Tropidonotus ferox. Pl. VI. fig. F.

Scales strongly keeled, in twenty-one or twenty-three series; anterior frontals very small, pointed; eye surrounded by a ring of small shields; maxillary teeth in a continuous series, slightly increasing in length posteriorly.

Habit stout; head somewhat depressed, of moderate width and length; eye rather small. Nostrils obliquely directed upwards; the nasal shield is entire above the nostril, and divided below. Rostral shield small, rather broader than high, scarcely reaching to the upper surface of the snout; anterior frontals very small, longer than broad, pointed in front, in contact with the rostral; posterior frontals small, about one-third the size of the vertical, broader than long. Vertical five-sided, with the outer edges parallel; occipitals rather small, rounded behind. Loreal rather large. Eye surrounded by six or seven small shields (the supraorbital not included), two of which may be considered as præoculars, and two as postoculars. Nine upper labials, the fifth of which is below the middle of the eye. Temporals $1+2+3$, the first being rather large, the others scale-like. Ventrals 146; anal bifid; subcaudals 72.

Upper parts dark brown or brownish black; sides lighter, with a row of subtriangular black spots. Each ventral shield with a black base; subcaudals entirely blackish.

Fernando Po. Total length $19\frac{1}{2}$ inches, the tail measuring $5\frac{1}{2}$ inches.

Besides the specimen in the British Museum, I have seen a second, larger one, alive, in the Zoological Gardens, Regent's Park. It measures about 2 feet, and is darker in coloration. It is very fierce, and, when driven into a corner of its cage, will raise the anterior part of the body and extend its gape, ready to strike. It is very nimble; and I never succeeded in catching it without being bitten.

The discovery of this snake proves the existence of *Tropidonotus* in West Africa—a fact new to our knowledge of the geographical distribution of Ophidians.

Bothrophthalmus brunneus. Pl. VI. fig. E.

Scales in twenty-three rows; upper parts of the body and tail uniform brown.

Body and tail rounded, of moderate length; head depressed, with a flat crown, of moderate length and width; the length of the snout equals the width of the interorbital space; a deep groove before, and a smaller one behind, the eye, which is of moderate size and has a round pupil. Cleft of the mouth wide. Rostral shield as high as broad, just reaching to the upper surface of the snout; anterior frontals small, one-third as large as the posterior, as long as broad; posterior frontals longer than broad. Vertical large, six-sided, with a very obtuse angle in front; occipitals not much longer than the vertical, somewhat pointed behind. Nasals two, the anterior lower than the posterior; loreal long, forming the bottom of the præocular groove; præocular bent, the lower portion forming the hinder wall of the groove, the upper being raised on the upper surface of the crown, without touching the vertical; two postoculars. Eight upper labials, the fourth and fifth entering the orbit. Two small temporals in front, only the upper of which is in contact with the oculars; then follows a long shield placed alongside the occipital; two other pairs of small temporals below this long one. Two pairs of elongate chin-shields, the anterior in contact with four labials, and longer than the posterior. Scales in 23 series, keeled. Ventral shields 205, not keeled; anal entire; 75 pairs of subcaudals.

The maxillary teeth are closely set, and form a continuous series; the anterior are the longest, and gradually decrease in size posteriorly.

Upper parts uniform brown, the lower yellowish. A brownish-red streak runs along the median line of the snout, and is bifurcate on the vertical shield, the branches terminating on the occipitals; labials with a whitish longitudinal band.

Fernando Po. Total length 32 inches; tail 6 inches; cleft of the mouth 9½ lines.

Heterodon modestus.

Scales smooth, in 21 *series; ventrals* 165; *subcaudals* 62, *all in pairs. Above, uniform light brown; uniform yellowish below.* Madagascar.

This species agrees in almost every point with *H. madagascariensis**, but is sufficiently distinguished from it by the characters given. The latter species has 23 series of scales, from 207–210 ventral shields, the anterior subcaudals simple, and

* We have lately received two specimens of this species, together with *Herpetodryas quadrilineatus*, D. & B.=*H. Bernierii*, D. & B.

numerous large, more or less regular, black spots on the upper parts, and smaller ones on the belly. Our specimen is 37 inches long, the tail measuring 8 inches.

Xenurophis.

Body rather slender, rounded; tail elongate, strong, with two series of very large shield-like scales above, so that there are only four series of scales nearly from its root; head of moderate length and width; eye large. Loreal present; one præ-, two post-oculars. Scales smooth, in fifteen rows. Ventrals less than 200, without keel; subcaudals two-rowed. Maxillary teeth of equal length, smooth.

Xenurophis Cæsar. Pl. VI. fig. C.

Scales perfectly smooth, in fifteen rows. Body rounded, rather elongate; tail long, not compressed; head of moderate length and width; eye large. One large præocular, just reaching to the upper surface of the head; two high, narrow postoculars; eight low upper labials, the fourth and fifth of which enter the orbit; temporals 2+3, of moderate size. Occipitals scarcely longer than the vertical, rounded and slightly divergent behind. Two pairs of elongate chin-shields, the anterior in contact with five lower labials. Ventrals 145, rounded, without keel; anal bifid; subcaudals? The maxillary teeth are closely set, numerous, equal in size, and forming one continuous series. Upper parts brownish olive, with 28 narrow, greyish, black-edged cross streaks extending to the belly: these bands are less distinct on the tail. Six yellow dots disposed in a ring on the crown of the head. Two oblique, yellow, black-edged bands on each side of the hinder part of the head,—one commencing from the postoculars, and descending to the angle of the mouth, the other from the occipital to the side of the neck. Lower parts uniform yellowish.

This beautiful snake is from Fernando Po. The single specimen we have observed has the tail injured; but a sufficient portion of it is preserved to show that it is of considerable length. Length of the cleft of the mouth 10 lines, of the trunk 18½ in., of the remaining portion of the tail 5 inches; probable length of the entire tail 9 inches.

Dromicus callilæmus.

Natrix callilæma, Gosse.

Scales in 19 rows, without apical groove. Head slightly depressed, of moderate width and length; rostral shield not quite as high as broad, just reaching the upper surface of the snout; anterior frontals one-third the size of posterior. Vertical five-sided, with the anterior and lateral borders equal in length; occipitals rather rounded behind, nearly as long as the vertical and posterior frontals together. Loreal square; præorbital single, extending on the upper surface of the crown, but not reaching the vertical; two postorbitals; seven low upper labials, the third and fourth entering the orbit; temporals 1+2+3. Two pairs of chin-shields, the anterior rather shorter than the posterior, and in contact with four labials. Ventrals 134; anal bifid; subcaudals 69.

Uniform brown, the anterior part of the lower side somewhat lighter; a faint yellowish line from the lower postocular to the angle of the mouth.

Jamaica. An adult specimen is 17 inches long, the tail measuring 5 inches. I have described it because I am not aware that this has been done from an old example.

Herpetodryas dendrophis and *H. brunneus.*

M. Jan, in a list of names, entitled 'Elenco sistematico degli Ofidi,' p. 81, attempts to give out *Herpetodryas brunneus*, Gthr., from Guayaquil, as a variety of *H. dendrophis*, Schleg. Probably he has never properly examined the former, if he has seen it at all. *H. brunneus* is distinguished by feeble keels on the dorsal scales, the four outer series being entirely smooth; *H. dendrophis* has very strong keels, visible even in the outermost series. *H. brunneus* (Pl. VI. fig. A) has an eye of moderate size, its longitudinal diameter being equal to the width of the vertical shield; in *H. dendrophis* (Pl. VI. fig. B) this organ is extremely large, the same diameter being much more than the width of the vertical shield. *H. dendrophis* has cross bands; *H. brunneus* never. However, the two species are similar to each other, both having 17* series of scales and almost the same number of ventral shields, 157–160.

I have but little doubt that *H. nuchalis* (Peters, Berl. Monatsber. 1863, p. 285) is identical with *H. dendrophis*; however, it has a black band round the occipitals, which I do not observe in any of the specimens collected by M. Sallé in Mexico and by Messrs. Godman and Salvin in Guatemala. The coloration varies a little, sometimes the black being prominent in the bands, and sometimes the white. One very large specimen is almost uniform black above, with a red tail; yet traces of the cross bands are visible. It was found at the same time and at the same place with others of the usual style of coloration.

* The number 15, stated by Schlegel and myself, is incorrect; in the single specimen which I formerly had for comparison there are 15 series only on the anterior part of the trunk, but 17 in the middle: Schlegel also represents 17 series of scales in his 'Abbildungen.'

Dipsas nigriceps.

Scales in 21 *series; head uniform blackish above.*

Body and tail very long and slender, much compressed; head broad and depressed; eye large. Vertical shield large and broad; loreal as high as long; one præocular, in contact with the vertical; two postoculars. Eight upper labials, the third, fourth, and fifth of which enter the orbit. Vertebral scales large, six-sided. Temporals rather irregular, 2+2+3. Ventrals 263; anal entire; subcaudals 120. The two or three anterior teeth on the palate somewhat larger than the others. Light reddish olive, irregularly mottled with brown; upper parts of the head uniform blackish, the lower yellowish.

Habitat —— ?

Total length 65 inches; tail $15\frac{1}{2}$ inches.

HETEROLEPIS, Smith, and SIMOCEPHALUS, Gray.

Sir Andrew Smith was the first who introduced these highly interesting Snakes into science, in his magnificent work on the 'Zoology of South Africa.' He was acquainted with two kinds: one of them, discovered by himself in the Cape Colony, was named and described by him as *Heterolepis capensis*; the second, from Fernando Po, was known to him from a specimen in the British Museum, named by Dr. Gray *Simocephalus poënsis*. Although he did not give a detailed description of the latter, he characterized it *sufficiently well to ensure its identification* by later herpetologists, referring it to the same genus as the form discovered by himself. Therefore it was perfectly superfluous on the part of Duméril and Bibron to introduce another name for the second species, which had previously been given to it in a manuscript or in a museum, but which could not have any claim to recognition whatever, because it had never been published with a proper diagnosis.

When the 'Catalogue of Colubrine Snakes in the British Museum' was published, it appeared to me that the great difference in the form of the head between these two snakes would be sufficient for their *generic* distinction, *Heterolepis capensis* being distinguished by an ovoid head, with a truncated and scarcely depressed snout, whilst the head of *H. poënsis* is much depressed, with the snout broad and spatulate. Therefore I adopted for this second species a generic name proposed by Dr. Gray, and characterized this genus *Simocephalus*. On re-examination, I still adhere to this opinion, although I have not had the opportunity of seeing the typical specimen of *Heterolepis capensis*, which, I am sorry to hear, has gone, with many other equally valuable typical specimens of the 'Illustrations of the Zoology of South Africa,' to the vaults of a second-rate collection.

I can now add a third species, for which the British Museum is indebted to Professor Grant. On account of the form of its head, it belongs to the genus *Simocephalus*. The two species of this genus may be distinguished thus:—

1. *Simocephalus poënsis.*

1849. *Heterolepis poënsis* (Gray), Smith, Ill. Zool. S. Africa: Reptiles.
1854. *Heterolepis bicarinatus* (Schleg.), Dum. & Bibr. vii. p. 422.
1858. *Simocephalus poënsis* (Gray), Günth. Col. Snakes, p. 194.

All the vertebral scales strongly bicarinate; posterior oculars two; the occipital is not in contact with a labial. Body and tail very much elongate; ventrals 250–257*; subcaudals 67–105.

Fernando Po; coast of Guinea; Camaroon Mountains; Old Calabar.

2. *Simocephalus Grantii.* Pl. V. fig. F.

The vertebral scales of the anterior two-thirds of the body very obtusely and indistinctly bicarinate. One postocular; the occipital is in contact with the fifth upper labial. Body and tail rather elongate; ventrals 167; subcaudals 55.

This species, although similar to the preceding, may be at once distinguished by its less elongate body, by the much smaller number of ventral shields, and by the less distinct keels. The head is flat and depressed, but the snout is less dilated than in its congener. Anterior frontals very small, posterior very large, nearly as large as the vertical, which is five-sided and as broad as long. Loreal elongate; præ- and post-ocular narrow; seven upper labials, the third and fourth of which enter the orbit; the fifth is in contact with the occipital; temporals elongate, 1+2. Scales in 15 rows, only those of the three series nearest to the vertebral row are keeled. Uniform black above, yellowish below; tail sometimes with black spots below.

West Africa. Several specimens are in the collections of Prof. Grant and of the British Museum; the largest is 18 inches long, the tail measuring $3\frac{1}{6}$ inches.

Enygrus superciliosus. Pl. VI. fig. D.

Two shields on each superciliary region.

This species is similar to *E. carinatus*, its snout being flat, prominent, obliquely truncated in front, with the canthus rostralis angular. Four pairs of small shields, longitudinally arranged, cover the upper surface of the snout, only the canthus rostralis and the superciliary edge being scaly; two larger shields,

* Counted in four individuals.

one behind the other, cover the superciliary region. Twelve upper labials, the seventh and eighth of which enter the orbit; mental shield triangular, broad. Scales strongly keeled, in 32 or 33 series. Ventrals 180; subcaudals 44.

There are two distinct variations of colour, as in the other species of this genus:—

α. Light brownish, with large, angular, partly confluent dark-brown spots along the back; small black dots, irregularly disposed, along the margin of the abdomen. A brown band from the nostril through the eye to the side of the neck.

β. Uniform reddish brown.

Pelew Islands. Total length 18½ inches.

Cacophis.

This genus differs from *Diemenia* in having a single nasal shield.

Cacophis Krefftii.

Scales smooth, in 15 rows. Head rather depressed, of moderate width and length. Rostral shield nearly twice as broad as high, scarcely reaching the upper surface of the head; anterior frontals not much smaller than posterior; vertical rather longer than broad, six-sided, with an obtuse angle in front, and with a somewhat acute one behind; occipitals rounded behind, nearly as long as the vertical and posterior frontals together. Nasal elongate, simple, pierced by the nostril in the middle, in contact with the single præocular (there is a small shield intercalated between the posterior frontal and the hind portion of the nasal*). Two postoculars. Upper labials 6; temporals 1 + 2. Three pairs of small chin-shields, subequal in size. Eye rather small, with the pupil round. Body rounded, of moderate length; tail rather short. Ventrals 156; anal bifid; subcaudals 28.

Upper parts black, each scale of the outer series with an indistinct dark violet streak. A yellowish band commences on the snout and passes through the eye and round the nape, where it is pure yellow, whilst its anterior and lateral portions are dotted with black; it is also longitudinally divided by a black line running from the eye for some distance backwards. Lower jaw brownish, marbled with yellowish. Each ventral shield yellow, with a black outer and hinder margin; a black band along the middle of the subcaudals.

Two specimens of this pretty species have been sent by Mr. G. Krefft; it is probably from Port Macquarie. The larger specimen is only 12 inches long, the tail measuring 1⅓ inch.

* This is an individual peculiarity, as this small shield is united with the posterior frontal in the smaller specimen.

Pseudechis australis.

Naja australis, Gray, Zool. Misc. p. 55.

We have received a second specimen of this Snake from the College of Surgeons, which agrees in all respects with the typical specimen; so that every doubt is removed as to its specific distinctness from *P. porphyriacus**.

The diagnoses for the two species would be as follows:—

1. *Pseudechis porphyriaca*, Shaw. Black above, each scale of the outer series red at the base, and black at the tip; ventral shields with black posterior margins. Ventrals 184–191; most of the subcaudal shields in pairs. S.W. Australia.

2. *Pseudechis australis* (*Naja australis*, Gray). Uniform light brown above, and yellowish below. Ventrals 214–221; only a few of the last subcaudals in pairs. N.E. Australia.

Hoplocephalus nigriceps.

Scales in fifteen rows; upper parts of the head and nape of the neck uniform black.

Body of moderate length; head rather depressed; tail short; eye small, with vertical pupil; snout broad. Vertical shield five-sided, two-thirds as broad as long; two postoculars; six upper labials, the third and fourth of which enter the orbit; temporals 2+2+3; only the upper of the two anterior temporals is in contact with the postoculars, the lower being intercalated between the fifth and sixth labials. The anterior pair of lower labials are large, as large as the front chin-shield. Ventrals 154; subcaudals 29. Uniform brownish olive above, each scale being lighter at the tip. Upper parts of the head and nape uniform black; lower parts whitish, immaculate.

Total length 16 inches, the head measuring 6½ lines, and the tail 2 inches. This species is probably from Australia, like its congeners, but from what part we do not know.

Hoplocephalus minor.

Scales in fifteen rows; vertical shield not quite twice as long as broad; temporals 2+2+2. Uniform olive-brown above, yellowish below.

This species is similar to *H. superbus*, but it remains much smaller. The head is rather small, of moderate length and width, not depressed. The lower of the two anterior temporals is small, smaller than the last labial. The chin-shields of the posterior pair are separated from each other by scales. Ventral shields 125–128 (*H. superbus*, 148–153); subcaudals 59 in the male,

* See Günth. Col. Snak. p. 218.

54 in the female. All the lower parts are yellowish, each ventral shield having a blackish base.

An adult (pregnant) female is $17\frac{1}{2}$ inches long, the tail measuring 4 inches. All our other specimens are still smaller, although mature. This species inhabits S.W. Australia, whilst *H. superbus* proves to be a Tasmanian species.

Tropidechis.

Mr. Krefft has described a very interesting Snake from the Clarence River district as *Hoplocephalus carinatus**. Although it agrees in other points with the species of that genus, the scales have quite the same structure and arrangement as in *Tropidonotus*—a point by which this species appears to me to be entitled to generic distinction, and I propose the name of *Tropidechis* for this new type.

Atractaspis aterrima.

Entirely deep black. Trunk slender, the circumference of its anterior portion being contained twenty-three times in the total length; ventrals 274; subcaudals simple, 20. Scales in 21 series. Two pairs of frontal shields; one præ- and one postocular; five upper labials; temporals 1 + 1, the anterior very large, four-sided, partly intercalated between the fourth and fifth labials.

West Africa. This species is very similar to *A. Bibronii*, from which it may be readily distinguished by its coloration, by its much more slender body, and by the increased number of ventral shields,—*A. Bibronii* having only 225–255. Our specimen is 14 inches and 2 lines long, the tail measuring 7 lines.

I have formerly identified *A. Bibronii* with *Elaps irregularis*, Reinh. (Colubr. Snak. p. 239). Both are, indeed, extremely similar to each other; but as Reinhardt speaks of *scutella caudalia*, it is possible that they are different, the term "scutella" usually implying that the subcaudals are paired, and not simple.

Causus (*Heterophis*) *rostratus.*

Rostral shield turned upwards, forming a prominent, sharpish, transverse ridge above; scales in seventeen rows; a series of large spots along the back.

The rostral shield has a flat oblique inferior surface, and forms above a curved, prominent, transverse ridge; it terminates posteriorly in a triangular process intercalated between the front part of the anterior frontals. The nostril is between three shields, viz. between a narrow longish anterior nasal, a small square posterior nasal, and the anterior frontal;

* Proc. Zool. Soc. 1863, p. 86.

the latter shield is larger and longer than the posterior, which is twice as broad as long. Vertical five-sided, rather large; occipitals small, shorter than vertical, truncated behind. Loreal square. The orbit is surrounded by four narrow shields (the supraorbital not included), so that none of the labials enter the orbit. Six upper labials; temporals 2 + 3. Scales small, smooth, in 17 rows. Ventrals 121; anal entire; subcaudals 15.

Greyish olive above, with a vertebral series of subrhombic white-edged black spots; neck with a triangular blackish spot, the point of which is directed forwards, and resting on the vertical shield. Lower parts whitish, along the middle blackish.

This interesting species was discovered in Ugogo by Captain Speke, on his expedition to the sources of the Nile. The single specimen is 10 inches long, the tail measuring 10 lines.

Ancistrodon bilineatus.

Shining deep black, with scattered white spots, arranged in narrow, distant, transverse bands; the white spots are more numerous and irregular on the belly; a yellow line runs from the rostral along the canthus rostralis and the supraciliary edge to behind the angle of the mouth. A yellow band along the upper labials, the lower margin of which is black. Rostral with a vertical yellow band, continued on the chin. Upper labials eight. Scales keeled, in 23 series. Ventrals 137; subcaudals 65, the 14 last double.

This beautiful species appears to be scarce; Mr. Salvin found it only once on the Pacific coast of Guatemala: the specimen is 39 inches long.

Bothriechis Godmanni. Pl. VI. fig. G.

Scales in 21 series, strongly keeled, except those in the outer row, which are smooth. Scales on the upper surface of the head faintly keeled and of unequal size, three of them being as large as the largest scales of the trunk; supraciliaries well developed, without small scales along the orbital margin; canthus rostralis angular, covered with small shields, the posterior of which enters the orbit. Rostral shield triangular, erect, not prominent or elevated; nasals small, separated by a suture; nine upper labials, the third of which is almost immediately below the facial groove; the fifth is the largest, below the eye, from which it is separated by two series of very small scales; the posterior gradually decrease in size; ten lower labials. Ventrals 142; subcaudals 28, the tail being short, very thin, and *not prehensile*. Upper parts uniform brown; a black band runs from the eye to behind the angle of the mouth; labial shields yellow; a series of rounded, light-edged black spots along the side of the anterior part of the trunk. Lower parts yellowish, marbled with blackish in the posterior half of the body; an irregular series of subquadrangular black spots along each side of the anterior half of the belly.

This species was discovered by Messrs. Godman and Salvin, near Dueñas and on other parts of the tableland of Guatemala. An adult female measures $17\frac{1}{2}$ inches, the tail being $1\frac{2}{3}$ inch.

XXXVI.—*Observations on Raphides.*

By George Gulliver, F.R.S.

The term raphides will be here used as defined in the 'Annals' for September last. Much perplexing obscurity has arisen from the too frequent practice of confounding such very different things as sphæraphides, or other microscopic crystals, with raphides.

The importance of these objects has been so far shown (see the October and preceding Numbers of the 'Annals') that descriptions of certain orders can never henceforth be regarded as complete, in any system pretending to be a natural one, without notice of the fact which implies that a fundamental end of the existence of those plants is the production of raphides; for, during their whole healthy lives, such plants may be truly characterized as Nature's laboratories of these curious crystals. And yet, valuable, weighty, and central as this character certainly is, I know not that it has ever yet been recognized by systematic botanists. No other single diagnosis for the orders in question is so simple, fundamental, and universal as this; and the orders to which it applies should be designated *raphis-bearing* or *raphidiferous*, and so of the genera or species when all the plants of an order do not produce raphides.

Onagraceæ.—This order, as shown in former papers, is so well and truly characterized in this manner that the raphides even in the seed-leaves may be sufficient for the diagnosis; and I know not that it had ever before been suspected that this rudimental part of the plant of one order would thus be adequate to distinguish it from other plants of the nearest allied orders.

Further, I have now to observe that the same difference may be demonstrated in the ovule. In its sacs and in the placenta the raphides abound, while they do not exist there or elsewhere in plants of cognate orders. Though I have made a few observations to this effect in other raphidiferous plants, I have chiefly studied the facts in Onagraceæ, because these are easily obtained, germinate freely, abound so much in raphides, and stand in the natural system between orders not thus producing raphides. The annexed woodcut (figs. 1 & 2) represents them in the ovule and in the berry of *Fuchsia.*

Fig. 1. Fig. 2. Fig. 3.

Scale, $\frac{1}{100}$ths of an inch.

Fig. 1. Raphides in the ovule of *Fuchsia.*
Fig. 2. Raphis-cells of the berry of *Fuchsia.*
Fig. 3. Raphis-cells of the berry of *Arum maculatum.*

Thus, taking the order Onagraceæ as a typical raphidiferous one, we have shown the presence regularly of raphides through every part and period of growth of the vigorous plant, from the ovule, cotyledons, axis, leaves and their modifications, to the parts of fructification, and, finally, to the pulp of the berry. In most, if not all, species of the order, the raphides occur more or less in the anthers, filaments, style, and stigma, and, less plentifully, in the petals.

Dioscoreaceæ.—The raphides are sometimes so very distinct and beautiful in this order, that they would be excellent examples for demonstration at lectures. By simply drying on glass some of the juice of the berry of *Tamus communis,* the raphides may be preserved for an indefinite time; and, as they are about $\frac{1}{124}$th of an inch long and $\frac{1}{5000}$th thick, they may be seen merely with the aid of a common hand lens. In the ripe berry the raphides generally occur naked, either singly or in the characteristic bundles, destitute of a cell-wall.

Araceæ.—But the raphis-cells are so large and plain in the berry of *Arum maculatum,* and thus continue for a long while in its ripe state, as to afford as good an example for the study of the development, form, and relations of the raphis-cell as the berry of *Tamus* is for the examination of the separate raphides. And, in this point of view, these very common berries are well worthy of the attention of teachers and pupils. In the woodcut, fig. 3, it will be seen that some of the raphis-cells of *Arum* are nearly $\frac{1}{50}$th of an inch in length and $\frac{1}{100}$th in breadth.

Asparagaceæ.—This is probably a true raphidiferous order; for, though I have not examined the exotic species, I have found raphides in all the British plants (except *Maianthemum,* which I have not seen). In *Asparagus officinalis,* raphides occur throughout the plant, and at all periods of its growth, from the first leaf-bud to the ripe berry.

Edenbridge, Oct. 14, 1863.

[To be continued.]

XXXVII.—*Contributions to an Insect Fauna of the Amazon Valley.* COLEOPTERA : LONGICORNES. By H. W. BATES, Esq.

[Continued from p. 288.]

Genus LEPTURGES, nov. gen.

Body depressed, oblong, elliptical or elongate, free from irregularities or tubercles on its surface, and clothed with fine, prettily variegated tomentum. Antennæ long and hair-like, sparsely clothed with short, stiff hairs; the basal joint greatly elongated, gradually thickened from the base, the club thus formed being waved or not in its outline beneath; the remaining joints (except the second) very slender. Thorax trapezoidal, depressed, the lateral spines placed close to the hind angles, or at a short distance from them. Elytra free from centro-basal ridges or tubercles, more or less truncated at the tip, except in rare instances, where they are entire. Abdomen with the terminal segment slightly elongated in the females, the dorsal plate obtusely pointed at the tip, the ventral truncated or scarce perceptibly emarginated; in the males the same terminal segment has both its ventral and dorsal plates entire at the tips. Legs moderate in length, the thighs moderately clavate, and the basal joints of the tarsi elongated.

This group, which comprises a large number of small Leiopodine Longicorns of Tropical America, is so closely allied to the European genus *Leiopus* that I have great hesitation in separating it. All the species, however, differ from the European *Leiopus nebulosus* (the type of the genus) in the shape of the thorax, and in the antennæ having very slender and elongated joints more or less clothed with stiff hairs. The thorax has, in nearly all the species, a trapezoidal outline, the lateral spines being placed very near to, or coincident with, the hind angles, the surface depressed, and the sides widening from the head towards the base. In one section, however, the spines are more or less distant from the hind angles, and they then have the acute tips and recurved shape of the thoracic spines of *Leiopus*; so that this character is not wholly to be relied on. The flatness of the thorax and the great slenderness of the antennæ are perhaps distinctive characters of more value. The species are prettily variegated in the hues of the fine pubescence with which they are clothed; and the group, whether treated as a section of *Leiopus* or as an independent genus, appears to me a very natural one*.

§ 1. Thoracic spines very near to, or coincident with, the hind angles; small, not curved posteriorly.

1. *Lepturges elegantulus*, n. sp.

L. subellipticus, depressus, carneo-fulvus, fusco variegatus: elytris oblique et obtuse truncatis: femoribus posticis vix clavatis, tarsis maxime elongatis. Long. $3\frac{1}{4}$ lin. ♂.

Head pinkish tawny. Antennæ the same, with the extreme tips of all the joints dusky; they are filiform, or rather stout, and nearly three times the length of the body (♂). Thorax with the lateral spines nearly coincident with the hind angles, porrect or standing out at right angles to the body; surface pinkish

* The genus *Leiopus* is represented by three European species, one only of which (*L. nebulosus*) I have been able to examine. Leconte enumerates several North-American species, and, according to the characters he gives of the genus, these seem to agree generically with the European forms; but one (*L. angulatus* of Georgia) would appear rather to belong to our new genus *Lepturges*. The chief features enumerated by Leconte as distinguishing *Leiopus* from the many allied genera are—(1) the shortness and conical shape of the ovipositor of the females (to which may be added the uncleft tip of the apical ventral segment which forms part of it), (2) the rounded apex of the dorsal plate of the apical abdominal segment in the males, (3) the naked antennæ, and (4) the elongation of the basal joint of the posterior tarsi. I propose to limit the genus to those species which have, in addition to the above characters, the thorax of quadrate outline and of more or less convex shape, with the lateral spines placed at a distance from the hind angles, long, acute, and curved posteriorly. I did not meet with a single species answering to this definition in the Amazons region: the following, however, found in South-east Brazil, seems to be a true *Leiopus*, with the exception of the antennæ being long and slender, and furnished with stiff hairs:—

L. amœnulus. Oblongus, convexiusculus, tomento carneo-griseo læte variegatus. Caput nigrum, vertice rufo. Antennæ elongatæ, tenues, setiferæ, rufo-piceæ, articulis (duobus basalibus exceptis) apice nigris. Thorax subquadratus, convexus, spinis lateralibus pone medium sitis, acutis, recurvis; tomento carneo-griseo vestitus, maculis duabus dorsalibus claviformibus nigris. Elytra apice breviter et obtuse truncata, modice convexa, punctata, nigricantia, utrinque plaga irregulari ab humero usque ad apicem extensa grisea, nigro quadrimaculata, apud humeros roseo tincta ornata. Corpus subtus rufo-piceum. Pedes picei, femoribus omnibus valde clavatis. Long. 2 lin. ♂. *Hab.* Rio Janeiro Brasiliæ. Coll. Bakewell, Bates.

grey, with a large irregular brownish blotch in the middle, and a stripe of the same colour on each side beneath, above the sockets of the haunches. Elytra depressed, tapering from base to apex, the latter obtusely and obliquely truncated; base near the scutellum slightly convex; surface punctured, pinkish fulvous or grey, silky, with a few brown spots and patches, namely, one on the convex part near the scutellum; a second, kidney-shaped, on the margin near the humeral angle; a third, behind the middle, extending as a large angulated blotch towards the suture; and a fourth, small and oblique, near the apex. Body beneath and legs pinkish fulvous or grey; front and middle thighs with dusky patches. Hind thighs gradually thickened. Tarsi greatly elongated, the hind pair nearly as long as the tibiæ, the basal joint especially being of excessive length.

This handsome little species was only once met with, namely, flying in the evening twilight on the banks of the river at S. Paulo, Upper Amazons. It differs from all other species of the genus in the length of its tarsi and the slenderness of its hind thighs, in which characters it approaches the genus *Paræcus*; but the depressed form and general facies make it consort better with *Lepturges* than with *Paræcus*.

2. *Lepturges linearis*, n. sp.

L. linearis, fuliginosus: elytris griseo bilineatis. Long. 4 lin. ♂ ♀.

Head sooty, with a shining olivaceous pile. Thorax with the lateral spines placed near the hind angles, and forming each a large acute tubercle separated by an impressed line from the body of the thorax; surface with an impressed dorsal line, sooty, varied with silky greyish-olivaceous pile. Elytra greatly elongated, almost linear, sinuate-truncate at the tips, the external angle of the truncature produced and acute; surface coarsely but somewhat evenly punctured, sooty brown, each elytron with two olive-grey vittæ united before reaching the apex. Scutellum grey. Body beneath and legs clothed with iron-grey pile. Legs rather short; all the thighs clavate; tarsi slender and elongate.

Ega; not uncommon on dry twigs in the forest.

3. *Lepturges flaviceps*, n. sp.

L. elongatus, sublinearis, niger: capite, vittis duabus thoracis, annuloque antennarum flavis. Long. 4 lin. ♀.

Head shining testaceous yellow, with two black vittæ extending from the front of the eyes to the occiput. Antennæ twice the length of the body, the basal joint very greatly elongated; black, with the basal half of the fourth joint pale yellow. Thorax with the lateral spines placed near to the hind angle; surface behind with a transverse depression, testaceous yellow, silky, with a broad black vitta in the middle, and another still broader on each side above the sockets of the haunches. Elytra elongated, depressed, with the sides nearly parallel, obliquely truncated at the apex, with the external angle of the truncature produced and acute; surface thickly punctured, sooty black, with an indistinct pale streak in the middle of the base on each side. Body beneath black, with the exception of the pro- and mesosterna, which are yellow. Legs black, coxæ and base of thighs yellow; thighs slenderly clavate; tarsi slender, the basal joint elongated.

One example, taken at Pará.

4. *Lepturges complanatus*, n. sp.

L. oblongus, depressus, carneo-griseus, fusco maculatus: thoracis spinis lateralibus angulos posticos constituentibus: elytris apice singulatim rotundatis. Long. $3\frac{1}{2}$ lin. ♂.

Head black. Antennæ reddish, with the extreme tips of all the joints dusky. Thorax blackish, clothed with ashy changeable pile, the lateral spines coincident with the posterior angles. Elytra oblong, broadly rounded at the tips, plane above and thickly punctured, with a slight indication of two longitudinal raised lines on each, pinkish grey in colour, with five dark brown spots or patches,—namely, one, minute, under the humeral angle; one, linear-oblique, in the middle of the base; a third, subtriangular, on the side near the base; a fourth extending as a broad irregular fascia nearly to the suture; and a fifth, wedge-shaped, near the apex. Body beneath and legs dusky. Front and middle thighs thickly clavate; hind thighs more slender. Tarsi moderately elongated.

One example, taken at S. Paulo, Upper Amazons, flying in the evening.

5. *Lepturges amabilis*, n. sp.

L. oblongus, depressus, griseus: thoracis spinis lateralibus prope angulos posticos sitis: elytris griseo nigroque læte variegatis, apice breviter oblique truncatis. Long. $3\frac{1}{4}$ lin. ♂ ♀.

Head sooty black. Antennæ greatly elongated, pitchy black. Thorax grey; the disk occupied by two large square black spots, which leave only a central line and the margins of the ground-colour; the lateral spines are prominent and porrect, a small space only intervening between them and the hind margin. Elytra oblong, very slightly narrowing towards the apex, which latter is obliquely and briefly truncated; the surface is slightly depressed and closely punctured; the colour is clear grey, with (on each) four black spots,—namely, one, oval-oblique, in the middle of the base; a second, elongate-bilobed, on the side near the base; a third extending as a broad fascia behind the middle to the suture; and a fourth, small and transverse, near the apex: the lateral spots are sometimes united on the extreme margin. Body beneath and legs clothed with grey pile; club of hind femora slender.

Ega; on dry twigs in the forest.

6. *Lepturges inscriptus*, n. sp.

L. oblongus, subdepressus, griseus, fusco læte variegatus: thoracis spinis lateralibus prope angulos posticos sitis: elytris oblongo-ovatis, apice sinuato-truncatis, griseis, plagis maculisque fuscis notatis. Long. $3\frac{1}{2}$ lin. ♀.

Head reddish brown. Antennæ reddish, extreme tips of the joints (from the third) black. Thorax regularly widened posteriorly; the spines situated near the hind angles, very acute and directed obliquely outwards; the surface finely punctured, greyish, with the sides and two dorsal vittæ brownish. Elytra oblong-ovate, briefly sinuate-truncate, with the angles obtuse; the surface finely punctured, slightly convex, grey, with various patches of a reddish-brown hue,—the patches consisting of a spot in the middle of the base, an elongate hooked spot on the side at the base, a lateral twin spot behind the middle, a V-like spot in the middle near the suture, and an oblique zigzag fascia between these latter and the apex. Body beneath and legs reddish brown. Legs rather slender; all the thighs slenderly clavate.

S. Paulo, Upper Amazons.

7. *Lepturges candicans*, n. sp.

L. oblongus, subdepressus, canescens: elytris pone medium fasciis duabus fuscis ad suturam convergentibus ornatis. Long. $3\frac{1}{4}$ lin. ♀.

Head clothed with hoary pile. Antennæ reddish, clothed with hoary pile. Thorax not much widened posteriorly, the spines placed near the posterior angles, the disk with a few scattered punctures, and clothed uniformly with hoary pile. Elytra oblong, the sides rounded and rather enlarged behind the middle, the tip sinuate-truncate, both angles slightly produced and acute; the surface punctured, hoary, with two irregular brown fasciæ behind the middle converging on the suture; the anterior fascia is broken towards the sides, and a narrow line connects the two in the middle; besides these fasciæ, there is a V-shaped brown mark in the middle of the base on each elytron and a streak on each side from the base to the middle. Body beneath and legs reddish, clothed with hoary pile. Thighs slenderly clavate.

Ega.

8. *Lepturges venustus*, n. sp.

L. subelongatus, griseus: thorace supra nigro trivittato: elytris maculis vittisque nigris. Long. $2\frac{3}{4}$–$3\frac{1}{4}$ lin. ♂ ♀.

Head greyish. Antennæ black. Thorax grey or light brown, the upper surface having three broad and regular black stripes, and the sides each having a similar stripe above the insertion of the coxæ; the lateral spines placed close to the hind angles, short, obtuse. Elytra oblong, rounded, and somewhat widened behind the middle in the ♀, shorter and more tapering in the ♂, broadly sinuate-truncate at the apex, outer angle of the truncature produced into a tooth in the ♀, both angles produced and acute in the ♂; upper surface with punctures scarcely apparent through the tomentum, grey or light brown, with a black vitta over the suture, dilated about the middle and narrowed towards the apex, a similar vitta, of more equal breadth, on each side, beginning at the shoulder, detached from the margin of the elytron at one-third its length, and ending in a curve before the apex, and two elongate black spots in the middle of each elytron —one near the base and one behind the middle. Body beneath and legs blackish, with grey pile.

Ega and Pará, on dried twigs and branches. The lateral vitta of the elytra is sometimes interrupted near its termination, leaving a detached spot on the disk near the apex.

9. *Lepturges dilectus*, n. sp.

L. oblongus, depressus: thoracis spinis lateralibus magnis, acutis, subporrectis: elytris profunde sinuato-truncatis, fuscis, plaga communi irregulari ante medium maculisque posticis griseis. Long. $3\frac{1}{4}$ lin. ♂.

Head brown. Thorax brown, with grey pile, punctured on the disk and hind margin; lateral spines placed near to the hind angles, large, prominent, and acute, standing out somewhat from the sides of the thorax. Elytra deeply sinuate-truncate, both angles of the truncature produced and acute, the outer ones most so; surface closely punctured, brown, with a large common grey patch about the middle, which emits short lines towards the base and apex; at the base, on each side the scutellum, there is a small round grey spot, and behind the large grey patch there are, on each elytron, two short grey lines, followed by a transverse grey streak connected with the suture near the apex. Body beneath and legs reddish, with grey pile.

Ega, on dead branches. There is a Cayenne species* resem-

* *L. Barii*, n. sp. Oblongus, depressus. Caput et antennæ rufescentes. Thorax rufescens, griseo-sericeus, disco et margine posteriore punctatis; spinis lateralibus prope angulos posticos sitis, parvis, subporrectis, acutis. Elytra apice sinuato-truncata, angulis truncaturæ pro-

bling the present one greatly in markings, but differing in the smaller size of the thoracic spines and in other minor features.

10. *Lepturges perelegans*, n. sp.

L. parvus, oblongo-ovatus, griseus: thorace lituris duabus nigris: elytris sinuato-truncatis, griseo fuscoque lituratis. Long. $2\frac{3}{4}$ lin. ♀.

Head blackish. Antennæ pitchy red. Thorax grey, with two black vittæ on the disk, and an oblique spot of the same colour on each side; lateral spines short, not distinct anteriorly from the outline of the thorax. Elytra sinuate-truncate, angles of the truncature not produced, surface punctured, grey, with several flexuous black bands and spots,—namely, one basal, S-shaped, extending from the shoulder to the suture; a second, in the form of a large spot, on the side; a third extending as a broad zigzag belt across the elytra behind the middle; and a fourth, comma-shaped, near the apex. Body beneath and legs dusky.

One example; S. Paulo, Upper Amazons.

11. *Lepturges lineatocollis*, n. sp.

L. parvus, oblongus, minus depressus, griseus: thorace supra nigro quinquelineato: elytris nigro lineatis et plagiatis, apice sinuato-truncatis. Long. 2 lin. ♂.

Head greyish, vertex with two dusky stripes. Antennæ pitchy red. Thorax with the lateral spines short and conical, placed at a short distance from the hind angles; grey, with five black vittæ, the middle one much the broadest; the sides of the thorax are also blackish. Elytra oblong-ovate, narrowed near the apex (♂), sinuate-truncate, angles of the truncature slightly produced; surface slightly convex, punctured, greyish, with irregular black patches near the base; middle, sides, and apex partially connected with each other by indistinct lines of the same colour. Body beneath and legs dusky.

Santarem; on dried twigs.

12. *Lepturges fragillimus*, n. sp.

L. parvus, oblongus, minus depressus, griseus: thorace supra fusco bivittato: elytris maculis circa septem fuscis ornatis, apice leviter sinuato-truncatis. Long. $2\frac{1}{4}$ lin. ♀.

Head dusky or reddish. Antennæ very long and thin, reddish; apical halves of the joints (including the basal one) blackish. Thorax grey; disk with two black vittæ; sides deep black, with

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ductis et acutis; dorso punctata, rufescentia vel brunnea, ante medium fascia antice posticeque dentata latera haud attingente, pone discum punctum minutum et prope apicem ad suturam macula unciformi griseo-albis. Corpus subtus rufescens, griseo tomentosum. Pedes pallidiores. Long. $3\frac{1}{4}$ lin. ♀. *Hab.* Cayenne. Dom. Bar legit.

silky grey pile; lateral spines placed close to the hind angles, acute. Elytra oblong, rounded on the sides; apex sinuate-truncate, angles of truncature not produced; surface grey, with (on each) about seven angular blackish spots,—namely, one under the shoulder; a second, oblique, near the scutellum; a third, of large size, on the side near the middle; a fourth, elongated, near the apex; and, finally, three, more or less contiguous, on the disk behind the middle: some of the spots are partially confluent in some examples. Body beneath and legs reddish, clothed with grey pile.

Santarem, on dry twigs.

13. *Lepturges pulchellus*, n. sp.

L. parvus, elongatus, carneo-griseus: thorace supra fusco trivittato: elytris maculis magnis fuscis, apice late sinuato-truncatis. Long. 2 lin. ♀.

Head clothed with changeable grey pile. Antennæ dusky. Thorax pinkish or tawny grey, with a broad black vitta in the middle and one on each side, the latter varying in hue according to the light; lateral spines placed close to the hind angles, very small and obtuse. Elytra oblong, rather narrow, broadly sinuate-truncate, the external angles of the truncature produced; surface punctured, pinkish or tawny grey, with a large dusky spot close to the scutellum, a second, larger and rounded behind the middle, near the suture, and a third, smaller, near the apex; the sides also, except near the apex, occupied by an elongate stripe or spot of a dusky colour. Body beneath and legs tawny grey.

Santarem; on dry twigs in the woods.

14. *Lepturges delicatus*, n. sp.

L. parvus, oblongus, depressus, griseus: thorace vittis duabus rufescentibus: elytris punctis numerosis rufescentibus, utrinque macula magna posteriore nigra. Long. 2 lin. ♂ ♀.

Head reddish, clothed with grey pile. Antennæ reddish testaceous, each joint from the third tipped with black. Thorax reddish testaceous, clothed with grey pile, and with two abbreviated vittæ on the disk of a darker reddish-brown colour; lateral spines distinct, acute, placed very near the hind angles. Elytra oblong-oval, depressed; apex obliquely sinuate-truncate, both angles of the truncature produced; surface punctured, grey, sprinkled with brownish-red spots, and having on each elytron behind the middle a large black spot extending from the side to the disk: in some specimens there is also a dusky spot on the side towards the base. Body beneath and legs reddish testaceous; tips of tibiæ and tarsi black.

Upper and Lower Amazons, at S. Paulo and Santarem.

15. *Lepturges musculus*, n. sp.

L. parvus, oblongo-ovatus, minus depressus, postice apicem versus rotundato-attenuatus, fuliginosus: elytris obscure griseis, punctis fuliginosis sparsis: corpore subtus rufo. Long. $2\frac{1}{4}$ lin. ♂.

Head blackish; labrum hirsute. Antennæ dull black. Thorax sooty black, with obscure greyish pile, which leaves two abbreviated oblique vittæ on the disk, of the sooty ground-colour; lateral spines placed near the hind angles, short, porrect, or standing out from the sides of the thorax. Elytra oval, apex briefly and obliquely sinuate-truncate; surface dull grey, sprinkled with small soot-coloured spots, some of which unite to form patches; in some specimens there is also a whitish speck on the side of each elytron near the middle. Body beneath, coxæ, and base of the thighs reddish; legs dusky. Tarsi shorter than usual in this genus; the basal joint of the hind foot, however, is as long as the two following taken together.

S. Paulo, Upper Amazons; flying, in the evening, on the banks of the river.

16. *Lepturges deliciolus*, n. sp.

L. parvus, oblongus, carneo-griseus, fusco læte variegatus: antennis pedibusque testaceis, nigro maculatis. Long. $1\frac{3}{4}$ lin. ♂.

Head dusky or reddish. Antennæ reddish testaceous, tips of the joints (from the third) blackish. Thorax reddish (black on the sides), clothed with pinkish or tawny-grey pile, and varied with four arcuated streaks or vittæ of a reddish-brown hue; lateral spines placed a short distance from the hind angles, and bent posteriorly, as in *Leiopus*. Elytra oblong, narrowed behind towards the apex, briefly sinuate-truncate, angles of the truncature slightly prominent; surface punctured, pinkish or tawny grey, varied with numerous reddish-brown spots,—namely, one, angular, over the shoulder; a second, transverse, near the suture behind the scutellum; three, oblong-linear, in an oblique row across the elytron before the middle; a sixth, N-shaped, on the disk behind the middle; and a seventh, minute, near the apex. Body beneath and legs reddish testaceous; tips of femora, tibiæ, and tarsi dusky.

This very pretty little species occurred only at Santarem, on dry twigs on the borders of woods.

17. *Lepturges angustatus*, n. sp.

L. parvus, angustatus, postice attenuatus, nigricans: elytris maculis linearibus obscure griseis. Long. $2\frac{1}{4}$ lin. ♂.

Head and antennæ black. Thorax black, with obscure grey pile and a faint grey dorsal line; lateral spines acute, placed almost coincident with the hind angles. Elytra elongated, narrowed towards the apex, briefly sinuate-truncate, outer angle of the truncature much produced; surface punctured, black, clothed with olivaceous-sooty pile, and varied with a few short grey streaks arranged in lines from base to apex. Body beneath and legs pitchy black, clothed with dull greyish pile.

Ega.

18. *Lepturges inops*, n. sp.

L. parvus, angustatus, depressus, obscure rufescens: elytris griseo lituratis, apice truncatis: femoribus posticis vix clavatis. Long. $2\frac{1}{2}$ lin. ♂.

Head reddish, with scanty grey pile. Antennæ dull reddish. Thorax reddish, with a dusky tinge, and scanty silky grey pile; sides reddish; lateral spines large, pointing backwards, and situated close to the hind angles. Elytra narrow, slightly widening towards two-thirds their length, truncated at the apex, with the outer angles of the truncature slightly produced; surface punctured, dull reddish, dusky on the sides near the base, variegated with dull greyish marks, there being a line on each side of the scutellum, an irregular, elongate, flexuous spot extending from the base to the middle near the suture, a small spot on the disk near the termination of the before-mentioned streak, and three oblong spots in a transverse row behind the middle of the disk; besides these marks, the suture near the apex and the apex itself of the elytra are bordered with dull grey. Body beneath and legs dull testaceous red. Legs feeble; hind thighs scarcely clavate.

S. Paulo, Upper Amazons*.

19. *Lepturges griseostriatus*, n. sp.

L. oblongus, postice attenuatus, fuscus: elytris rufescenti-fuscis, utrinque lineis griseis octo, quarum tribus interioribus postice interruptis, notatis: pedibus validis, femoribus fortiter clavatis; tarsis posticis maxime elongatis. Long. $3\frac{3}{4}$ lin. ♂.

Head and antennæ dull reddish. Thorax above blackish, thinly clothed with hoary pile; the disk with a few punctures; lateral spines large and thick, placed very near to the hind

* A species inhabiting South-east Brazil closely resembles *L. inops* in general appearance and markings; the following is a description of it:—

L. miser. Parvus, oblongus, subangustatus, depressus, obscure fuscus, griseo variegatus. Caput nigricans, tomento fulvo vestitum. Antennæ tenues, parce setosæ, rufescentes, articulo basali piceo, reliquis apice obscuris. Thorax nigricans, griseo parce tomentosus; spinis lateralibus parvis, acutis, paulo ante basin sitis. Elytra apice integra, dorso punctata, obscure fusca; fascia valde dentata ante medium liturisque subapicalibus griseis. Corpus subtus pedesque nigro-picea; femoribus omnibus clavatis. Long. 2 lin. ♂. *Hab.* Rio Janeiro. Coll. Bakewell.

angles. Elytra rather elongate, narrowed from base to apex, sinuate-truncate, both angles of the truncature slightly produced; surface feebly convex, punctured, light brown, each with eight longitudinal lines (besides a short one near the scutellum) of an ashy-grey colour; the second, third, and fourth from the suture interrupted a little beyond the middle of the elytron, and leaving a considerable space free from lines; towards the apex these three lines are represented by a thick streak. Body beneath and legs dull reddish, clothed with ashy pile. The legs are rather long and stout, the thighs thickly clubbed, the hind tarsi greatly elongated, especially the basal joint, which is much longer than the remaining three taken together.

Forests of the Cuparí, River Tapajos.

20. *Lepturges alboscriptus*, n. sp.

L. oblongo-ovatus, niger: elytris utrinque linea arcuata lineolisque duabus albis ornatis. Long. $3\frac{1}{2}$ lin. ♀.

Head black, with a few silvery-grey hairs. Antennæ black, furnished with numerous bristles. Thorax black, with patches of silvery-grey pile; surface sparingly punctured; lateral spines prominent and acute, placed very near the hind angles. Elytra oblong-ovate, slightly convex, very briefly and obtusely truncated; surface punctured; each elytron with a distinct white line extending from the shoulder to the suture behind the middle, and then sharply bent, terminating on the lateral margin; besides this line, there are two short white streaks placed transversely,—namely, one on the side, at one-third the length of the elytron, and the other very near the apex. Body beneath and legs dusky. Legs moderately stout; hind tarsi moderately elongated.

One example, taken at Caripí, near Pará.

21. *Lepturges dulcissimus*, n. sp.

L. oblongus, depressus, testaceo-flavus: capite nigro, lineola flava: elytris fulvo-griseis, apice flavis; marginibus, sutura fasciaque subapicali nigris. Long. $3\frac{3}{4}$ lin. ♀.

Head deep shining black; labrum and a short and broad line on the crown yellow. Antennæ black. Thorax testaceous yellow; disk clothed with rich golden pile; lateral spines reduced to mere tubercles, and placed near to the hind angles. Elytra oblong, slightly narrowed near the tip, depressed, broadly truncated, outer angle of the truncature slightly produced; surface punctured, clear tawny grey, with the suture, lateral margins, and a fascia near the tip deep black; the apical space behind the fascia yellow. Body beneath reddish testaceous, except the tip of the terminal abdominal segment, which is shining black. Legs shining black; basal halves of the femora reddish testaceous. Thighs all somewhat abruptly clavate; basal joint of the hind tarsi moderately elongated.

I met with only one example of this charming species. S. Paulo, Upper Amazons.

§ 2. Thoracic spines placed at a distance from the hind angles: large, acute, curved posteriorly.

22. *Lepturges dorcadioides*, White.

Leiopus dorcadioides, White, Cat. Long. Col. Brit. Mus. ii. p. 382.

"*L.* punctulatus, brunneus, cano sublineatus: capite inter antennas linea impressa transversa et linea longitudinali ab ore ad verticem currente; oculis supra distantibus: thorace cinereo, fusco punctulato, vittis duabus medianis antice approximatis; scutello cinereo: elytris singulis apice oblique abruptis; margine, sutura et lineolis abbreviatis cinereis." (White, *l. c.*) Long. $3\frac{1}{4}$ lin.

The lateral spines of the thorax are placed at some distance from the hind angles, and are long, acute, and directed obliquely outwards with a slight curve. The elytra are obliquely truncated in a waved line, and the external angle of the truncature forms a small tooth directed outwards; their colour would be better described as hoary or ashy, with (on each side) a broad, irregular, arcuated, blackish vitta, extending from near the scutellum to three-fourths the length of the elytra, and followed by a small, angular subapical spot of the same colour. The legs and antennæ are of the same shape as those of the many allied species.

Ega and Pará. In my own Collection and that of the British Museum.

23. *Lepturges obscurellus*, n. sp.

L. parvus, elongatulus, fuliginosus: elytris griseis utrinque medio macula magna triangulari nigricante, apice sinuato-truncatis, angulis obtusis. Long. $2\frac{1}{4}$ lin. ♂.

Head blackish. Antennæ reddish. Thorax dusky, with obscure grey pile; the lateral spines placed a short distance from the hind angles, acute, and directed posteriorly. Elytra oblong, apex briefly sinuate-truncate, angles of the truncature not produced; surface punctured, dull grey, with (on each side in the middle) a large triangular blackish spot, whose apex touches on the suture the apex of the corresponding spot on the other elytron. Body beneath and legs dull pitchy red, shining.

Ega.

24. *Lepturges minutissimus*, n. sp.

L. minutus, oblongus, rufescens, tomento rufescenti-griseo variegatus: elytris apice integris. Long. $1\frac{1}{4}$ lin. ♂.

Head rust-coloured. Antennæ twice the length of the body, reddish testaceous, naked. Thorax rusty red, clothed with dull grey pile, leaving the sides and two dorsal vittæ of the rusty ground-colour; lateral spines placed a little behind the middle, large, acute, slightly curved posteriorly. Elytra elongate-ovate, convex, entire at the apex; surface coarsely punctured, rusty red, clothed partially with dull grey pile, leaving the region of the scutellum, two short basal vittæ, and an irregular dentated fascia behind the middle, of the ruddy ground-colour. Body beneath and legs testaceous red. Thighs all clavate; basal joint of the posterior tarsi moderately elongated.

Santarem; on dry twigs*.

Genus Parœcus, nov. gen.

Body elliptical, narrowed equally anteriorly and posteriorly, and slightly convex. Antennæ stout, filiform rather than setaceous, greatly elongated, two and a half times the length of the body in both sexes. Thorax of trapezoidal outline; lateral spines thick and conical, placed close to the hind angles. Elytra without prominences on the surface, apex of each sinuate-truncate and bispinose. Legs rather long and stout; front and middle thighs thickly clavate; hind thighs gradually thickened from base to apex; hind tarsi greatly elongated, the basal joint longer

* The following species also belong to section 2 of this genus:—

L. spinifer. Elongatus, modice depressus, cinereus, brunneo lineolatus et maculatus. Caput brunneum, oculis postice cinereo marginatis. Antennæ testaceæ, tomento cinereo parce vestitæ. Thorax cinereus, dorso maculis duabus brunneis cinereo marginatis; spinis lateralibus magnis, acutis, retrorsum oblique spectantibus, basi cinereis. Elytra angustata, apice peroblique et obtuse breviter truncata; dorso punctata, cinerea, vittis abbreviatis basalibus quatuor pallide brunneis, maculis et fascia irregulari pone medium obscurioribus. Corpus subtus et pedes testacea, tomento cinereo parce vestita; femoribus omnibus clavatis, tarsis posticis elongatis. Long. 2–$2\frac{1}{2}$ lin. ♂. *Hab.* Rio Janeiro. Coll. Bakewell, Bates.

L. humilis. Oblongus, postice paulo ampliatus, deinde apicem versus attenuatus, fuliginosus, cinereo lineatus et fasciatus. Caput piceum, vertice linea cinerea. Antennæ rufo-piceæ. Thorax fuliginosus, dorso cinereo trilineatus; spinis lateralibus grossis, minus acutis. Elytra thorace latiora, pone medium paulo ampliata, apice vix truncata; dorso convexiuscula, punctata, fasciis duabus e maculis oblongis obscure cinereis, una ante, altera pone medium. Scutellum cinereum. Corpus subtus et pedes rufo-picea; femoribus omnibus clavatis; articulo primo tarsorum posticorum modice elongato. Long. 2–$2\frac{1}{2}$ lin. ♂ ♀. *Hab.* Rio Janeiro. Coll. Bakewell, Bates.

than the three remaining taken together. Ovipositor of the female elongated ($1\frac{1}{2}$ line long), tubular; dorsal plate of the terminal abdominal segment pointed, ventral plate notched; ventral plate of the same segment in the males notched or sinuated, dorsal plate entire or sinuated.

The general appearance of the two species which I place in this genus resembles that of the *Anisopodi* and of the larger species of *Lepturges*; but the thickness of the antennæ and the length of the ovipositor of the females forbid their being associated with either genus.

1. *Parœcus ellipticus*, n. sp.

P. ellipticus, tomento carneo-cinereo vestitus: elytris plaga magna communi irregulari subtriangulari maculisque posticis nonnullis adjacentibus. Long. $3\frac{1}{2}$–5 lin. ♂ ♀.

Head clothed with ashy-fulvous pile; forehead dusky. Antennæ reddish ashy; tips of most of the joints slightly thickened. Thorax clothed with pinkish-ashy pile, sparingly punctured on the disk and hind margin; lateral spines conical, oblique, placed very near to the hind angles, and separated from the body of the thorax by a deep fovea. Elytra sinuate-truncate at the tip, both angles of the truncature produced into a short spine; surface faintly punctured, thickly clad with pinkish-ashy changeable tomentum, and having a large, common, dark brown blotch of irregular triangular shape, the apex of which touches the scutellum, and the base (behind the middle of the elytra) broken into two or more elongate spots followed by an oblique spot (on each elytron) of the same hue lying nearer to the apex. Body beneath reddish; sides of breast dusky. Legs dull reddish, sparsely clothed with ashy pile. Apical ventral segment in the males deeply notched, dorsal entire.

Fonte Boa, Upper Amazons, on fallen trunks of gigantic trees of the order Leguminosæ. The pupæ were found in numbers, lying in oval chambers formed by the larvæ between the bark and the wood.

2. *Parœcus rigidus*, n. sp.

P. oblongo-ellipticus, parum convexus, tomento cinereo vestitus: thorace fusco notato: elytris lateribus fuscis, cinereo maculatis. Long. $4\frac{1}{2}$ lin. ♂.

Head clothed with ashy-fulvous pile, forehead dusky. Antennæ reddish, clothed with ashy pile. Thorax rather strongly punctured on the disk; lateral spines conical, oblique, placed very near the hind angles; ashy, varied with small, oblong fuscous spots, two of which form an interrupted vitta on each side of the dorsal line. Elytra strongly sinuate-truncate at the tip, both angles of the truncature produced into spines, the external one very long; surface punctured, ashy, the sides occupied by a dark-brown streak or elongate patch, of very irregular outline and broken throughout with short spots and lines of the ashy ground-colour of the elytra. Body beneath clothed with ashy pile. Legs reddish; hind tibiæ with rather long apical spurs.

Ega.

[To be continued.]

XXXVIII.—*Notice of a new Species of* Kinixys *and other Tortoises from Central Africa.* By Dr. J. E. Gray, F.R.S. &c.

Among the other very interesting zoological specimens brought from Central Africa by Capt. Speke, and presented to the British Museum, is an imperfect specimen of a Land-Tortoise, which appears to indicate the existence of a species that has not hitherto been recorded in the catalogues.

I therefore propose to record it provisionally as *Kinixys Spekii*, hoping that some other traveller will be able to bring more perfect specimens, and thus give us a more complete notion of the animal.

Kinixys Spekii.

Shell oblong, rather depressed, pale brown; the dorsal and upper part of the marginal plates yellow, deeply and distinctly concentrically grooved, with a black spot on the areola of each shield. The areola of the dorsal plates subcentral, small, granular, of the marginal plates small, rather behind the middle of the shields. The nuchal plate distinct, oblong-elongate. The sternum flat, convex on the sides, yellow, varied with numerous black-brown rays, which reach nearly to the margin; the anterior part of the sternum rather produced and truncated in front, the gular plates being short and rather small; the hinder end of the sternum short and rounded, and slightly nicked in the middle.

It is most like *K. Homeana*; but unfortunately it wants the hinder moveable part of the back, and therefore we cannot tell whether it has the prominence of the upper part of the fifth vertebral plate, which is characteristic of that species.

It differs from the older specimens of that genus (and the young have not occurred to me) in being longer and more oblong, and it has a very distinctly marked, large square spot occupying the areola of each of the dorsal plates, and a smaller but equally distinct black spot occupies the upper part of the areola of each of the marginal plates.

It may be only a richly coloured specimen of the young of *K. Homeana*; but the adult animal shows no indications of having a dark areola, and there is a very great difference in the form and extension of the marginal (and especially of the anterior marginal) plates.

Along with the above specimen, Capt. Speke has also sent to the British Museum a specimen of *Testudo pardalis*, which differs from the general ventricose form by being elongated, like the Indian *Testudo stellata*. It is very solid for its size, and the black mark forms rays rather like the Indian species abovenamed. There are the head and feet of a *Testudo* in the same Collection, in spirits, which are believed to belong to the above shell. They agree with *T. pardalis*, which is peculiar for having the head covered with small scales, and only a pair of rather small thin frontal shields just over the ends of the nose.

XXXIX.—*On the Skeleton of a Seal* (Phoca Grœnlandica?), *and the Cranium of a Duck, from the Pliocene Beds, Fifeshire.* By Robert Walker.

Fossils have not heretofore proved common in any of the Pliocene beds of the east of Fife; and although some of our clay-beds have been worked for many years, the discovery of fossil remains in any of them is of rare occurrence; and when they happen to be met with, it is always in the upper clays, no fossils of any kind, so far as I know, having ever been found in the boulder-clay of this district. In the spring of 1857, a nearly entire skeleton of a Seal was discovered in the red brick-clay of Stratheden, about nine or ten miles inland, and ranging from 100 to 150 feet above the level of the sea. This specimen was exhibited, and a paper on its discovery read, by Mr. Page, at the meeting of the British Association in Leeds: the specimen is in the Natural History Museum, Edinburgh. Another Seal, in fully a better state of preservation, was found in the same clay-pit in April 1859, and is now in the Natural History Museum, St. Andrew's. This skeleton, as well as the preceding one, had belonged to a young animal, and had evidently been imbedded in the clay while all the ligaments, if not the muscles, were entire. That this was the case may be inferred from all the bones being in their respective places, any little derangement of position being merely due to subsequent pressure. This skeleton measures about 3 feet 2 inches in extreme length. The vertebral formula is—7 cervical, 15 dorsal, 5 lumbar, 3 sacral, 13 caudal. The skull, which is very thin in this as well as in most of the Seal family, was completely crushed; and it was found impossible to restore more than the occipital and part of the parietal and temporal regions. The cervical vertebræ are all in good order; and it may be remarked that the transverse processes of the last are not perforated. But a few of the dorsal are a good deal broken and decayed, more especially the centra, some of which are completely gone: this appears to have been mainly caused by the corroding action of the contents of the stomach and intestines, as all the bones in the gastric region were more or less stained black, while the rest were of a cream-colour. All the other bones may be said to be in good order, although many of them were broken by the pressure they had sustained. They are now, however, restored, and put in their several places, with the exception of a few of the carpal bones of the left arm and two or three of the phalanges of the posterior extremity, which had unfortunately been overlooked in lifting the specimen. The superior maxillaries are completely destroyed; the only portions of them remaining entire consist of little more than the alveoli of the left side containing the teeth, and a fragment of the right side containing the two posterior grinders. There are five molar teeth on each side, above and below, placed straight in the jaws, with a small space between them. In the upper jaw, the first grinder has a single fang, the next four have double fangs; but in the second the fangs are connate. Each molar has an anterior and a posterior basal cusp, besides a centre one, which is compressed, conical, and slightly curved backwards in the first four teeth; in the fifth it is not so large, and is straight up. The anterior cusps are but feebly indicated on all the upper teeth, more especially on the first three or premolars. In the lower jaw, the first two molars of the left side and the first three of the right side are wanting; of those present, the third, fourth, and fifth have double fangs. The alveolar cavity of the second shows that that tooth had double fangs also, but the fangs appear to have been connate; the first molar, like that of the upper jaw, had only a single fang. The crowns of the third and fourth molars have each a central conical cusp, slightly curved backwards, one anterior and two posterior basal cusps, while the fifth has only one cusp before and one behind the centre one: in all these lower-jaw teeth the anterior basal cusps are larger than the posterior. The canine teeth are strong, with compressed roots, their upper part round, sharply pointed, and bent backwards. Some of the incisive teeth are lost; of those preserved, two are much larger than the rest, and have compressed roots and round pointed crowns, with the tips hooked inwards. They appear to belong to the outside of the upper series. The middle incisors are very small and somewhat compressed, the crowns sharp and hooked inward. With the exception of the dorsal vertebræ (which will be immediately noticed), the rest of the bones correspond so closely to those of the common Seal that there appears to be no peculiarity about any of them deserving of special notice in this place; and some of them will be noticed in the sequel. The dorsal vertebræ are chiefly remarkable for the depressed condition of the neural arches, and the total absence of neural spines in all but the first, and perhaps the second vertebra. In these vertebræ the neurapophyses form a series of flattened domes over the central axis; they are completely coalesced, and project backwards, somewhat lapping over the anterior notch of the contiguous vertebra. In the second vertebra the anterior edge of the middle of the neural arch is exactly on a level with the upper edges of the diapophyses; in its course backwards, it gradually rises, till, at its posterior margin, it is about $\frac{3}{16}$ths of an inch higher; in the third, the neural arch, at its posterior extremity, where it is highest, is exactly the same height as the diapophyses; and here the margin is about $\frac{3}{8}$ths of an inch broad from side to side, and slightly notched in the middle. From this part these arches become gradually lower and lower, till in the tenth vertebra the top of the arch is almost flat, and about an eighth of an inch under the height of the diapophyses. In the eleventh the arch is quite flat, and is exactly at a right angle with the anterior face of the centrum: this, as well as some of the preceding vertebræ, has a round posterior margin, which begins a little behind the zygapophyses; they have likewise a small notch on the middle of their posterior edge. From this to the second last dorsal the arches are still flat; but in the last dorsal and succeeding lumbar they rise high in the middle; and then the neural spines, although not particularly prominent, are still distinctly developed. From the eleventh dorsal vertebra the round on the posterior margins of the neural arches becomes gradually less as they approach the first lumbar, where the margin is straight across; after this the margins are slightly concave, but in the posterior lumbar they are notched under the neural spines. The diapophyses are similar in size to those of the common Seal, *P. vitulina*; and there are metapophyses feebly developed on the last four dorsal vertebræ.

I have thus far attempted to describe this Pliocene Seal; for, although the bones of Seals have been occasionally met with in the upper clay-beds of Scotland and other places, they have heretofore been found in too detached and fragmentary a condition to admit of any description showing their specific identity.

How far the present Seal agrees with or differs from any of the existing species is the next point of importance to be considered. The broken condition of its cranium, the absence of the characteristic palatal and nasal bones, and the immature state of the specimen, on the one hand, and, on the other, the little that seems to be known of the osteology of many of the recent species, the discrepancies in the different works on the subject, and the confusion in which some of the species are still enveloped, make this not a very easy nor perhaps certain matter. In *Phoca vitulina* the oblique insertion of the molar teeth, the two posterior cusps on those of the upper jaws, and the much larger size of the molar teeth of young individuals about the size of the fossil make it obvious that it does not belong to that species. *P. hispida* appears to me to be the next Seal deserving of notice; and the close resemblance its cranium bears to that of the fossil requires for it a somewhat lengthened comparison. The osteology of this species appears to be but indifferently known; but its cranium, as figured by F. Cuvier in the 'Mémoires du Muséum,' tome xi., agrees exactly with the fossil, so far at least as the latter is entire, not only in the extreme length, but when taken in detail. Thus, when the lower jaw is measured from the anterior edge of the canine tooth to the articular condyle, and then from the posterior edge of the glenoid cavity to the extremity of the occipital condyle, the lengths in both cases are exactly the same proportionally as those of the figure. F. Cuvier's description of the teeth is not very clear; he only says of them, "et qui ont des mâchelières un peu plus simples que celles du Phoque commun." Nilsson * appears to consider *P. hispida* as only a variety of his *P. annellata,* but states that he dare not positively say so; and of this variety he says that there are "nicht mehr als 1 Spitze hinter und 1 vor der Hauptspitze im Oberkiefer." This description is so applicable to the fossil teeth, that had Nilsson been decided that this variety included *P. hispida,* it would have gone far, I think, taken along with the corresponding size of the cranium to Cuvier's figure, to have settled the question as to the species. G. Cuvier's description of *P. hispida*† comes near enough the fossil: he says *P. hispida* resembles *P. Grœnlandica* and *P. vitulina,* but has a larger head and a shorter snout; his account of the teeth, however, is somewhat at variance both with those of the fossil and with Nilsson's description given above: he says, "Ses dents sont comme au *Grœnlandica,* et même les supérieures, excepté la dernière, manquent du petit lobe en avant." Such being the case, the next Seal deserving attention in connexion with the present inquiry seems to me to be *P. Grœnlandica,* which, taken in all, appears to be the Seal to which the fossil has the closest alliance. Indeed, I have little doubt that it is a young individual of that species. At the same time there are one or two matters in connexion with this requiring a little consideration. Bell's

* Wiegmann's 'Archiv für Naturgeschichte,' 1841.

† Ossemens Fossiles, tome viii.

figure of the cranium of this Seal, in his 'British Quadrupeds,' appears to be drawn one-third of the natural size, and is the same proportionally as Home's full-sized figure*. When the fossil cranium is compared with these figures, the posterior part is found to be nearly the same in length. But there is a considerable difference in the length of the lower jaws: in the figures they are represented as 5 inches in length (that is, from the posterior part of the articular condyle to the anterior part of the canine tooth); in the fossil jaw the same measurement only gives $3\frac{1}{4}$ inches. In both cases, however, the teeth occupy precisely the same space proportionally in the jaws. The fossil teeth likewise agree in size with those of Home's figure: they are not, however, nearly so wide apart; but as they belong to an immature individual, perhaps the space between them would have gradually increased as the jaws grew longer. The lower jaw agrees with Bell's figure both in its upper curve and in the straight margin about the middle of its lower edge; the molar teeth, in like manner, are exactly the same in shape as those given in his figure. Most authors on the subject to whose works I have had access state that the anterior cusps are obsolete on the upper molar teeth of *P. Grœnlandica*; if this were invariably the case both in old and young animals, then, of course, there could be no doubt whatever that the specimen in question could not be of that species. Nevertheless these anterior cusps appear to me to be indicated in Prof. Bell's figure of the skull of this species, which Nilsson says belonged to a young animal. It would likewise appear, from F. Cuvier's description†, that these cusps were developed on the teeth of some at least of the crania examined by him, which he says he had of all ages, and remarks that the molars are small, separate from each other, "et qui n'ont qu'un seul petit tubercule en avant ou en arrière du grand, aux mâchelières supérieures." In the 'Dictionnaire d'Histoire Naturelle,' tome ix. 1847, the description of the teeth of *P. Grœnlandica* is "à mâchelières petites et écartées, n'ayant, à la mâchoire supérieure, qu'un seul tubercule en avant ou en arrière du tubercule moyen." Macgillivray gives a short notice, in the 'Nat. Library,' vol. vii., of a young individual of the present species examined by him: "It was 39 inches in length, the head being $6\frac{1}{4}$. The incisors conical, compressed; the canine teeth conical; the *grinders tricuspid*." This account is valuable, short though it be, as it shows the length of the head, in proportion to the body, in an individual about the size of the fossil, the skull of which, measured from the anterior of the lower canine, is $5\frac{7}{8}$ inches in length, to which a little must be added

* Philosophical Transactions, 1822.

† Mémoires du Muséum, tome xi.

for the projection of the upper jaw. It would likewise appear, both from the fossil and from Macgillivray's statement, that the head is larger in the young animal, in proportion to the body, than it is in the adult. Macgillivray does not give the length of the lower jaw of his specimen; but it will be seen, from the length of that organ already given, that in the fossil the extra size is in the cerebral portion of the cranium. In Prof. Owen's description of the skull of *P. Grœnlandica**, which was originally figured by Home, and previously referred to, he speaks of "the principal cusp in all but the last lower molar having one accessory basal cusp in front, and two behind. According to Cuvier's statement in the 'Ossemens Fossiles,' this was likewise the cranium of a young animal. The truth would seem to be, that the cusps vary somewhat with age, and of course the number given by an author will depend much upon whether the animal he is describing be old or young. The dorsal vertebræ of *P. Grœnlandica*, as described by Prof. Owen†, appear to correspond nearly with those of the fossil. The neural arches, he observes, of the middle dorsal vertebræ "are without spines, and are very narrow, leaving wide unprotected intervals of the neural canal." He also states that there are "metapophyses developed on the last five dorsal vertebræ." The vertebral formula, however, is somewhat different: he gives 4 sacral and 8 caudal for his specimen. In the fossil there are 3 sacral and 13 caudal (allowing Cuvier's opinion to be correct, that there are 4 sacral in the Seals when the animal is adult, there would still be 12 caudal), and metapophyses are only developed on the last 4 dorsal vertebræ. Whether these and some other minor characters are of sufficient specific importance to separate the fossil from *P. Grœnlandica* I must meantime leave to those possessed of the requisite knowledge of the subject to determine. In 1860 there was a right humerus of a Seal found in the red clay of the Gar Bridge Tile-works: this clay is about 50 or 60 feet above the level of the sea, and some four miles west from St. Andrew's. This bone had belonged to a larger Seal than the preceding, but, except in its larger size, it does not differ from the humeri of the latter in any appreciable way; there are the same strongly pronounced deltoid ridges and the prominent inner tuberosity observable in both; they are likewise similar in having the inner condyle perforated for the passage of the cubital artery.

About the time that the last-mentioned Stratheden Seal was found, there were likewise discovered, in the same clay-bed, some bones apparently belonging to two genera of Ducks, which

* Catalogue, Osteological Series, Royal College of Surgeons, vol. ii.
† *Op. cit.*

are now, I believe, in the Natural History Museum, Aberdeen. I only saw a portion of these bones for a few minutes shortly after they were discovered, and have had no opportunity of examining them since; but Mr. Page (in whose possession they were) stated, at the Aberdeen Meeting of the British Association, that they belonged to some species of *Oidemia* and *Somateria*. However this may be, there is, in the Natural History Museum, St. Andrew's, the cranium of a duck, minus the bill, the zygomatic, tympanic, and pterygoid bones, that was found in the brick-clay of Tyrie, near Kirkaldy. This cranium has the closest resemblance to that of *Oidemia nigra*, but is much larger than the cranium of this or any other of the genus that now frequents our coasts. The skull of *O. perspicillata*, however, I have never seen; but Gould and others represent *O. fusca* as the largest of the genus. When the fossil cranium is compared with the latter species, it is found to be a full eighth of an inch larger in transverse diameter; its vertical diameter is likewise greatest. The cranium of *Somateria mollissima* exceeds the fossil in size exactly in the proportion that the latter exceeds *O. fusca*. If the body bore the same proportion to the cranium in Pliocene times as now, this Duck must have been intermediate in size between *O. fusca* and *S. mollissima*. This is the more remarkable when we consider the close resemblance which exists between the fossil cranium in all its parts and that of *O. nigra*; for, excepting the larger size of the former, there appears to me to be no tangible difference whatever in the crania of sufficient importance to separate them specifically. The fossil cranium is perhaps a little more depressed than the recent, and the post-orbital processes form a rather better defined angle on each side with the posterior of the orbital cavity than they do in *O. nigra*, and in this respect somewhat resemble *O. fusca*. But there are the superiorly approximating orbits, the upward and backward ascending processes on the lachrymal (?) bones; although large in the fossil, they form part of the circular ridge across the base of the bill, followed by a deep median depression, as in *O. nigra*. The foramina appear to be the same in both; the fossil cranium has likewise a single optic foramen, and well-defined grooves for the olfactory nerves.

XL.—*On the Habits of* Pagurus Prideauxii *and* Adamsia palliata. By Lieut.-Col. Stuart Wortley.

In the month of July last, while dredging on the 'Diamond' off Hastings, I obtained many specimens of this interesting Hermit Crab with its lovely lilac-and-white companion. I selected a pair, of convenient size, living in the shell of a *Natica monili-*

fera. Bringing it to London, I gave it a glass vase, 12 inches in diameter, with 3 inches of water, and about an inch or sand, for its future home. At first the Pagurus was very shy, withdrawing itself into the shell whenever I went to look at it; but it gradually became less timid, and after I had had it about three weeks in the aquarium, I was pleased to find it eagerly eat a small piece of meat dropped into the vase by its side. It ate a second piece; but on my giving it a third, I was agreeably surprised to see it seize the piece with its large claw, and insert it into the expectant mouth of the Adamsia. Being anxious to verify this somewhat singular fact, I waited a few seconds, and then lifting the pair out of water, found the piece of meat disappearing down the throat of the Adamsia. About half an hour after, he acted in a precisely similar manner with a fourth piece of meat. The digested pieces were afterwards rejected by the Adamsia. Whenever I feed him, I see him feed the Adamsia as soon as he has had enough himself.

On two occasions of my dropping meat into the vase at a time when the Pagurus was not hungry, he inserted his claw within the tentacles of the Adamsia, and jerked it backwards and forwards; but the tentacles not closing on the claw, he appeared to decide that Adamsia was also not hungry, and rejected the meat altogether.

This attachment of the Pagurus to the Adamsia appears very great, and it cannot bear to be separated from it. When it changes from one shell to another, immediately on having securely established itself in its new house, it returns to the shell just vacated, and drags the Adamsia off with its pointed legs, holding fast the shell the while with its large fore claw. The Adamsia does not resent this rough treatment from its friend (though the slightest irritation from any other source will cause it to pour forth in great quantity its acontia), but, detaching its broad lobes, drops off the shell. As soon as Adamsia is free, Pagurus takes it up, and holds it firmly in his fore arms pressed against the shell, till the Adamsia has re-attached its base. On one occasion, Pagurus had to hold Adamsia thus in his arms for upwards of an hour, Adamsia evidently disliking the new shell, and being reluctant to fasten itself to it. When fastened, Adamsia did not feel at home, as instead of firmly attaching the lobes to the shell above Pagurus's head, they were allowed to float loosely in the water. This was evidently a hint to Pagurus that the shell was an unsuitable one; and he shortly vacated that shell, and returned to the old one, where Adamsia soon attached itself as completely and firmly as before. On all other occasions of Pagurus changing his shell, I have constantly observed that his remaining or not in the new one appeared entirely to depend on

Adamsia finding it suitable or not, the latter showing its dislike to the shell by not attaching the lobes above the crab's head. Finding, after an hour or so, this to be the case, Pagurus invariably sought another shell.

On one occasion I found Pagurus out of his shell, in the act of searching for a new habitation; and it was curious to see how little he seemed to care for the exposed position of his own tail, so long as he could continue firmly to clasp the Adamsia in his arms. On another occasion, Pagurus was in his new shell, and had not yet succeeded in detaching Adamsia from the old one, when I was anxious to take out the Adamsia in order to examine the acontia under the microscope. I took up the shell to which Adamsia was still fixed; but the crab could not be induced to leave hold, preferring to be lifted quite out of the water to forsaking his companion. I was obliged to drop them both back into the water, when Pagurus, with the most rapid of movements, whipped his tail from out the new shell and back into the one to which Adamsia was still attached; he then stood and gazed at me in the most impudent and provoking manner, evidently feeling that he had disappointed his enemy and saved his friend.

He is now very sociable and not at all shy; but the way in which he constantly twiddles his antennæ prevents me, I am sorry to say, from obtaining a satisfactory photograph of him, which I am anxious to obtain, to add to my other photographic illustrations of marine natural history.

It is difficult to imagine why the Pagurus so insists on the companionship of the Adamsia. He may be luxurious enough to appreciate the soft cushion which Adamsia makes for his back and chest, or he may find that the white worm-like tentacles of the Adamsia act as a sort of bait to small creatures, who thus bring themselves incautiously within the reach of Pagurus's sharp claws.

Anyhow, I see enough to prove that *Adamsia palliata* is almost a necessity of existence to *Pagurus Prideauxii.*

The Pagurus has changed his skin once since he has been in my possession.

I have thrown these few remarks together, as I am told by those keepers of aquaria with whom I am acquainted that they have never succeeded in keeping these animals alive; and it is possible that some of their peculiarities may be new to the readers of the 'Annals of Natural History.'

Oct. 18, 1863.

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The Naturalist on the River Amazons: a Record of Adventures, Habits of Animals, Sketches of Brazilian and Indian Life, and Aspects of Nature under the Equator, during Eleven Years of Travel. By HENRY WALTER BATES. 2 vols. 8vo. London: John Murray, 1863.

PENNED with a homely simplicity which almost seems studied, and owing certainly no charms to what is called "word-painting," the record of Mr. Bates's long sojourn in South America is perhaps one of the most important works of its kind that has ever appeared. In these days it is somewhat of a relief to come across a book honestly written, without any attempt on the part of its author to produce a "sensation." If we were disposed to find fault with these volumes, we should say that Mr. Bates, by sinking his own individuality too much, has failed to make them as interesting as they might have been. There are few of those touches in them which show that a naturalist, after all, may be as other men are. The world gives the class credit for having eyes—albeit, as it appears in the present case from some of the illustrations, they require the aid of spectacles; but the enjoyment of other "organs, dimensions, senses, affections, passions," seems to be sometimes denied to the fraternity, as Shylock imagined it was to his kindred. Consequently this book, it must be confessed, has a certain dryness about it. Still the mellifluous phrases of a Macaulay or the glowing periods of a Gibbon do not of themselves constitute history; and, in the interests of science, there is no need to quarrel with Mr. Bates because to him has not been vouchsafed the classic grace of a Gilbert White, the poetic fancy of an Alexander Wilson, or the fiery ardour of a Charles Waterton.

The name of Mr. Bates, from his frequent and valuable contributions to our pages, must be so well known to our readers that it is unnecessary for us to say a word by way of introduction. Throughout the protracted period of voluntary exile which he has endured, he has been so unremitting in his consignment of zoological specimens to his agent in London, that there can be but few collections of importance, in any branch of the animal kingdom, which his labours have not served to enrich. Yet, knowing all this, we confess at having been utterly astonished at the tabulated results of his eleven years' wanderings. In his preface, Mr. Bates gives the following as an approximate enumeration of the total number of species which he obtained:—

"Mammals	52
Birds	360
Reptiles	140
Fishes	120
Insects	14,000
Mollusks	35
Zoophytes	5
	14,712,"

adding that "no less than 8000 of the species here enumerated were *new to science.*" This stupendous amount has, not unnaturally, been received with some hesitation in certain quarters; but our conviction is that Mr. Bates will prove there is no exaggeration in his estimate*. The temper of the times is against testing the accuracy of any book by the application of simple arithmetic; but we may take the liberty of remarking that his computation amounts to the capture of more than *two new species daily* (omitting Sundays) for the eleven years of his absence—a feat, indeed, of which any man may well be proud. With respect to Insects, our author, it will be seen, deals in round numbers; and therefore to him will not apply (as it might to many another collector) the story of the American gunner, who, when boasting that he had killed ninety-nine Canvas-backed Ducks at a single "shoot," was asked by a bystander why he did not make it a clean hundred at once. "Sirree," said the Yankee, with dignity, "do you think I'd tell a lie for *one* darned duck?" We imagine, however, that we have cause for complaint against Mr. Bates that he has nowhere told us how many of these 8000 new species remain yet to be described: he speaks of the work done or doing, in the way of description, by Drs. Bowerbank, Gray, Günther, and Sclater; but how about the insects? Some, it is true, he himself has already described; but when, where, and by whom will the rest, forming (as of course they do) the bulk of the 8000, be named and distinguished? We entirely participate in the regret he expresses that "a complete set of the species has nowhere been preserved," not only for the reason he modestly assigns (a very proper one though it be), but because we conceive that, for the very honour of our country, the national collection should have become possessed of a *perfect* series of Mr. Bates's specimens, if it were merely to show foreigners what the perseverance and industry of one of her sons, not supplied from the public purse, and not equipped with state documents, in his own private capacity was able to accomplish.

Though, as we have said, Mr. Bates is no sluggard, yet he has taken the advice of the wise man, and gone to the ant to consider her ways. It seems as if the interest connected with each of the widely differing groups that in English bear that name in common were inexhaustible. Notwithstanding the mass of information respecting Termites and Ants (properly so called) to be found in books of natural history, Mr. Bates has a good deal that is new to tell us

* In confirmation of the assertion, we may refer to two statements made by Mr. Wallace, in his 'Narrative of Travels on the Amazon, &c.'—a work to which naturalists generally have accorded all the praise bespoken for it in this Journal nearly ten years since (Annals, ser. 2. vol. xiii. p. 57). In two months that gentleman, being then in company with Mr. Bates, collected 1300 species of insects (p. 49); and at the time of his writing, he mentions that our author had then obtained 1200 species of diurnal *Lepidoptera*, 600 of which might be met with within a day's journey of Pará (p. 469)!

about them. Here is an extract from what he says of the Saüba (*Œcodoma cephalotes*):—

"The workers of this species are of three orders, and vary in size from two to seven lines......... The true working-class of a colony is formed by the small-sized order of workers, the worker-minors as they are called. The other two kinds, whose functions, as we shall see, are not yet properly understood, have enormously swollen and massive heads: in one the head is highly polished, in the other it is opake and hairy. The worker-minors vary greatly in size, some being double the bulk of others. The entire body is of very solid consistence, and of a pale reddish-brown colour. The thorax or middle segment is armed with three pairs of sharp spines; the head also has a pair of similar spines proceeding from the cheeks behind. ...... The perfect sexes are winged on their first attaining the adult state; they alone propagate their kind, flying away, previous to the act of reproduction, from the nest in which they have been reared. This winged state of the perfect males and females, and the habit of flying abroad before pairing, are very important points in the economy of ants; for they are thus enabled to intercross with members of distant colonies which swarm at the same time, and thereby increase the vigour of the race—a proceeding essential to the prosperity of any species. In many ants, especially those of tropical climates, the workers, again, are of two classes, whose structure and functions are widely different. In some species they are wonderfully unlike each other, and constitute two well-defined forms of workers. In others there is a gradation of individuals between the two extremes. The curious differences in structure and habits between these two classes form an interesting but very difficult study. It is one of the great peculiarities of the Saüba Ant to possess *three* classes of workers. My investigations regarding them were far from complete. I will relate, however, what I have observed on the subject.

"When engaged in leaf-cutting, plundering farinha, and other operations, two classes of workers are always seen. They are not, it is true, very sharply defined in structure, for individuals of intermediate grades occur. All the work, however, is done by the individuals which have small heads, whilst those which have enormously large heads, the worker-majors, are observed to be simply walking about. I could never satisfy myself as to the function of these worker-majors. They are not the soldiers or defenders of the working portion of the community, like the armed classes in the Termites or White Ants, for they never fight. The species has no sting, and does not display active resistance when interfered with. I once imagined they exercised a sort of superintendence over the others; but this function is entirely unnecessary in a community where all work with a precision and regularity resembling the subordinate parts of a piece of machinery. I came to the conclusion at last that they have no very precisely defined function. They cannot, however, be entirely useless to the community; for the sustenance of an idle class of such bulky individuals would be too heavy a charge for the species to sustain. I think they serve, in some sort, as passive instruments of protection to the real workers. Their enormously large, hard, and indestructible heads may be of use in protecting them against the attacks of insectivorous animals. They would be, on this view, a kind of 'pièces de résistance,' serving as a foil against onslaughts made on the main body of workers" (vol. i. pp. 23–31).

This last is an ingenious suggestion of our author's, and if he had not so honestly confessed the incompleteness of his investigations, we should have been inclined to attach much weight to it; but, as the case stands, it must remain for future observers to establish its probability. We may here remark that Mr. Bates (as might be inferred from the foregoing passages) is a strenuous advocate of Mr. Darwin's views*; indeed he states that it is owing to the encouragement given him by that gentleman that we see the work now before us. But we have here no intention of being dragged into the depths of a discussion on the derivative theory. Both opponents and promoters of that hypothesis will find much in the 'Naturalist on the Amazons' to interest them; and in future Mr. Bates's work is certain to be constantly referred to by either side.

But other Ants there are not so innocuous in their disposition. The terrible "Formiga de fogo" (*Myrmica sævissima*), "whose sting is likened by the Brazilians to the puncture of a red-hot needle," abounds on the Tapajos, a river flowing into the Amazons at Santarem. "It is found only on sandy soils in open places, and seems to thrive most in the neighbourhood of houses and weedy villages, such as Aveyros: it does not occur at all in the shades of the forest. I noticed it in moist places on the banks of the Amazons; but the species is not very common on the main river, and its presence there is scarcely noticed, because it does not attack man, and the sting is not so virulent as it is in the same species on the banks of the Tapajos. Aveyros was deserted a few years before my visit, on account of this little tormenter, and the inhabitants had only recently returned to their houses, thinking its numbers had decreased.....They seem to attack persons out of sheer malice: if we stood for a few moments in the street, even at a distance from their nests, we were sure to be overrun and severely punished; for the moment an ant touched the flesh, he secured himself with his jaws, doubled in his tail, and stung with all his might" (vol. ii. pp. 95–97). The remedy for this pleasant state of things is found in anointing the legs of chairs and foot-stools and the hammock-cords with copaiba balsam, which drug, it appears, is more than even Fire-ants can stomach, and by its application people are enabled to have a little peace.

We have not space to quote the long and extremely interesting account which Mr. Bates gives (vol. ii. pp. 350–365) of the ants of another group, the genus *Eciton*. These inhabit the densest parts of the forest, moving in vast armies. The main column, from four to six deep, marches forward, clearing the ground of all animal

* See also the clever paper in the 'Transactions of the Linnean Society,' vol. xxiii. p. 495, the principles maintained in which, be they right or wrong, at least possess the merit of entire originality.

matter, dead or alive, throwing off here and there a thinner column to forage for a short time on the flanks of the main body, and re-enter it again after their task is accomplished. On meeting with a place rich in spoil, such as a mass of rotten wood abounding in insect larvæ, a delay takes place, and a strong force is concentrated upon it. "The excited creatures search every cranny, and tear in pieces all the large grubs they drag to light." Even wasps' nests are no impregnable fortresses to them: they escalade the low shrubs on which they are built, gnaw away the papery covering to get at the larvæ, pupæ, and newly-hatched wasps, and, regardless of the infuriated owners, cut everything to tatters. Mr. Bates says, they "never march far on a beaten path, but seem to prefer the entangled thickets, where it is seldom possible to follow them." He was not once able to find an army that had finished its day's course and returned to its hive. Indeed, he never met with a hive at all: "Wherever the Ecitons were seen, they were always on the march." No wonder, then, that "wherever they move, the whole animal world is set in commotion, and every creature tries to get out of their way." However, their life, even on the march, is not always spent in marauding, "fighting still and still destroying." In sunny glades, the hosts would sometimes halt, and while the columns preserved their relative position, the ranks would be broken, and the plunderers would walk slowly about, or busy themselves by attending to their toilette, brushing their own or their neighbours' antennæ. Here and there an ant was to be seen stretching forth first one leg and then another to be washed by a comrade, who performed the task by passing the limb between the jaws and the tongue, finishing by giving the antennæ a friendly wipe. "It is probable," says our author, "that these hours of relaxation and cleaning may be indispensable to the effective performance of their harder labours; but whilst looking at them, the conclusion that the ants were engaged merely in play was irresistible." Two species at least of *Eciton* are blind. These fellows are great engineers, moving wholly under covered roads, which they construct rapidly as they advance, and, protected by them, push on till they reach some happy hunting-ground in the shape of a rotting log, into the crevices of which they pour in search of booty. Their arcades extend occasionally for a distance of one or two hundred yards; but Mr. Bates does not give us as full an account of these extraordinary creatures as of their congeners who are blessed with organs of vision.

However, we have passed enough time with the ants, and must press onwards. Nearly every class of animal and vegetable life obtains a notice in Mr. Bates's book, whose pages absolutely teem with valuable information respecting beasts, birds, reptiles, and fishes, insects of all orders, and curious plants. We must not omit to draw the reader's attention to his observations on the origin and variation of species (vol. i. pp. 255–265); but, for the reason we have before given, we content ourselves here with only mentioning these much-vexed questions. In like manner, without going into the subject, we can but refer to our author's pertinent remarks on animal distribution (vol. i. pp. 108–111) in the Amazons' delta, and his judicious deductions therefrom.

Before concluding, however, we must express our satisfaction at the handy size of Mr. Bates's work. Instead of a mighty cumbrous book, we have here two volumes of small and convenient dimensions; and the first is furnished with a very excellent map, which greatly enhances the pleasure we have in following the traveller's progress on the "Mediterranean of South America." The work, too, has a liberal supply of illustrations, some of which are good, though of others we cannot say much. They are all woodcuts, and, for figures to be inserted in the text, nothing more is required; but for whole-page engravings, we think this system, so much employed in the publications of Mr. Murray, is decidedly to be reprobated. Mr. Wolf's designs are, of course, beautiful: nothing can be more animated than the drawing of the frontispiece, representing Mr. Bates "mobbed" by an angry crowd of croaking Toucans, or of the assemblage of water-birds in the foreground of the river-view in the first volume. But both are marred, and the first absolutely spoilt and rendered ridiculous, by the coarse clumsy hand of the wood-cutter, whose name, though it is perceptible in the corner of the engraving, we will mercifully withhold here*. What, however, shall we say of the illustration representing the big Spider garotting the Finches, or rather, we suppose, the Tanagers? We should like to know whether Dr. Sclater (for whose special delectation that pretty family of birds is supposed to have been developed) is aware of a species having *four anterior toes,* and these toes *equally articulated*; for such a one is here delineated by the artist, whose name, whether Brown, Jones, or Robinson, is immaterial. It is enough to say it is not Wolf.

Here, then, we must leave this interesting work. We can only tender our hearty congratulations to Mr. Bates on his safe return among us; and trusting that his four years' residence at home may have fully restored his health, so materially impaired by his unremitting toil on the Amazons, hope that in England he will not forget that virtue which carried him so successfully through all his difficulties in Brazil, but that, by still continuing the wholesome practice of "paciencia," he may be enabled thoroughly to work out all his remaining collections, and thus reap to the full the well-merited fruits of his labours.

Iceland: its Scenes and Sagas. By SABINE BARING-GOULD, M.A. &c. With numerous Illustrations and a Map. London: Smith & Elder, 1863.

A nephew of so distinguished an Arctic voyager as the present highly respected President of the Royal Society, it seems but natural

* Since the above was written, we perceive that the critic of our learned cotemporary, the 'Natural History Review' (July 1863, p. 389), especially commends this frontispiece as "one of the best *executed* scenes" ever produced! Of a truth, tastes differ.

for Mr. Sabine Baring-Gould to exclaim with the Prince of Morocco, "Farewell heat, and welcome frost." The magnificently illustrated volume on Iceland, its Scenes and Sagas, without doubt deserves a brief mention in these pages; for the author, in addition to his accomplishments as a classical and an Icelandic scholar, shows that he has a very fair knowledge of natural history. Indeed, if we are not greatly mistaken, the book before us contains more information on the zoology of Iceland than has ever hitherto been given by any of our fellow-countrymen, and, with regard to the botany, more than has been published in the English language since Sir William Hooker, some fifty years ago, brought out his 'Journal.' Mr. Baring-Gould narrates his adventures in a very agreeable manner, interspersing them with fragments of Sagas, most of which will be new to the British public, and, what is more to our purpose, with notices of the natural history of the island. To these are added certain appendices —one, on Icelandic Ornithology, contributed by Mr. Alfred Newton, and another, by the author himself, giving a list of Icelandic Plants. The former seems to have been drawn up with some care, though at least one species, *Ibis falcinellus*, recorded so long ago as 1836, and by so distinguished an authority as the late Professor Reinhardt (Vidensk. Selsk. Afh. vii. p. 96), has escaped attention. Altogether we feel sure that our readers will derive a large amount of amusement and interest from the perusal of this work, and we have much pleasure in recommending it to their notice generally, but more especially to any intending visitor to Iceland.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Jan. 27, 1863.—G. R. Waterhouse, Esq., V.P., in the Chair.

Contribution to the Herpetology of Ceram.
By Dr. A. Günther.

We are indebted for our knowledge of the reptiles of Ceram to Dr. P. v. Bleeker, who, in a paper, "Over de Reptilien-Fauna van Ceram"*, enumerates thirty-eight species collected at Wahaai, on the northern coast of that island, and at Paulohi on the southern coast.

Having received a small collection of these animals from North Ceram, I am enabled to add the following species:—*Tiliqua rufescens*; *Cyclodus carinatus*, n. sp.; *Coluber holochrous*, n. sp.; *Fordonia unicolor*, Gray; *Cerberus acutus*, Gray; and *Diemennia Mülleri*, Schleg. However, it is probable that three of these species are comprised in Bleeker's list, but under different names, viz., *Cyclodus carinatus*, mihi, as *C. Boddaërtii*, D. & B.; *Fordonia unicolor*, Gray, as *Eurostus plumbeus*, D. & B.; and *Cerberus acutus*, Gray, as *Cerb. boæformis*, D. & B. Therefore, taking the number of Ceramese reptiles known as forty-one, we find that thirty-five of

* Nat. Tydschr. Nederl. Ind. 1860.

them are referable to the fauna of the Indian Archipelago, whilst the remaining six belong to genera which have hitherto been considered as peculiar to the Australian region. Those six are *Cyclodus, Liasis, Enygrus, Acanthophis, Diemennia,* and *Pelodryas* (*Hyla cyanea*).

Dipsas irregularis appears to be one of the most common Snakes in Ceram. One large specimen had swallowed the egg of a bird, probably that of a middle-sized parrot; it was but slightly cracked on one end. This Snake has no œsophageal teeth.

Fordonia unicolor feeds on freshwater crabs.

Enygrus carinatus has twenty-seven series of scales. Schlegel has counted thirty-three.

Acanthophis cerastinus.—The specimens from Ceram differ from those of the Australian continent in the coloration. They are light reddish olive, with indistinct darker cross-bands in young age; a series of black dots runs along each side of the front part of the belly and of the tail. The other markings of the head are the same as in Australian specimens; and as there is no other difference in the form, in the shields, or scales, I consider it merely as a variety, for which I propose the name of *ceramensis*.

The two following species appear to be new:—

Cyclodus carinatus.

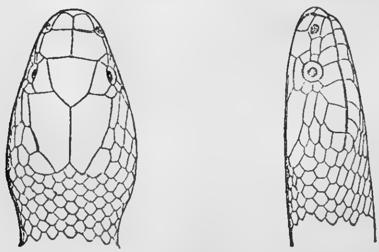
Similar to *C. gigas*, and with the same elongate temporal shields; but the scales are larger, there being thirty-two in a series round the body, and fifty in a longitudinal row between the axils of the fore and hind limbs*. The median scales along the back are very distinctly keeled, the keels forming slight longitudinal ridges along the back of the tail.

Brownish olive, with about ten narrow black bands across the back of the trunk; sides and belly marbled with black; limbs black.

Total length 18 inches, of which the tail measures 8 inches.

Coluber holochrous.

Scales smooth, without groove, in seventeen rows. Seven upper labials; two anterior and two posterior oculars. Uniform brownish grey; belly and the outer series of scales dull yellowish.



Body and tail moderately elongate, but slightly compressed.

* *Cyclodus gigas*, from New Holland, has thirty-six series of scales round the body, and fifty-seven or sixty between the fore and hind limbs.

Rostral shield broader than high, scarcely reaching to the upper surface of the head; anterior frontals not quite half as large as the posterior; vertical pentagonal, as broad as long, the lateral edges being shorter than the anterior. Occipital shields moderate, slightly notched behind. Nostrils wide, the suture between the two nasals being very indistinct. Loreal large, longer than high; two anterior and two posterior oculars, the upper anteocular not being in contact with the vertical. Seven upper labials, the third and fourth coming into the orbit. Eight temporal shields in three transverse series; the two anterior temporals are somewhat elongate, and the upper of them is in contact with both postoculars, the others are scale-like. Eight lower labials, five of which are in contact with the chin-shields. Ventral shields 206; anal entire; subcaudals eighty-seven. There are six or seven rather strong teeth in each maxillary, and ten in each mandible. Eye rather small, two-fifths of the length of the snout.

Total length 43 inches.

If we divide the *Colubri* with equal or subequal teeth into the subgeneric divisions of *Coluber, Elaphis, Cynophis, Spilotes,* and *Coryphodon,* as indicated in my 'Catalogue of Colubrine Snakes,' p. 84, the present species does not enter any of these sections; and we may propose the name of *Lielaphis* for a sixth group, of which *C. holochrous* is the type, and to which also *Spilotes samarensis,* Peters, belongs. Its characters would be:—Rostral moderate; body and tail rather elongate and compressed; two anterior and two posterior oculars. Scales smooth. Teeth subequal, in small number.

Feb. 24, 1863.—E. W. H. Holdsworth, Esq., in the Chair.

The following letter, relating to the habits of the Caddis-worm (larva of *Phryganea*), addressed to Dr. Gray by Miss E. M. Smee, was read to the Meeting:—

"Feb. 19, 1863.

"My dear Sir,—I have ventured to send for your inspection a box containing cases made by the Caddis-worm, the worms of which were collected by myself from that part of the Wandle which runs through our garden at Wallington.

"I found, on examining the natural cases, that they were made of different materials. For instance, some were constructed of small stones finely glued together, others of sticks, and some were formed of sticks and stones combined. Again, some were made of leaves of water-plants, and I observed that others were formed of the shells of creatures which inhabited the same stream.

"As I had never seen or heard of these Caddises before, I felt much astonished that creatures somewhat resembling maggots, and living at the bottom of the river, should live in houses built by themselves, and yet that these houses should differ so greatly in their construction. Indeed I was so interested that I determined, if possible, to discover the capabilities which these creatures possessed of forming different kinds of dwellings under different circumstances. I very much desired to know whether they could construct cases from other kinds of materials, besides those usually existing in the river in which they lived.

" To ascertain the fact, I accordingly turned the worms out of their natural cases, and gave them different substances to work upon; but I found that they had not an equal facility with every material; for whilst with some they formed cases which were attended with good results, with others they entirely failed.

" The worms succeeded well when they were supplied with pieces of glass, amethyst, cairngorm, cornelian, onyx, agate, coral, coralline, marble, shells, jet, brass shavings, gold-leaf, silver-leaf, when existing as small fragments.

" When, however, the worms were supplied with round objects, they invariably failed; and although I have repeatedly tried them with small glass beads and other round objects, I never found that with these they were capable of forming a case.

" But these Caddises also failed to make themselves houses from other causes than that of the roundness of an object; for I found that if these creatures were placed among materials strongly scented, or which contained poisonous matter, not only were they unable to build with them, but in most cases the substances proved fatal to the worms. When I tried them with pine-wood, my Caddises would in a short time become completely stupified from the turpentine contained in the wood, from which they often never recovered. With pieces of coal, brick, or slate they never succeeded in making a case, although these substances did not cause their death. The reason for their failure I attributed to some kind of odour which might have emanated from these different materials. With painted or varnished objects they also failed. Not every kind of metal was suitable for their buildings; for neither with tin, or lead, or copper did they succeed. I found that if one Caddis was not able to make a case out of any one kind of material, no other Caddis could succeed, although I might try several others with the same material.

" After a Caddis had made two or three houses, I used to give it something fresh to work upon, and oftentimes I supplied it with a totally different material. With these new substances it proceeded to build as quickly as before, constructing its new habitation according to the shapes of the pieces it had then to deal with.

" The maximum amount of artificial cases I could get any Caddis-worm to make was five, the last one being very brittle, the parts being scarcely glued together. After they had built so many houses, if turned out of the last house, they would simply bury themselves and remain in a quiescent state. But I think that if the Caddises were procured early in the year, the number of their cases might be considerably increased.

" It is a most curious sight to see these little creatures building their houses, beginning by cementing a number of pieces loosely together. This is merely used as a foundation for building its subsequent structure; for it is always cast off before the house is completed. After they have laid the foundation, they proceed by lifting up each piece of stone, or whatever the material may consist of, with their feet, turning it on all sides to discover whether it will fit into the space, and if it does not, as is frequently the case, that piece of stone is instantly rejected, and another is tried after the same manner, until they succeed in finding a suitable piece, when it is cemented to the other stones by a secretion which I ascertained proceeded from their mouth.

"When their house is made, the body of the creature is completely encased; their heads and feet alone protruded.

"In their natural state, the weight of these cases varies much. They are twice as heavy, and made of more solid materials, when the creatures inhabit rapid streams than when they live in still waters. The reason of this difference is, I suppose, to enable themselves to keep, by the weight of their cases, at the bottom of the water.

"I noticed that, after the Caddis-worms were turned out of their cases, air-bubbles appeared on the surface of their bodies. If placed under these circumstances in running water, these air-bubbles would cause the creatures to rise to the surface and there float until they died from exhaustion, caused by their hard endeavours to reach the bottom. According to the roughness of the water, so must be the weight of their cases.

"When in the pupa-state, their heads and feet are entirely withdrawn into their cases; and they remain in a dormant state, neither eating nor moving, until they turn into flies, their cases being more or less split in the act of transformation.

"I used to feed some of my Caddises whilst in the larva state with small pieces of raw meat, which they ravenously devoured; they would even eat a common house-fly, leaving only the wings, head, and legs; but however hungry they might be, yet they never could be induced to touch cooked meat.

"I found it was quite necessary for the Caddises to have plenty of food whilst in the larva state, to enable them to have strength to undergo the transformation.

"Trout are the great enemies of the Caddises, as they eat them up, cases and all, in every stage of their existence; but they consider the worms without the cases as especially dainty morsels.

"On the 24th of January this year, I observed that the Caddises were just hatched; and although some were so small that they were only visible with a lens, yet every one was busily employed in making its little house.

"They have grown so quickly that, since that date, they are now quite conspicuous at the bottom of the river.

"The box I send to you contains in the centre the cases made from the various materials I gave to the worms, and encircling the artificial cases are the natural habitations as taken from the river.

"Trusting you will find them worthy of your inspection,

"Believe me to remain,

"My dear Sir,

"Yours faithfully,

"Elizabeth Mary Smee."

"*To Dr. Gray, F.R.S.,*
of the British Museum."

"P.S. The Caddises are so excessively pugnacious that I am always obliged to keep each in a separate vessel. If that precaution were not taken, instead of peaceably constructing their houses, a fierce warfare would be carried on between them, which would result in the death of the weakest party. After one was killed, the survivor would set about building its house. I generally kept about thirty small white earthen jars at a time, each being filled with water, and containing a single Caddis-worm, with the particular material of which I wished its house to be constructed.

"The Caddises are provided with two little hooks, situated one on each side of the *tergum*. These little hooks are curved and sharply pointed. With these they securely fasten themselves in their houses, by which extra strength is given to resist their being torn from their cases. At first, on account of these hooks, I experienced some difficulty in turning them out of their habitations. Indeed, I was often so unfortunate as to break and consequently spoil their cases; or sometimes, after catching the creature by its head and trying to pull it forcibly out, I have known the creature to retain its hold so firmly by means of its hooks, that its body has been pulled in two rather than it would let go its hooks and suffer its house to be taken from it. At last I found that when a pin was gently pushed into the end of the case, the slight irritation would cause the Caddis to crawl entirely out of its house, and thus I was enabled to preserve the case without causing injury to the worm."

On a New Bird from the Island of Madagascar. By Alfred Newton, M.A., F.L.S., F.Z.S.

My brother, Mr. Edward Newton, Assistant Colonial Secretary at Mauritius, and a Corresponding Member of this Society, having had last autumn the good fortune to make a second visit to Madagascar, has sent me a collection of birds from that island, containing many objects of great interest, among which is one that I believe forms a genus very distinct from any previously known. This I have now the honour to exhibit and describe.

Hypherpes*, genus novum *Certhianum* vel *Sittinum*.

Char. Gen.—*Rostrum breve, robustum, leviter emarginatum, ad apicem aliquanto compressum, rictu setoso. Alæ mediocres, rotundatæ, ad caudam mediam attingentes, remige quarto, quinto et sexto æqualibus; tertio septimum, et octavo secundum, superantibus; primo multo breviore. Cauda mediocris, prope æqualis, rectricibus duodecim aliquanto rigentibus. Pedes validissimi, tarsis quam digiti medii posticique longioribus, unguibus compressis, subvalidis.*

Hypherpes corallirostris, sp. nov.

Capite, gutture, pectore et abdomine schistaceo-brunneis, olivaceo indutis; collo, dorso, alis caudaque supra fusco-cæruleis, virente tinctis: remigibus fuscis, extus pallide marginatis, intus cer-

* ὑπὸ, *sub*; ἕρπης ex ἕρπω, *repo*.

vino latius limbatis, ut in Tichodroma: *uropygio et crisso subrufescentibus, rectricibus obsolete fasciatis: rostro toto coccineo; pedibus plumbeis: iridibus obscure rubris.*

Longitudo tota 4·8 poll. Angl. et dec.; rostri a fronte ·4, a rictu ·65; alæ 2·9; caudæ 2·2; tarsi 0·9; digiti medii cum ungue 0·8, postici 0·97.

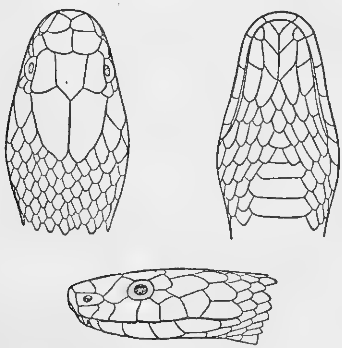
March 24, 1863.—W. H. Flower, Esq., F.Z.S., in the Chair.

Description of a New Species of Hoplocephalus with Keeled Scales. By Gerard Krefft, Corr. Memb.

Hoplocephalus carinatus, sp. nov.

Scales in 23 rows. Anal entire. Ventrals 165. Subcaudals 54.

Body elongate and rounded; tail rather short, not distinct from the trunk, tapering, ending in a conical spine. Head broad, quadrangular, distinct from the neck; muzzle short and broad; eye moderate, pupil rounded; rostral broad, just reaching the surface of crown, with a groove along the lower edge; anterior frontals moderate; posterior frontals much larger, five-sided, rounded behind. Vertical moderate, five-sided, with an acute angle behind; superciliaries large, raised above the eye; occipitals moderate; one anterior ocular, slightly grooved; two posterior ones; one large temporal shield, two smaller ones behind; no loreal, this being replaced by the nasal; the second upper labial, anterior ocular, and posterior frontal bend down on the sides. Seven upper labials, the third and fourth touching the orbit.



Scales rather narrow and elongate, in twenty-three rows anteriorly, somewhat broader, and in nineteen rows posteriorly, strongly keeled, forming fourteen raised lines upon the back and sides; brownish olive above, with some irregular interrupted blackish rings, which become more and more obsolete towards the tail; skin between and upon the underside of the scales black; belly whitish, clouded with purplish grey on the sides, much darker towards the tail, which is of a uniform purplish colour below.

This *Hoplocephalus* differs from all the other known species in the strongly keeled scales and the seven upper labial shields. Total length 38″.

Discovered by Mr. James J. Wilcox near Grafton, in the Clarence River district.

MISCELLANEOUS.

On the Habits of Lycosa Blackwallii.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—In the description of the large Madeiran *Lycosa* (*L. Blackwallii*), printed in the August Number of the 'Annals,' I was not able to say much about the habits of this spider. I have, however, been lately favoured with some notes on this subject by my friend Mr. F. Pollock, who obtained specimens from the mountains above Funchal, in localities at a height of 2000 feet at least above the sea. He kept them alive for some months, and brought several females with him to England. These notes you will, I dare say, consider worthy of being printed.

"It seems to be the custom," Mr. Pollock writes, "for this spider either to take possession of or to excavate holes, four or five inches deep, in a sloping bank, at the height of four or five feet above a piece of level ground. At the mouth of the hole is placed a web, with an opening at the middle for the egress of the spider; but I do not think the inside of the hole is lined with a web. They are rather slow in their movements when dug out during the daytime. Instead of running away, they would stand at bay, even showing fight and seizing with their falces any stick presented to them. As I never met with one outside its hole, their habits are probably nocturnal; and when they issue from their places of concealment in search of prey, their movements are doubtless more rapid than by day. When two or three have been put into the same box, I have seen them run after one another with great quickness. They are exceedingly pugnacious; for on one occasion, when I placed several individuals together in the same box, they all fought together, and not one survived. They are remarkably fearless, and would seize a wasp and devour it at once, without any sort of protection such as an *Epeira* makes by surrounding its prey with web.

"From the 7th to the 19th of April, I kept some of these spiders alive in separate cells of a box, feeding them on bluebottles and wasps. I then brought them to England with me, where they arrived on May 7th, having been shut up in a box which was placed in a packed portmanteau, which portmanteau was also put in the hold of the ship; so that it is evident they require very little air, and can go a long time without food. On arriving in England, they were placed in small sieves with a sheet of glass over them. They never seemed to make any lines, except on one occasion, when two very fine females got loose and fought like bull-dogs, and I had great difficulty in separating them: during the combat, I observed one of them attach herself by a line to the box she was in. In the middle of the summer, however, they began to line the whole of the inside of their cage with fine whitish web, not quite so close as the web of a house-spider. They then each made a white cocoon (this was about the middle of July), about the size of a damson-stone, which they kept jealously under their bodies, carrying it about with them where-ever they went; and one of them shut herself up for a day or two in a kind of den, which she wove in the corner of her cage, but soon cut her way out again, to get food, I conclude. About the 1st of September the eggs in both the cocoons appear to have been hatched; but I did not see the young ones till they were some ten or twelve days old; and when I first observed the mothers after this event, their abdomens had the appearance of being covered with a thick brown moss, which, when examined with a lens, proved to be a collection of some fifty young spiders, holding on to the mother, with their heads downwards and their legs and abdomens sticking out. Now (the 17th of September) they have evidently much increased in size since they were hatched; and I am puzzled to think what they have had to eat—whether they have derived any sustenance from the mother herself, or whether they have devoured each other, which latter I think highly improbable; neither do I think that they take any part of the food given to the mother (for the old ones still continue to feed on bluebottles rather largely). The handsome appearance of the mothers has certainly very much fallen off since they were first taken; and this, in conjunction with the fact of the young ones adhering so closely all round the abdomen of the mother, would rather incline one to suppose that they receive some nourishment thereby.

"For the last two or three days, the young spiders have got very restless, and several of them have left the mother, to wander about the cage."

I am, Gentlemen,
Your obedient Servant,
Sept. 22, 1863. James Yate Johnson.

On a Sternothærus *from Central Africa.* By Dr. J. E. Gray, F.R.S. &c.

Dr. Kirk has just presented to the British Museum a living specimen of a young *Sternothærus* from the river Shiré, near the Murchison Rapids, in the Zambezi.

It appears, from the small temporal shields, to be the young of *S. subniger*; but it differs so much from the adult specimens of that species as to be worthy to be described.

Shell oblong, rather shelving on the sides, with a sharp interrupted dorsal keel, more prominent and forming tubercles behind. It is blackish olive and black beneath, with a large central white blotch occupying the greater part of the sternum.

The dorsal and marginal shields have a rather large, rugose, subposterior areola, with very numerous regular radiating grooves, and a few distinct concentric grooves near the margin. The first vertebral shield is quadrangular, about as broad as long, and narrowed behind; the second, third, and fourth are hexagonal, the second rather broader than long, and the fourth longer than broad; the second has a very blunt keel, occupying its hinder half; the third and fourth are sharply keeled, the keel being prominent near the hinder edge, especially of the fourth shield; the fifth shield four-sided, much contracted in front, and with a slightly raised sharp central keel.

The margin is very narrow on the sides, wider and sharper-edged in front, wide and rather arched over the hinder legs, rather narrow and very strongly dentated behind. The sternal shields are like the dorsal ones, radiately and concentrically striated, but not so strongly. The head is olive black-speckled above, beneath pale yellowish, darker-marbled on the sides; the legs and feet are uniform brown, covered with small scales, the front ones with two broad band-like scales just over the feet; the toes are united together to the end; the claws are narrow and sharp. Length 3½, breadth 3 inches.

Note on a Species of Molva *from the Gulf of Genoa.* By Dr. A. Günther.

M. Canestrini, in a paper "I Gadidi e Macrouridi del Golfo di Genova"*, has briefly mentioned and figured a Gadoid fish which he considers as identical with *Lota lepidion*, Risso. Mr. J. Y. Johnson was so fortunate as to rediscover this fish of Risso at Madeira; and the specimen, which I have fully described under the name of *Haloporphyrus lepidion* †, proves that the main characters given by Risso, especially that of the four-rayed first dorsal fin, are correct. On the other hand, M. Canestrini's fish has fourteen rays in that fin, and therefore it cannot be identified with that of Risso. It is evidently a species of *Molva*, and, if not identical with *M. vulgaris*, one closely allied to it. I must leave M. Canestrini to settle this point, and can only add that it is improbable that a northern species like the Ling should be found in the Mediterranean.

On the Osteography of the Sirenia compared with that of the Pachydermata and Cetacea. By J. F. Brandt.

In his memoir on *Rhytina Stelleri*, Professor Brandt compares the skeleton of that animal with those of the Manatees, Dugongs, and *Halitheria*. The latter fossil animals may be regarded, from the presence of traces of hind limbs, as the most perfect forms of the Sirenia; the *Rhytinæ*, on the contrary, from the want of teeth in the adults, as the most imperfect. Thus the Dugongs would constitute a form intermediate between the *Halitheria* and the *Rhytinæ*, whilst the Manatees, notwithstanding the different affinities which they present with the Dugongs, *Halitheria*, and *Rhytinæ*, would be collateral forms, distinguished by the tail and teeth, and approaching the Pachydermata, especially the Tapirs and *Dinotheria*. In this way the Sirenia would be related to the Pachydermata on two different sides, by the *Halitheria* and the Manatees.

* Arch. per la Zool. ii. p. 366.

† Catal. Fish. iv. p. 358.

The Sirenia, according to Brandt, are not Cetacea, but rather purely aquatic Pachyderms, which, however, in accordance with our principles of classification, may very well form a distinct order.—*Comptes Rendus*, Sept. 7, 1863, p. 489.

Note on the Lemming (Lemmus norvegicus, *Desm.*). By M. Guyon.

The emigrations of the Lemmings, like those of the migratory Locusts, are not periodical, and are attended, like them, by a greater or less amount of damage in their course. The Norwegian Lemming inhabits the highest parts of the mountains, where it lives chiefly upon mosses and lichens. Like all its congeners, it sleeps through the day, and only wakens at the approach of night. Its activity is then extraordinary: it moves, as it were, in every direction at once—tearing, gnawing, and murmuring.

For some years the Norwegian Lemmings had not migrated; but they migrated again in the spring of the present year, although in smaller numbers than usual. Towards Lillehamar, in the early part of July many were still to be seen running about in the gardens, and along the houses, and crossing the streets, which were completely strewed with their dead bodies. Notwithstanding its tenderness, the Lemming is strong and courageous. When pursued, it flies at first, but soon turns and defends itself with teeth and claws: it bites severely. Whilst on its defence, it utters very sharp cries. The Lemmings often fight together; and it seems probable that, under certain circumstances, they devour each other.

The cause of the emigration of the Lemmings has been supposed by some naturalists to be the presentiment of a severe winter, by others the deficiency of nourishment at the points where they live, and by others, again, their too great multiplication in certain years. Let us examine these three supposed causes of the emigration of the Lemmings.

1. *A severe winter, of which the animals have a presentiment.*—If this were the case, the emigration would always take place at a period more or less approaching winter. But the emigration took place this year in the spring.

2. *The deficiency or scarcity of nourishment at the points inhabited by them.*—The Lemming, as already stated, lives upon lichens and mosses; and these plants have not been less abundant on the mountains this year than in preceding ones.

3. *The great multiplication of the animals in certain years.*—This cause appears the most plausible, and we may adopt it until a more probable cause is discovered.

It has been said that the Lemming, in its emigrations, follows invariably a direct line, and is stopped by no obstacle, however large; but no doubt a little of the marvellous has been intermixed with the history of this interesting little mammal. In all probability, the direction which it follows in its emigrations is given to it by the declivity of the soil, so that it will always descend like water from its mountains.

In all probability, also, at a given moment in the years of emigration, and as if responding to a general call, the Lemmings will descend from their respective mountains, unite their bands at the base, and continue their march across the country. This march is made in columns more or less close, according to the number of emigrants, which diminishes from day to day by death. In inhabited districts, numbers perish by the agency of man and the domestic animals (the dog, cat, and pig); and the wild animals which follow their columns wage a continual war upon them: these are the birds of prey, and, among mammals, the *Isatis* and the fox. It is also asserted that the reindeer, notwithstanding its herbivorous nature, does not spare them. Hence the Lemmings quit their mountains never to see them again; but it is not known whether the emigrants consist of old or young individuals.

The author procured five specimens, with the view of bringing them to France; but three of them died before he quitted Norway. They fed freely upon biscuit, and also ate walnuts, nuts, almonds, and raisins, which were varied on the voyage with some fruits from their mountains.—*Comptes Rendus*, Sept. 7, 1863, p. 486.

Description of a new Species of Galago. By A. D. Bartlett.

In the month of November last I had occasion to call at the house of Mr. L. A. Monteiro, and that gentleman showed me a specimen of a *Galago*. I at once told him that the animal was new and unknown to me. It differs from the known species in being larger and lighter in colour and in having a much longer tail. Mr. Monteiro informs me that it was sent to England by his son, Mr. J. J. Monteiro, who obtained it at Cuio Bay, to the south of Loando, in Angola. It is very gentle, and sleeps much during the day, feeds on *fruit, bread, milk,* and other sweet things, particularly bananas.

The entire length of the animal is 28 inches, of which the tail measures 16 inches.

The colour is light chinchilla grey all over the head, body, and tail, nearly white on the throat; the toes and feet dark brown, nearly black; nose black; the eyes greyish brown; the ears nearly black, 2 inches long, $1\frac{1}{2}$ inch broad at the base. The animal has the power of turning its ears back and folding them up when at rest: when moving about or in search of food, they spread out and stand upward and forward, reminding one of the Aye-Aye; but when folded back and down, the animal's face bears a strong resemblance to the Douroucouli. The pupils of the eyes are oval and vertical.

This animal is considerably larger than the specimen in the British Museum, known as *Otolicnus crassicaudatus*; but as I am unable to determine the exact structure of its teeth, in order to say positively that it belongs to that genus, I propose to name it *Galago Monteiri*, in order to identify it with the gentleman who has added from time to time many rare specimens to our collection.—*Proc. Zool. Soc.* June 9, 1863.

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[THIRD SERIES.]

No. 72. DECEMBER 1863.

XLI.—*On* Polytrema miniaceum, *a Polythalamian.* By Professor Max Schultze*.

[Plate VII. figs. 1–10.]

Under the name of *Polytrema corallina*, Risso† describes certain small, red, coral-like calcareous structures which occur pretty widely in the Mediterranean upon seaweeds, shells, and other marine productions. They form calcareous crusts, measuring 3–4 millims. or less in their greatest diameter, of a dingy carmine-red colour, and with an irregular surface; they adhere firmly usually to a flat surface, but are also frequently met with forming rings round thin stems of Algæ.

These structures resemble small Millepores, with which indeed they were formerly placed. Linnæus's *Millepora miniacea*‡ must be referred to our species. Lamarck describes them as *Millepora rubra*§, whilst De Blainville|| combined Risso's generic name *Polytrema* with the Linnæan specific name *miniacea* (or, more properly, *miniaceum*), which appellation is here adopted.

On the surface of these structures the lens shows numerous roundish shallow depressions, which extend equally over the lobed or cock'scomb-like elevations and over the depressed parts between these. (Pl. VII. fig. 1). The depressions are usually very shallow, and are occupied at the bottom by precisely the same mass which is seen between them. Frequently the bottom of the little depressions rises in the form of a somewhat spherical dome, like a mountain cone ascending from the depths of a crater and gradually filling the latter completely.

* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1863, p. 81.

† Hist. Nat. Eur. Mérid. v. p. 340.

‡ Systema Naturæ, ed. Gmel. vi. p. 3784.

§ Hist. Nat. Anim. sans Vert.

|| Man. d'Actin. p. 410, pl. 69. fig. 4.

The apices of the lobes and combs of the surface also bear similar shallow depressions. But, on these, orifices passing further inwards are very frequently met with—the commencement of canals which penetrate the interior. These orifices I do not regard as natural, but as produced by the breaking off of the processes or by the erosion of the surface.

Dr. Krohn had the kindness to give me some *Polytremata* which he had collected on seaweeds at Nice and brought with him in a dry state. At the first glance of these I was vividly reminded of the Polythalamian structures from the Philippines, described by me as *Acervulina acinosa**, which are of the same size and colour, and occur under similar circumstances, but present a somewhat different relief on the surface. Krohn had already ascertained that *Polytrema* exhibits a structure of the calcareous walls similar to that presented by the thick-walled Polythalamian shells. But what had especially attracted his attention was, that in *Polytrema* it appeared that *siliceous spicules* occurred constantly, as in the Sponges, sometimes projecting freely from the above-mentioned orifices at the apices of the lobes, but in other cases only becoming visible when the calcareous shell was crushed.

The examination of the dry specimens given to me at once confirmed the similarity of the structure of the calcareous walls with that of the thick-walled Polythalamian shells, and at the same time the occurrence of sponge-spicules in the interior of the *Polytrema.* These were chiefly siliceous, and exactly of the structure of ordinary sponge-spicules, awl-shaped, with a fine axial canal, and either pointed at both ends or knobbed at one of them. (Pl. VII. fig. 10.) A few calcareous spicules were intermixed with them, as could be ascertained at once, and without chemical tests, by means of the polarizing apparatus. Very small spicules, hooked at both ends, also occur (fig. 10 *a*). Of any organic matter occupying the cavity the dried specimens showed mere traces.

The interest attaching to the structures under investigation could not but be extraordinarily increased when it appeared, from further inquiry into the literature of the subject, that very nearly allied structures had been examined by Dr. Gray, and placed as intermediate forms between the Rhizopoda (Foraminifera) and Sponges. Gray found structures resembling *Polytrema* adhering to various marine productions (corals and shells), and published descriptions of them under two new generic names, *Carpenteria* and *Dujardinia*†. By the examination of thin sections of the calcareous shells of these parasitic organisms,

* Ueber den Organismus der Polythalamien, p. 68.

† Ann. & Mag. Nat. Hist. ser. 3. vol. ii. p. 381 (1858).

Carpenter had proved their Foraminiferous nature; but, as sponge-spicules occurred in their chambers, Gray regarded the structures as transitional forms between Foraminifera and Sponges. Gray also met with the *Polytrema miniaceum* of the Mediterranean, but leaves it doubtful whether this is to be arranged with the Foraminifera or with the Bryozoa near *Cribrillina*. He gives it the new name of *Pustularia rosea**.

At Gray's request, Carpenter then more fully investigated the structures arranged in the genus *Carpenteria*, and published a memoir upon them in the 'Philosophical Transactions' for 1860 (vol. cl. pp. 564 *et seq.*), in which he also mentions the *Polytrema miniaceum* of De Blainville as an organism which possesses a Foraminiferous structure of the calcareous shell, and is most nearly allied to the genus *Tinoporus* (p. 561). Carpenter found the sponge-spicules constantly in the chambers of the Polythalamian named after him, and intimates his adhesion to Gray's view that it is a transition form between Foraminifera and Sponges.

Whether we regard Sponges as animals or plants, the occurrence of transition forms between them and the Polythalamia must, under any circumstances, be in the highest degree interesting. An organism of the nature of the Rhizopod-body is supposed to produce simultaneously an external calcareous shell and an internal framework of siliceous spicules. The Sponge-structure, the characteristics of which consist in a much higher histological differentiation of the living substance than appears to occur in the Polythalamia, is supposed to pair with the simple protoplasm-body, not divisible into cells, of the calcareous-shelled Rhizopoda. The affair evidently deserved the most thorough consideration and the most careful testing; there was a fundamental importance attaching to it. For this reason, it was with much pleasure that I found amongst the spirit-specimens collected, in the summer of 1861, by Prof. de la Valette, for the Anatomical Museum of this place, a Crab and a tube of *Vermetus* covered with numerous specimens of the same *Polytrema miniaceum* which I had previously examined in the dry state. As these specimens *contained sponge-spicules* and also exhibited the organic contents of the chambers in a very perfect state of preservation, I resolved to make a careful investigation of all the specimens at my disposal, in order to determine whether any facts could be discovered which would show it to be either certain or probable that the calcareous shell with its or-organic contents and the siliceous spicules all three combine to form one organism.

* Annals, ser. 3. vol. ii. p. 386.

There were evidently three possibilities to be taken into consideration here:—

1. *Polytrema* might be a Sponge with a reticulated calcareous skeleton, forming a network like the horny substance of the officinal sponge. Within the gaps of this network would be the organic sponge-substance which forms siliceous spicules.

2. *Polytrema* might be a Polythalamian. The organic substance within the calcareous skeleton would then be a Rhizopod-body, and the siliceous spicules must have penetrated accidentally, or been eaten, or derived from a Sponge living parasitically in the Polythalamian.

3. The structure might, like *Carpenteria* in the opinion of Gray and Carpenter, represent a transitional form between Sponges and Polythalamia, inasmuch as the calcareous walls possess Foraminiferous structure, but the body of the animal is allied to the Sponges in its faculty of producing siliceous spicules.

As regards the first possibility, the preparation of thin sections of the calcareous mass shows that it does not consist of calcareous rods anastomosing in a netlike form like the horny skeleton of the common Sponge, but of lamellæ which enclose a system of anastomosing chambers nearly similar in form and size, and, further, that these lamellæ (the walls of the chambers, as has already been stated) possess an exquisite Foraminiferous structure. A thin section of *Polytrema*, perpendicular to the surface and viewed by transmitted light, is shown in Pl. VII. fig. 3. The colour of the calcareous walls is reddish, even in thin sections. They are all penetrated by the ordinary pore canals of the Polythalamia, which usually run perpendicularly and by the shortest course towards the surface. The thickness of the calcareous walls varies, although no definite rule could be detected. In fig. 3 a thicker calcareous wall runs from *a* towards *b* on the surface of the section of *Polytrema*; but similar thick walls are also frequently met with through considerable spaces in the interior of the structure. In very thin sections a stratified structure may be detected, especially in the thicker walls; and, corresponding with this, the canals of the wall exhibit a peculiar division into segments*, which may be perceived very distinctly, after the solution of the calcareous matter, in the membranous tubes which occupied each canal (fig. 9).

The pore canals of the surface are very closely approximated, being at an average distance of 0·009 mill. from each other. In the interior septa, on the contrary, they are often much further apart. The width of the canals themselves is 0·004–0·006 mill.,

* Figured in the same way by Carpenter in *Carpenteria*, Phil. Trans. 1860, pl. 22. fig. 15.

which is not unimportant for the determination of the species. Thus, for example, *Acervulina acinosa* is very clearly distinguished from *Polytrema miniaceum* by the greater diameter of its canals, which usually measure 0·012 mill.

If the calcareous matter be dissolved by dilute muriatic acid from specimens which have been preserved in spirits, the organic substance occupying the chambers is obtained free, forming a true and connected cast of the internal system of cavities. From these casts it can be proved, much better than from sections which never open out more than one plane, that the interior of the calcareous shell is divided into chambers (figs. 5, 6, & 7), which are connected together by siphons. Especially at the base and in the centre of the *Polytrema* the siphons are very sharply divided from the chambers, whilst towards the surface the siphons are frequently so dilated that they attain the diameter of the cavities of the chambers, as is shown in the representation of the cast of a small portion of the inner space of the rind of a *Polytrema* in fig. 4. Although no regularity is to be detected in the general arrangement of the chambers, the portion of a natural cast of *Polytrema* shown by me in fig. 6 deserves especial consideration. This was brought to light by breaking up a preparation treated with muriatic acid. The perfectly irregular contents of the superficial chambers having been removed, an unmistakably spiral arrangement in the more deeply seated chambers made its appearance. The connexion with the rest of the mass was broken; so that only the six chambers figured could be seen in their natural connexion. The finer structure of the membrane and contents of these segments left no doubt that the regularly grouped masses in figure 6 and those represented in figures 5 and 7 really belonged to the same specimen. This discovery agrees with that described by Carpenter in *Tinoporus**.

The organic substance remaining after the treatment of specimens of *Polytrema* preserved in spirits consists of an external membrane and a tenacious brownish-red substance, rich in strongly refractive granules and drops, which render it opake. Both the envelope and contents precisely resemble the brownish-red contents of the chambers of many Polythalamia. I have figured this in plate 3. figs. 11 & 12, plate 5. figs. 12 & 13, and in other parts of my work on the Organization of the Polythalamia, and indeed partly from spirit-specimens, so that the figures cited are directly comparable with those here given of *Polytrema*. The organic envelope of the contents of the chambers of the Polythalamia is described by me as follows, at p. 15

* Phil. Trans. 1860, pl. 21. fig. 11, and pl. 22. figs. 2, 3 & 4.

of the same book:—"The calcareous shell of the Rhizopoda is lined by a delicate organic membrane. If a *Rotalia, Rosalina,* or *Textularia,* living or preserved in spirit, or dried with its organic contents, be dissolved in dilute acid, there is observed within the above-mentioned organic foundation of the calcareous shell, a thin, but sharply contoured, homogeneous membrane, of a more or less brown colour, which lies close to the former, and, like it, is penetrated by pores. This uniformly lines all the chambers, and is continued through the siphons of the septa from one to the other. It is only in the last and youngest chambers, which during life are nearly colourless, that this membrane is so delicate that one might suppose it to be formed only simultaneously with the reception of colouring matters into the animal contents." This description applies perfectly to the organic lining of the chambers of *Polytrema* as here represented (fig. 8). It forms a delicate, brownish, empty tube, occupied only at its lower part with granular remains of the body of the animal, which remained after the solution of the lime, but is not the organic foundation of the shell itself. The latter contains so little organic substance, that, in dissolving it in acids, I never could succeed in obtaining a coherent portion of membrane. But the place which it occupied, and its thickness, may nevertheless be recognized in shells which have been carefully dissolved, and, indeed, in the organic linings of the pore canals which penetrate the latter. As the cavities of the chambers are limited by a dense organic membrane, the tubules which pass straight through the thick shell, and which are rather wide in *Polytrema,* are also lined with a similar membrane. Some such delicate tubes, isolated by the acid, are shown in figure 8, lying partly upon and partly near the membrane; others, in much greater number, are shown in their natural position in figure 4; and figure 9 represents some similar tubes, of remarkable length. They therefore correspond with the pore canals passing through the shell, represented in figure 3. They exhibit the same difference of length according to the thickness of the shell, and show the same peculiar segmentation, which seems to be connected with the stratification of the shell.

The brownish-red contents of the chambers, lastly, show no other structure than that which I have described for the contents of the shells of Polythalamia.

If, however, from the structure of the calcareous walls of the shell of *Polytrema,* and from the nature of its contents, the notion that we might have in it a Sponge with a reticular calcareous framework is to be regarded as set aside, and it is rather proved that *Polytrema* approaches the Polythalamia in every respect, we have still to settle the question as to how the siliceous spicules get into the interior of the chambers. Are they produced in the *Polytrema*? Have we to do with a transitional structure between Rhizopods and Sponges, according to the notion of Gray and Carpenter? or are the siliceous spicules foreign bodies in the Polythalamian, either introduced as food or belonging to a parasitic Sponge? With regard to this question, the following observation is to be made:—The siliceous spicules never occur in the above-described yellowish-brown animal contents of the *Polytrema*, which are to be regarded as the Polythalamian body, but always *beside* these, in an extremely destructible, transparent, colourless, finely granular substance, which shows but little coherence, and is consequently distinct from the former. During the solution of a *Polytrema*, with its animal contents well preserved, in a dilute acid, the difference between the two substances (the dense yellowish-brown one, and that which contains the spicules) at once strikes the eye. The latter is, however, usually so extremely small in quantity around the siliceous spicules, which frequently lie as if quite uncovered, that it is impossible to prepare it in connexion. It breaks up as the spicules separate from each other; and only traces of it adhere to individual spicules or groups of spicules (fig. 10). It is, moreover, of particular importance that *by no means all specimens of* Polytrema *contain spicules*, and that, when these do occur, they usually occupy only the peripheral chambers. The twelve spirit-specimens of *Polytrema* which I examined by means of dilute acids gave the following results:—Two of them had no trace of siliceous spicules; all the chambers were completely filled with the yellowish-brown substance, which diminished a a little in intensity of colour towards the periphery. Three specimens contained the remains of the yellowish-brown substance only in the more deeply seated layers; nearly all the chambers were full of siliceous spicules and the small quantity of colourless organic substance belonging to them. All the rest likewise contained siliceous spicules, but only in the peripheral chambers, and often only in one part of them; the greater part of the interior system of cavities was filled with the brown substance, as shown in figs. 4–7. The siliceous spicules therefore may be entirely wanting; and when they occur, they never lie in the true Polythalamian substance, but rather diffuse themselves, with displacement of the latter, from the periphery towards the deeper parts; moreover they are imbedded in an organic substance which does not appear to belong to the Polythalamian body. The nature of the last-mentioned substance certainly cannot be positively determined. It might possibly be colourless Polythalamian substance. But, in opposition to this, we have, in the first place, its want of solidity, its want of cohesion after the solution of the calcareous shell, and then its diffusion, in certain cases, even into the central parts of the shell. Polythalamia which exhibit a yellowish-brown coloration of the body in the central chambers always, according to my observations, present the same or nearly the same colour through all the chambers, with the exception only of the few last-formed ones. This was also the case in several *Polytremata* which contained no siliceous spicules, and as to the true Polythalamian nature of which there could be no doubt. Now, may the originally brown substance become colourless again during the appearance of these spicules? Our previous experience furnishes no reason for such a supposition; and therefore we must argue against it, so long as another course is open to us.

Of such, three present themselves:—Either the siliceous spicules have penetrated accidentally, or they have been taken in as food, or, lastly, they belong to a parasitic Sponge. I have already mentioned that many specimens of *Polytrema* exhibit erosions of their surface, especially at the apices of the comb-like or tooth-like elevations—apertures by which a glimpse is afforded of the inner system of cavities. The siliceous spicules are always to be found in abundance at such spots, in the chambers nearest to the orifice. Frequently, as was observed by Krohn at Nice, the spicules project freely from the apertures, so as to be detected at once by the microscope. The siliceous spicules, if not produced in the Polythalamian body, have certainly penetrated from the apertures. It might be in vain to attempt to prove that they have not penetrated accidentally, or been taken in as nourishment. But no probable grounds can be adduced for either of these views. How could sponge-spicules, however numerous they might be in the water surrounding the *Polytremata*, find their way into the innermost chambers of the labyrinthic system of cavities, still at least partly filled with organic substance? Must not the filling of the peripheral chambers with such spicules, crossed in all directions, prevent the penetration of the latter into the deeper layers? And if Sponges were the favourite food of the *Polytremata*, how could adherent Polythalamia get at adherent Sponges in order to devour them?

There is consequently no reason why we should not embrace the last possibility, and assume that *Polytrema* is infested by a parasitic Sponge. That Sponges bore into many calcareous structures, and live like parasites, is well known. The genus *Cliona*, upon which Lieberkühn * has recently published some exact observations, is one of these boring Sponges. Its extraordinary diffusion appears from the fact that on many coasts

* Müller's Archiv, 1859, p. 515.

(Heligoland; Northumberland, according to Hancock) it is scarcely possible to find an oyster-shell or a piece of limestone which is not completely riddled by *Clionæ.* In any case the parasitism of a Sponge in *Polytrema* presents nothing remarkable; and the next question is, whether the form and arrangement of the spicules support the notion that they belong to a Sponge like *Cliona.* Of the spicules of *Cliona celata,* which occurs in particular abundance in oyster-shells on Heligoland, Lieberkühn says that they are knobbed at one end, but that "frequently a very short point projects beyond the knob; and an inflation of the middle of the spicule also occurs, although extremely rarely." This is all that I can learn as to the forms of the spicules in the *Clionæ.* Unfortunately it does not suffice for the discrimination of a siliceous Sponge; for knobbed spicules are common to many species, and often associated with ordinary awl-shaped spicules. The greater part of the spicules of our *Polytrema*-Sponge are subulate at both ends, as shown in Pl. VII. fig. 10. Many are broad; but the small forms resembling a clasp or cramp (fig. 10 *a*) are rare. *Capitate spicules* also occur, in which the axial canal, which is wanting in no siliceous spicule, presents an inflation in the knob. All the spicules are comparatively short, so that they extend at the utmost through two or three chambers of the *Polytrema.* A few fragments of larger spicules that I have seen, as also the extremely rare and likewise fragmentary calcareous spicules which are sometimes observed, I should regard as accidental admixtures. The short subulate spicules frequently lie parallel to each other in groups, as they are found *in situ* in Sponges.

The preceding statements suffice, in my opinion, to prove that, when siliceous spicules occur in the shells of Polythalamia, together with the organic contents of the chambers, the notion that in such cases we have before us transition forms between Foraminifera and Porifera has but little probability in it. The question now is, whether, in the case of *Carpenteria,* in which, according to Gray and Carpenter, a Foraminiferous structure of the calcareous shell and an occupation of the chambers by siliceous spicules also occur, there is any more reason to uphold the view promulgated by the English zoologists. Carpenter's description of the Polythalamian named after him, which is found living parasitically upon various marine productions, and especially numerous upon a fragment of a *Porites,* is, like all his works upon Polythalamia, so careful and accurate that we can obtain from it a perfectly clear idea of the structures in question. I am therefore the more confirmed in my opinion, because there does not appear to me to be the least reason for conceiving the relation between the sponge-spicules and the calcareous shell in

Carpenteria otherwise than in *Polytrema.* The calcareous shell in both cases is completely Foraminiferoid. The siliceous spicules lie scattered in the chambers, and are enveloped by but a small residue of organic substance. The *central chambers* (and this is of particular importance) were filled, in *Carpenteria,* also with *a firmer yellowish-brown substance containing no spicules,* exactly as in *Polytrema.* Lastly, the form of the spicules, according to Carpenter's figures (*l. c.* pl. 22. fig. 16), agrees almost exactly with that of those found in *Polytrema,* inasmuch as they are either pointed at both ends or knobbed at one end, bowed, and of small size.

As might have been expected, it occurred to Carpenter also that the spicules might be referred to a Sponge living parasitically in the Polythalamian. But, in finally coming to the conclusion that both belong to one organism, he lays particular stress upon the discovery of the above-mentioned yellowish-brown organic substance in the cavities of the central chambers, regarding this as true sponge-substance, without spicules indeed, but too dense and firm to be taken for the sarcode-body of a Polythalamian. Here Carpenter is in error. As I have already stated, from innumerable examinations of Polythalamia and Sponges, both dry and preserved in spirits, the substance of the Polythalamia is much denser, firmer, and more resistant than the organic substance of the Sponges. With the exception, of course, of the horny substance of the horny Sponges, the organic envelope of the sponge-spicules breaks up and becomes decomposed with such remarkable ease and rapidity that I have never succeeded with spirit-specimens of Sponges, even when I had myself put them quite fresh into spirit, in isolating moderately large coherent portions of the organic substance, or making any investigations into its nature. In Polythalamia, on the contrary, in which the organic substance is so resistant that it remains capable of life for weeks even in the midst of decaying substances, and that they may be kept alive for months far more easily than any other marine animals, the action of spirit or desiccation causes such a hardening that the contents of the chambers may be isolated precisely in the state which Carpenter adduces in opposition to their Polythalamian nature.

For this reason I cannot regard the conditions in *Carpenteria* otherwise than as in *Polytrema,* and therefore believe that the boundary between Polythalamia and Sponges, which has hitherto been considered as a very sharp line, must still be maintained in all its integrity.

Supplementary.

In combination with W. K. Parker and T. Rupert Jones, two naturalists who have made themselves celebrated by their researches upon Foraminifera, Dr. Carpenter has just published a great work, through the medium of the Ray Society, under the title of 'Introduction to the Study of the Foraminifera.' In this (pp. 235 *et seq.*), *Polytrema,* which was only mentioned incidentally by Carpenter in his previous works, is described in detail, and illustrated by figures (pl. 13. figs. 18–20). During a visit which I lately paid him in London, Dr. Carpenter had the kindness to show me his rich collection, including his preparations of *Polytrema.* Although his specimens were obtained from the South Sea, and mine from the Mediterranean, and his exhibit more variation than mine in their external form, I do not think that there can be any doubt as to their specific identity. Carpenter has arrived at the same result as myself—namely, that *Polytrema* is a Polythalamian. His investigations have, however, been made only with dried specimens, and have no reference to the organic contents of the chambers. Carpenter had no inducement to discuss the question whether *Polytrema* produces spicules, and is thus allied to *Carpenteria,* as his specimens contained *no spicules in their interior.* Nevertheless he mentions having seen specimens with the surface entirely covered with a parasitic Sponge, the spicules of which, however, penetrated scarcely, if at all, into the interior of the chambers. By this means Carpenter establishes a sharp distinction between *Polytrema* and *Carpenteria.* If in the former there could be no doubt as to the parasitic nature of the Sponge, as to the second Carpenter still adheres to Gray's opinion that the sponge-spicules are produced in the interior, and that *Carpenteria* is consequently a transition-form between Sponges and Foraminifera. Perhaps my observations upon *Polytrema,* which indicate the remarkably close affinity between that genus and *Carpenteria,* may serve to shake Carpenter's faith in his opinion.

Upon the systematic position of *Polytrema* among the Polythalamia I have hitherto said nothing, except mentioning its near affinity in appearance with my genus *Acervulina.* The *Acervulinidæ,* which form a peculiar family in my System of the Polythalamia as established in 1854, are characterized chiefly by the irregularity of their growth, in consequence of which they appear like a misshapen aggregation of chambers deposited one upon the other without any definite system. I was indeed aware that in several families, especially that of the *Rotalidæ,* an irrelarly growing form may be produced from a Polythalamian which was at first regularly spiral; but these, from their comparatively great transparency, were always easily referred to the Rotalide type, whilst in the form which I named *Acervulina* no such spiral nucleus had been detected; so that, without forgetting that the boundaries of the families of the Polythalamia generally are very artificial, and that every system cannot be satisfactory in every direction, I did not hesitate to form a distinct family for the sake of the preliminary revision. Nevertheless it appears that the irregular increase in age occurs more frequently than was previously supposed in species which showed regular spiral shells, and that a spiral nucleus is to be detected in the centre of many apparently quite irregular aggregations of chambers, which were therefore true *Acervulinæ*. Hence it would be better, with Carpenter, to adopt the irregular growth only in the generic or specific diagnoses, and to give up the family *Acervulinidæ*. With this I perfectly agree, only remarking that in *Acervulina acinosa*, the typical form on which the genus was founded by me, no spiral or other regular commencement has been detected, and that, for all such forms, the genus *Acervulina* must still be provisionally retained. In Carpenter's system, *Polytrema* would come in the family *Globigerinidæ*, near *Tinoporus*, on account of the spiral commencement (imperfectly seen even by that observer) and of its shell-structure. *Carpenteria* must then be reckoned among its nearest allies.

If I say a few words in conclusion upon the systematic division of the Foraminifera proposed by Carpenter, I can only give my general approval of it. It is distinguished from previous attempts of the same nature by its placing in the foreground, for the definition of the principal groups and families, certain peculiarities of the shell-structure which have hitherto been either employed only for the determination of genera and species, or not sufficiently recognized, whilst that which has hitherto furnished the main classificational character—the arrangement of the chambers—has only a secondary importance attached to it. There is no doubt that the two suborders formed by Carpenter, *Foraminifera imperforata* and *F. perforata*, form sharply differentiated and in themselves coherent groups. It must, however, be expected that, however natural the classification may be in general, in detail many apparently unnatural separations may occur. I instance only the dismemberment of the genus *Cornuspira*, one species of which has a brown, translucent, imperforate shell, and the other a hyaline perforated one, although perfectly similar as regards the internal cavity, the direction of the spiral, the size, &c.; so that the two species now naturally stand, with different generic names, in two different suborders.

The six families which Carpenter distinguishes are, of the Imperforata—1, *Gromida*, with a membranous shell; 2, *Milio-*

lida, with a calcareous porcellanous shell; and 3, *Lituolida*, with a calcareo-siliceous shell containing sand-grains: of the Perforata—4, *Lagenida*, with very fine pore canals; 5, *Globigerinida*, with larger pore canals; and 6, *Nummulinida*, in which, in addition to the ordinary pore canals, never usually very fine, there is a system of peculiar cavities and canals, giving the shell a very complicated structure. The families are sometimes very large, and might well be divided into subfamilies, which would nearly agree with the families established by me,—for example, Carpenter's *Miliolida* into the *true Miliolidæ*, the *Peneroplidæ*, *Soritinæ* (*Orbitulitinæ*), *Alveolinidæ*, &c. From the wonderful perseverance and great skill which Carpenter has shown in his researches upon the shells of the Polythalamia during many years, and considering the enormous amount of materials, consisting of the most various forms from every zone, which he had at his disposal, one can understand how he comes to undervalue a little the works of his predecessors, and especially mine, in so far as they treat of the shell-structure. Indeed it was the chief object of my researches to ascertain the exact nature of the animal body which inhabits and forms the shell, for which reason I confined myself especially to the forms observed by me in a living state, and their nearest allies. Moreover, although I was assisted by many of my friends, I found it impossible to bring together all the species, as I desired and indeed required for the elaboration of a systematic revision. For example, I was almost entirely destitute of the living species of Carpenter's *Nummulinida*, and thus had not the opportunity of seeing the system of ramified tubes first described by Carter, as stated at page 15 of my book. Nevertheless my observations upon the shell-structure are not so scanty as Carpenter seems to suppose. In opposition to his repeated assertion *, that I have too much neglected the investigation of the shell-structure, and confined myself to the examination of the animal, I may be allowed to urge that, independently of the representations of the shell-structure of the species observed living by me, such as *Polystomella strigillata* (pl. 4 & 5. figs. 2, 6, 7, 9, 10), *P. gibba*, *P. stella*, *P. borealis*, and *P. venusta* (pl. 6. figs. 2, 5, 8), of which I think I may assert that they are not exceeded by Carpenter's, there are in various parts of my work (especially in the chapter "On the Shells of the Marine Rhizopoda," and in section iii. p. 37) a great number of remarks, founded upon personal observation, as to the structure of numerous exotic Rhizopod-shells, such as the *Sori-*

* Phil. Trans. 1856, p. 187; Introduction to the Study of the Foraminifera, p. 10.

tinæ (*Orbitolitinæ*), *Orbiculinæ*, *Alveolinæ*, *Siderolites*, *Calcarinæ*, *Fusulinæ*, &c., which Carpenter has nowhere quoted. Even the foundations of Carpenter's new system of the Foraminifera are to be found expressed in my book (p. 12), in the following words:—"In respect of the finer structure of the shell, the calcareous Foraminifera may be divided into *two series*, namely, into those which have the shell perforated throughout with numerous fine apertures or canals, and those in which the shell appears solid and homogeneous."..."Sufficiently transparent forms, or thin sections of opake ones, when examined under the microscope by transmitted light, either appear as colourless as glass or show a brown coloration. To the latter belong all the solid and not finely porous shells, and therefore the whole of the *Miliolidæ*, the *Ovulinæ*, *Cornuspira planorbis*, and the *Peneroplidæ*." To the same category I referred also *Orbiculina* and *Sorites* (*Orbitolites*), although here I erroneously supposed their shell to be perforated by small apertures, which, as Carpenter rightly asserts, they do not possess. In opposition to these *calcareous-shelled* Rhizopods, I placed the only *siliceous-shelled* species then known, the *Polymorphina silicea**, observed by me at Ancona. Carpenter might consequently have sought the first sure foundation of his family *Lituolidæ* also in my observations, which, however, appear to have been quite unknown to him, as also my later communications upon a form resembling *Nonionina*, with a granular siliceous shell†. The latter possesses a particular interest, inasmuch as it contained in its interior numerous small globular shells agreeing in structure with the large shell, and which, in accordance with my observations on the reproduction of the *Miliolidæ* and *Rotaliæ*, must be regarded as young. If these, therefore, form a siliceous shell while still within the body of the parent, Carpenter's notion that the siliceous particles of the shells of Foraminifera are *always* derived from the surrounding sand‡ must require modification.

However, I must repeat that I welcome with pleasure the classification of Foraminifera proposed by Carpenter, as a real step in advance. That it is a natural and true expression of our knowledge of the Foraminifera, which has made such consider-

* Ueber den Organismus der Polythalamien, pp. 9, 11 & 61. Reuss has since (Sitzungsber. der böhmischen Ges. der Wiss. zu Prag, Nov. 28, 1859) justly called attention to the fact that the species would be better referred to the genus *Bulimina*, in which many sandy siliceous forms occur. I leave it to Reuss to give the species a suitable name.

† *Nonionina silicea* (Müller's Archiv, 1856, p. 171, pl. 6. fig. 4) will also have to receive a new name, and must be referred to the genus *Lituola* or *Haplophragmium*, Reuss.

‡ Introduction, &c., pp. 47 & 140.

able progress during the last ten years, is strikingly shown by the fact that the most experienced student of the Foraminifera in Germany, Professor Reuss, of Prague, in his most recent works, proposes a systematic distribution of these animals according to exactly the same principles as those adopted by Carpenter. Reuss's chief work, "Entwurf einer systematischen Zusammenstellung der Foraminiferen," is printed in the Number of the 'Proceedings of the Academy of Sciences at Vienna' for October 1861, and is cited by Carpenter in the bibliographical section of his last work (p. xxi. no. xci. *a*), but appears to have reached him after the impression of the text, as it is nowhere quoted in the latter. In it (see especially the 'Nachschrift,' p. 394) the Foraminifera are divided, as by Carpenter, into those with *non-porous* and those with *porous* shells; and, as Reuss excludes the *Gromida*, there remain two groups in the first section,—(1) those with sandy siliceous shells; (2) those with compact porcellanous shells. In the second group Reuss distinguishes—(1) those with finely porous, hyaline calcareous shells; (2) those with manifoldly (?) porous calcareous shells; (3) those with calcareous shells permeated by ramified systems of canals. It is evident that the systems of Carpenter and Reuss perfectly agree. In its further development, however, I am inclined to prefer that of Reuss, as he distinguishes *smaller* families, more closely following the necessities of the zoologist and the previous systematic works, and, I believe, agreeing better with nature.

EXPLANATION OF PLATE VII.

Fig. 1. A specimen of *Polytrema miniaceum* from the surface of a Crab; magnified 15 diameters.

Fig. 2. Part of the surface of the same *Polytrema*; magnified 300 diameters, to show the apertures of the pore canals.

Fig. 3. Thin section through the calcareous wall of *Polytrema*; magnified 300 diameters.

Fig. 4. Part of the animal-body of a *Polytrema* preserved in spirits, laid bare by muriatic acid. In the place of the thick calcareous wall, only the membranous linings of the pore canals are retained *in situ*.

Figs. 5, 6 & 7. Parts of the body similarly prepared. Fig. 6 shows the spiral arrangement of the chambers, probably the first-formed part of the *Polytrema*.

Fig. 8. Membranous lining of the chambers without the body, or with only a few traces of the latter; isolated by acid.

Fig. 9. Two membranous linings of pore canals, with many indications of joints.

Fig. 10. Siliceous spicules from different chambers of *Polytrema*.

XLII.—*On a new Genus of Terrestrial Mollusks from Japan.* By Arthur Adams, F.L.S. &c.

[Plate VII. figs. 11, 12.]

Genus Blanfordia, A. Adams.

Rostrum elongatum, transverse corrugatum, ad apicem emarginatum. Tentacula brevissima, triangularia, depressa, ad apicem acuta; oculi sessiles ad basin superiorem tentaculorum ; pes magnus, sulco transverso in partes duas divisus, ad latera utrinque lobatus, postice lobo dorsali operculum gerente præditus.

Operculum corneum, subspirale.

Testa ovato-conica, epidermide olivacea obtecta, apice truncato ; anfractibus lævibus.

Apertura elliptica; peristomate continuo, incrassato, duplicato, interno subacuto, externo subvaricoso.

1. *B. japonica*, A. Adams. Sado, Japan. Pl. VII. fig. 12.
   Tomichia, sp. Annals, Oct. 1861.
2. *B. Bensoni*, A. Adams. Matsumai, Japan. Pl. VII. fig. 11.
   Tomichia, sp. Annals, Oct. 1861.

In Japan, at Matsumai and Sado, I discovered two species of terrestrial Mollusks, with similar animals, which (in the 'Annals' for October 1861) I referred to the genus *Tomichia*, Benson, a form of Truncatellidæ from the Cape. Since then, I have sent specimens of the shells, accompanied by drawings of the animals, to Mr. Benson; and he assures me that his *Tomichiæ* are very different. He writes to me as follows :—

"A comparison of the animal of the Cape *Tomichia* with that of your Japanese shells leads to the impression that your discoveries belong to a distinct genus, which, but for the operculum, may rather be regarded as a land-shell. I have examined a specimen, and find it horny and subspiral in construction, the same as that of *Tomichia*, but more solid."

In *Tomichia* the animal is similar to that of *Truncatella*, the tentacles being filiform, and the eyes on tubercles, near the upper bases of the tentacles. The foot is short, with anterior lateral lobes, and with a simple operculigerous lobe.

Mr. Benson found *Tomichia* at the Cape, in a freshwater ditch communicating with a stream which discharges itself into False Bay. "At Bazuarm's Kraal, the adult specimens, for the most part, crept about on the moist earth by the edge of the water; but the younger individuals were immersed, in company with a small soleniform *Cypris*. I observed that, aided by the lightness of their shells, the young *Tomichiæ* were enabled to swim resupinate at the surface."

In *Blanfordia* the tentacles are short and triangular; in *Tomichia* they are filiform: in *Blanfordia* the eyes are sessile on the upper bases of the tentacles; in *Tomichia* the eyes are placed upon tubercles near the upper bases of the tentacles. The foot in *Blanfordia* would seem to be somewhat similar to that of *Tomichia*, being lobed on each side in front and with a posterior dorsal lobe which bears the operculum. Both my species are found on damp banks covered with vegetation, in rocky situations near the sea.

I have dedicated the genus to my friend W. T. Blanford, who has discovered many new and interesting forms of Land-Mollusks in India.

XLIII.—*Characters of new Operculate Land-Shells from the Andamans, and of Indian and Burmese Species of* Pupa. By W. H. Benson, Esq.

1. *Helicina Scrupulum*, B.

H. testa parva, sublenticulari, crassiuscula, sublævigata, vix nitidula, minutissime oblique striatula, superne fuscescente, anfractu ultimo albido-cornea, supra peripheriam fasciis 2 rufescentibus inferiore latiore ornata; spira depresso-conoidea, apice obtuso, sutura lineari; anfractibus 4½, superioribus vix convexiusculis, ultimo obtuse angulato; apertura obliqua, subtriangulari-lunata; peristomate expanso, reflexiusculo, marginibus callo magno incrassato subcirculari retrorsum expanso polito junctis. Operculo tenui, albido.

Diam. 5, alt. 3 mill.

Habitat in insulis Andamanicis.

This is the second species of *Helicina* which has been found in the Andamans. A single specimen, fortunately in good order, was received by Mr. W. Theobald.

2. *Omphalotropis distermina*, B.

O. testa perforata, globoso-conica, oblique striatula, supra suturam, ad peripheriam, et circa umbilicum oblique vel radiatim costulato-striata, sub epidermide fusca non nitente albida; spira acuminato-conica, apice acutiusculo, sutura profunda; anfractibus 6, convexis, ultimo ad peripheriam et circa umbilicum subcarinato, carina umbilicali extus linea impressa notata; apertura subobliqua, angulato-ovata, spiram æquante; peristomate recto, acuto, marginibus remotioribus callo tenui junctis; columellari subincrassato. Operc. —— ?

Long. 3, diam. 2½ mill.

Habitat in insulis Andamanicis.

A single specimen, deprived of the operculum, was sent by Mr. W. Theobald as a *Cyathopoma*. The aperture, the mode of carination, and umbilical radiate costulation at once prove its proper place.

3. *Cyathopoma* (?) *tignarium*, B.

C. testa minuta, umbilicata, turbinato-conica, liris spiralibus subtus confertioribus cincta, oblique striatula, sub epidermide luteo-fusca albida; spira conica, apice obtusiusculo, sutura profunda; anfractibus 5, valde convexis, ultimo cylindrico; apertura vix obliqua, circulari; peristomate continuo, simplici, recto, acuto, ad anfractum penultimum breviter adhærente. Operculo calcareo, medio anguste concavo, nigrescente, polito, margine lato planato, arctissime spirali.

Diam. 2, alt. $2\frac{1}{2}$ mill.

Habitat in insulis Andamanicis.

A single specimen, forwarded by Mr. W. Theobald, is deficient in the double peristome observable in the typical species of Mr. W. T. Blanford's group, *Cyathopoma filocinctum*, Bens., and *C. Malabaricum*, Blanf. The operculum has not attained the singular development of the margin exhibited in the Nilgherry shells and in a new species found by Mr. Blanford on the Bhore Ghat, near Khandalla, one specimen of which, however, with an immature operculum, received from the discoverer, has a tendency to the formation presented by the operculum in the Andaman species.

My description of the operculum of *C. filocinctum*, recorded in the paper on *Opisthoporus* published in the 'Annals' for January 1855, p. 16 ("Operculo extus concavo; anfractibus paucis, margine scabre elevato"), indicates a more advanced, but not the full development of the operculum first observed by the Messrs. Blanford.

4. *Pupa bathyodon*, B.

P. testa profunde rimato-perforata, ovato-conica, oblique striatula, fusco-cornea, translucente; spira conica, apice obtuso, sutura subprofunda; anfractibus 5, convexis, ultimo antice ascendente circa umbilicum excavatum compressiusculo; apertura quadrato-ovata, marginibus expansis subreflexis concoloribus callo parietali expanso superne junctis, 4-dentata, dente parietali 1 intrante majore, palatalibus 2 minutis remotiusculis, columellari 1 profundo.

Alt. 3, diam. 2 mill.

Habitat ad Teluk Sendur, prope Hoshungabad, non procul a flumine Nerbudda. Detexit W. Theobald, jun.

5. *Pupa Planguncula*, B.

P. testa perforata, elliptico-cylindrica, oblique striatula, striis anfractus ultimi et prope suturam magis conspicuis, non nitente, albida; spira oblonga, versus apicem obtusum convexa, sutura subprofunda, margine crenulato; anfractibus 6, convexis, ultimo subtus angustato, antice leviter ascendente, medio pone aperturæ marginem foveato; apertura subaxiali, elongato-auriculari; peristomatis margine expansiusculo, subreflexo; plica parietali subtorta, intrante; dentibus 2 palatalibus, superiore magno incrassato dicruri, columellari 1 crasso, marginali subduplici, basali minuto remoto.

Long. 3, diam. $1\frac{1}{3}$ mill.

Habitat in regione Orissæ et prope fluvium Nerbuddæ. Detexit W. Theobald.

This shell has some relation to *Ennea,* but is at once distinguished by the parietal tooth.

6. *Pupa Diopsis,* B.

P. testa perforata, oblongo-ovata, oblique striatula, striis nonnullis remotis elevatiusculis, sub epidermide cornea albida; spira oblonga, versus apicem obtusiusculum conoidea, sutura impressiuscula; anfractibus 5, convexiusculis, ultimo antice leviter ascendente; apertura oblongo-ovata, superne angulata, bidentata, plica parietali mediana angusta oblique intrante denteque columellari obliquo remoto superne munita; peristomate tenui, margine dextro simplici recto, columellari expanso.

Long. 2, diam. 1 mill.

Habitat in valle Nerbuddæ.

A single specimen, in a worn state, was sent by Mr. W. Theobald for examination.

7. *Pupa Serrula,* B.

P. testa rimata, ovato-conica, oblonga, oblique subcostulato-striata, albida; spira elongato-conica, apice obtuso, sutura profunda crenulata; anfractibus 5, superioribus, valde convexis, ultimo antice ascendente; apertura quadrato-ovata, sexdentata, lamina parietali 1 subduplici, columellari 1 superiore denteque minuto inferiore, dente minuto basali, palatali 1 superiore laminaque inferiore profunda munita; peristomate undique expanso, marginibus tenuibus callo lato superne junctis.

Long. 2, diam. $\frac{2}{3}$ mill.

Habitat in India centrali. Detexit W. Theobald.

A single derelict specimen was received from Mr. W. Theobald, jun. It approaches the Ceylon *P. mimula,* B.

8. *Pupa Seriola,* B.

P. testa vix perforata, ovato-oblonga, subcylindrica, oblique striatula, sericina, flavescente, cornea; spira oblonga, apice obtusiusculo, sutura impressa; anfractibus 5, superioribus convexis, ultimo convexiusculo antice vix ascendente; apertura subovata, superne angulata, dente 1 parietali mediano remotiusculo induta; peristo-

matis marginibus callo tenui junctis, dextro vix, columellari superne late expanso.
Long. $2\frac{1}{2}$, diam. $1\frac{1}{3}$ mill.
Habitat in regione Orissæ (Cuttack). Detexit W. Theobald.

Mr. W. T. Blanford, in his description of the South-Indian *Ennea Salemensis*, has referred to this species as an *Ennea*. It has more affinity to *Bulimus* than to that genus. In one of the two specimens received, the parietal lamina is not apparent.

9. *Pupa Himalayana*, Hutton, MS.

P. testa rimato-perforata, ovato-oblonga, subcylindracea, oblique minutissime costulata, translucente, pallide cornea; spira oblonga, apice obtuso, sutura impressa; anfractibus 7, brevibus, convexis, ultimo antice leviter ascendente; apertura rotundato-ovata, edentata; peristomate tenui, margine expansiusculo, dextro superne leviter antice progrediente.
Alt. 2, diam. 1 mill.
Habitat in montibus Himalayanis occidentalibus, ad Simla et Mussoorie. Detexit Capt. T. Hutton.

In form and general appearance, as well as in the toothless aperture, it approaches the Swiss *Pupa inornata*, Michaud. Capt. Hutton found three specimens near Waverley at Mussoorie.

10. *Pupa Avanica*, B.

P. testa umbilicata, ovato-oblonga, subcylindrica, vix striatula, nitida, fusco-cornea, translucente; spira oblonga, versus apicem obtusiusculum conica, sutura valde impressa; anfractibus $5\frac{1}{2}$, subconvexis, ultimo antice ascendente; apertura ovata, superne obtusa sexdentata, plica parietali 1 duplicata intrante, dentibus columellaribus 2 profundis et palatalibus 3 profundis munita; peristomate undique expanso, marginibus tenuibus callo parietali lato junctis.
Long. $2\frac{1}{2}$, diam. $1\frac{1}{3}$ mill.
Habitat in regione Avæ. Detexit W. T. Blanford.

This shell is related to the Western Himalayan *P. Huttoniana*, Bens., but differs in surface, in having an additional upper palatal tooth and a more distinctly double parietal plica.

Cheltenham, Nov. 3, 1863.

Note.—In the 'Annals' for last May I described *Clausilia Bulbus*, a singular form from Moulmein. I find that, in the 'Proc. Boston Soc. Nat. Hist.' for July 1856, Dr. Gould described an allied species from Tavoy. With reference to the dimensions recorded, it would appear that Gould's species is longer as well as narrower than *C. Bulbus*. It scarcely exceeds *C. Philippiana* in breadth, while the length attains to that of specimens of *C. insignis*,—approaching, therefore, in nowise to the stout bulbous form of the Moulmein shell.

In order to allow a comparison, I add Gould's published description, in which several material characters are omitted:—

"*Clausilia Vespa.* Testa solida, sinistrorsa, vespæformis, deflecta, lævis, intense rufa; anfr. 6, anteriori raptim attenuata, proxima corpulenta, apicalibus cito decrescentibus; sutura impressa, vix marginata: apertura ovata; columella biplicata; peritremate late reflexo, rufo.

"Long. 1, lat. $\frac{3}{10}$ poll. Inhabits Tavoy. Rev. F. Mason.

"This very singular wasp-like shell is allied to *C. insignis*, Philippii, *C. Cochinchinensis*, &c., but distinguished from all by its peculiar form."

XLIV.—*On the Nomenclature of the* Foraminifera. By W. K. Parker, Esq., and Prof. T. R. Jones, F.G.S.

Part X.—*The Species enumerated by D'Orbigny in the 'Annales des Sciences Naturelles,'* vol. vii. 1826.

We have now to take in hand a critical review of the many species and varieties of Foraminifera enumerated by D'Orbigny in his "Tableau Méthodique des Céphalopodes," published in the 7th volume of the 'Annales des Sciences Naturelles,' 1826. The principles on which D'Orbigny grouped these Microzoa as "Cephalopoda Foraminifera" were long since known to himself to be erroneous; and the errors in his classification have been fully pointed out by Dr. Carpenter*. But we must never forget that D'Orbigny laboriously and conscientiously worked out an enormous mass of material, and reduced it to such order that naturalists could recognize hundreds of organic forms previously either quite hidden or vaguely known, and could advantageously add the results of their own research to his classified material, although his plan of arrangement† was artificial and defective. By his careful, though imperfect, elaboration of what earlier observers had done towards the elucidation of specific forms of Foraminifera, and his illustration of many of the most important species by means of a hundred large plaster models, and by the eight plates accompanying the 'Tableau Méthodique,' he opened the way towards a knowledge of these little creatures, thousands of which he had himself collected from sea-sands of every region and from many fossil strata. He adopted many already published specific determinations, often correcting the generic rela-

* Introduction to the Study of the Foraminifera, 1861, Ray Soc.

† Based on the arrangement of the chambers of the shell.

tionships; he made a selection of the Foraminifera figured in Soldani's great work ('Testaceographia et Zoophytographia parva et microscopica,' 1789–98), grouped, and named them; and he enumerated (with binomial appellations) a very large number of specific and varietal forms observed by himself, and many of which were subsequently described and figured in his several fine monographs on the Foraminifera of Cuba*, of South America†, of the Canaries‡, of the White Chalk of Paris§, and of the Vienna Tertiary Basin‖.

D'Orbigny's views relating to the Foraminifera, in 1844, are expressed in the article "Foraminifères," in the 'Dict. Univers. Hist. Nat.' vol. v. pp. 662, &c.; and his latest published determinations as to their generic and family relationships are to be found in his 'Cours Elémentaire de Paléontologie et de Géologie,' vol. ii. fasc. 1. pp. 189–207 (1851).

In treating of the species accepted and determined by D'Orbigny, we propose, firstly, to enumerate the species adopted by him from earlier authors; secondly, to pass in review those that he illustrated, in 1826, by engraved figures (in the 'Ann. Sc. Nat.' vol. vii.), and by models in 1823; thirdly, to determine the forms selected by D'Orbigny from Soldani's figures; and afterwards to enumerate the other species determined by him, as far as the means at our disposal serve.

In the determination of the right specific names for the several type forms indicated, we are guided, as heretofore, by the fitness of the several forms to stand as types, in accordance with their possession of some trace of all or nearly all the features characteristic of their species, priority of publication giving permanence to one of any two or more names of identical forms. The 'Models' having been published in 1823, the type forms represented by them take precedence of identical forms subsequently published in the 'Tabl. Céph.' or elsewhere.

It should be recollected that, in our continued critical examination of the works of earlier labourers in this particular field of research, we still have in view only the careful elaboration of the several groups of Foraminifera that are sufficiently distinct

* Histoire Physique, Politique, et Naturelle de l'île de Cuba, par Ramon de la Sagra. Paris, 1839, 4to. Foraminifères de Cuba et des Antilles, par M. d'Orbigny.

† Voyage dans l'Amérique Méridionale pendant les années 1826–33. Paris, 4to, 1834–42: vol. v. partie 5, Foraminifères. 1839.

‡ Histoire Naturelle des îles Canaries, par MM. P. Barker-Webb et Sabin Berthelot. Paris, 4to, 1835–50: vol. ii. partie 2. p. 123, Foraminifères, par M. d'Orbigny, 1839.

§ Sur les Foraminifères de la Craie blanche de Paris: Mémoires de la Soc. Géol. de France, vol. iv. p. 1. 1840, 4to, Paris.

‖ Foraminifères fossiles du Bassin Tertiaire de Vienne. Paris, 4to, 1846.

from other groups, as to their shell-tissue, the form and mode of growth of their shells, and their habits of life (as indicated by their habitats), to warrant our retaining for them "specific" names on zoological grounds. Having indicated these more or less exactly defined "species" (and, in many instances, their subspecies, varieties, and even subvarieties), we feel ourselves at liberty still to use, for convenience-sake, distinct binomial terms even for varieties of minor value in a zoological sense, because the whole tale of specific and subordinate denominations of not a few of the recognizable forms would be very cumbersome, and because even subvarietal forms are often characteristic of certain sea-zones and of certain fossil deposits, and therefore often the subjects of discussion.

I. *Species adopted by D'Orbigny in the 'Annales des Sc. Nat.' vii. (1826), from earlier Authors.*

1. Alveolina Boscii, *Defrance*, sp. Page 306, no. 5. Modèle no. 50. See Ann. Nat. Hist. ser. 3. viii. pp. 161, &c., for a notice of the *Alveolinæ*. This form was previously named *Miliolites sabulosus* by De Montfort.

2. Alveolina Melo, *Fichtel* & *Moll*, sp. Page 306, no. 2. Comprising the two varieties indicated by Fichtel & Moll. Ann. N. H. ser. 3. v. p. 181.

3. Biloculina lævis, *Defr.* sp. Page 298, no. 8. The same subvariety of *Miliola ringens* that D'Orbigny has named *B. bulloides*, Ann. Sc. N. vii. p. 297, no. 1. Modèle no. 90. A common Biloculine *Miliola*. Ann. N. H. ser. 2. ii. p. 299; ser. 3. v. p. 469; & xii. p. 216.

4. Biloculina ringens, *Lamarck*, sp. Page 276, no. 2. A common *Miliola*. Ann. N. H. ser. 3. v. p. 469.

5. Calcarina Spengleri, *Gmelin*, sp. Page 276, no. 4. *Calcarina* is so closely allied to *Rotalia* that at first we thought the former to be subordinate to the latter (Ann. N. H. ser. 3. iii. p. 481); but we now regard *Calcarina* as of equal value with *Rotalia*. (Carpenter's 'Introd. Foram.' p. 223.) Among the synonyms of this species, D'Orbigny has "*Tinoporus baculatus*, Montf.;" this, however, according to Montfort's figure, has more of *Orbitolina* than of *Calcarina* in it; and Dr. Carpenter proposes to use the term "Tinoporus" instead of "Orbitolina" (Introd. Foram. p. 224).

6. Cristellaria [acut-]auricularis, *Fichtel* & *Moll*, sp. Page 292, no. 23. A subglobose *Cristellaria*. See Ann. N. H. ser. 3. v. p. 114.

7. Cristellaria Cassis, *F.&M.* sp. Page 290, no. 3. Modèles nos. 44 & 83. A more or less discoidal and foliaceous *Cris-*

tellaria, often of large size and elegant shape. Ann. N. H. ser. 3. v. p. 115.

8. Cristellaria Galea, *F.* & *M.* sp. Page 291, no. 6. An extremely outspread, flat *Cristellaria.* Ann. N. H. ser. 3. v. p. 115.

9. Cristellaria (Saracenaria) Italica, *Defrance,* sp. Page 293, no. 26. Modèles nos. 19 & 85. This is a trihedral *Cristellaria.* D'Orbigny regarded *Saracenaria* as of subgeneric value only. Ann. N. H. ser. 3. xii. p. 217.

10. Fabularia Discolithus, *Defrance.* Page 307, no. 1, pl. 17. f. 14–17. Modèle no. 100. This form was previously named by De Roissy *Nummulites ovata.* Ann. N. H. ser. 3. xii. p. 204.

11. Frondicularia complanata, *Defr.* Page 256, no. 5. For remarks on this subspecies, see Ann. N. H. ser. 3. xii. p. 204.

12. Marginulina Raphanus, *Linn.* sp. Page 258, no. 1, pl. 10. f. 7, 8. Modèle no. 6. This is a variety of *Nodosaria Raphanus,* Linn. sp., in which the septal aperture is excentric, and the early chambers arranged on a curved instead of a straight line; the shell, too, is more or less compressed, and the septal floors more or less oblique. In all these points the degrees of modification are gentle and indefinite, insensibly leading *Nodosaria* into Marginuline, Vaginuline, Planularian, and Cristellarian varieties,—all being members of the generic group (*Nodosarina*) of which *Nodosaria Raphanus* is a leading member. Ann. N. H. 1859, iii. p. 477, & 1863, xii. p. 213. The slightly Marginuline modification of *N. Raphanus,* having plain indications of all the chief characters found in the various members of the group, presents the best type of *Nodosarina,* as it has the rectilinear plan of *Nodosaria* combined (in the early chambers) with the curvature of *Cristellaria*: it has also a tendency to compression, and a variable eccentricity of the stolon-tube, and shows the characteristic costation of the genus.

13. Nodosaria Bacillum, *Defr.* Page 254, no. 34. This is *N. Raphanistrum,* Linn. sp.; the full development of symmetrical Nodosarian rectilinear growth. Ann. N. H. ser. 3. iii. p. 478.

14. Nodosaria costata, *Montagu,* sp. Page 253, no. 23. The same as *N. Raphanus*: probably from the London Clay. Ann. N. H. ser. 3. iv. p. 345.

15. Nodosaria (Dentalina) Scorpionus (Reophax Scorpiurus, *Montfort*). Page 255, no. 40. We have explained that this is *Lituola nautiloidea,* Lam., var. *Scorpiurus,* in Ann. N. H. ser. 3. vi. p. 346.

16. Nodosaria Fascia, *Linn.* sp. Page 253, no. 22. A variety of *N. Raphanus.*

Among the abundant and fine Foraminifera found in the sea-sand near Rimini, on the Adriatic, are some Nodosarians allied to the beautiful *Vaginulina Legumen,* Linn. sp., some smooth, some gently striated, that have the septal lines coated with exogenous shell-matter to a great extent, or, in other words, are intensely limbate. One specimen in particular, a smooth form intermediate to *D. communis*, D'Orb., and *Vaginulina Legumen*, has the clear exogenous septal bands of nearly equal width with the intervening portions of the chamber-walls. Soldani has figured such a limbate Dentaline *Nodosaria* (named *N. interrupta* by D'Orbigny, Ann. Sc. N. vii. p. 252, no. 11) in his 'Testaceogr.' vol. i. pt. 2. pl. 102. vas 236. fig. B, and described it, at page 96, as fossil near Sienna.

At Rimini there are also other Nodosarians that are nearly as strongly limbate as the above-mentioned, and which might be classed, some with *Nodosaria Raphanus*, Linn. sp., others with *Dentalina Acicula*, Lam. sp., and others with *D. communis*, D'Orb.; but it is to be noticed that, whenever a specimen of either of these three groups (to the first or second of which *Nodosaria Fascia*, Linn. sp., probably belongs) becomes strongly limbate, it is sure to be passing into *Vaginulina Legumen*.

17. Nodosaria (Orthocerina) Clavulus, *Lamarck*, sp. Page 255, no. 48. Modèle no. 2. This is *Valvulina triangularis*, D'Orb., var. *Clavulus*; the same as *Spirolina cylindracea*, var. *β* (*recta*), Lamarck, and *Nodosaria Clavulus*, Lam. Ann. N. H. ser. 3. v. p. 287 & p. 468.

Though the one species here mentioned does not belong to it, yet *Orthocerina* is kept as a genus, to which *Orthocerina quadrilatera*, D'Orb. (For. Cuba, pl. 1. f. 11, 12), *O. Murchisoni*, Reuss, sp. (Denkschr. Akad. Wien, vii. pl. 25. f. 1, 2), *O. anomala*, Reuss, sp. (Sitzungs. Akad. Wien, xl. pl. vii. f. 5), *O. Rœmeri*, Reuss, sp. (*ibid.* f. 6), and *O. globulifera*, Reuss, sp. (*ibid.* f. 7), belong. We regard the second of these as the type. See Carpenter's 'Introd. Foram.' p. 166.

18. Nodosaria Radicula, *Linn.* sp. Page 252, no. 3. Modèle no. 1. A simple form of *Nodosaria*. Ann. N. H. ser. 3. iii. p. 479.

19. Nodosaria spinulosa, *Montagu*, sp. Page 253, no. 15. A delicate, spiny, Dentaline variety of *N. Raphanus*, Linn. sp. From the London Clay. Ann. N. H. ser. 3. iv. p. 346.

20. Nonionina asterizans, *F.* & *M.* sp. Page 294, no. 22. A Nautiloid *Nonionina* with a radiating growth of exogenous shell-matter around the umbilicus. As it stands between the smooth forms and those with much astral limbation, we take it as the type of the Nonionine subgroup of the *Polystomella* genus. Ann. N. H. ser. 3. v. pp. 101, 103.

21. Nonionina Auricula, *F.* & *M.* sp. Page 295, no. 24. This is *Pulvinulina repanda*, F. & M. sp., var. *Auricula*. Ann. N. H. ser. 3. v. p. 176.

22. Nonionina crassula, *Walker* & *Jacob,* sp. Page 294, no. 7. A subvariety of *N. asterizans,* with sunken septal lines and rather open spire. Ann. N. H. ser. 3. iv. p. 339.

23. Nonionina Faba, *F.* & *M.* sp. Page 295, no. 23. An oblong form of *N. striatopunctata.* With this D'Orbigny associates Fichtel and Moll's *N. Scapha,* which, however, is the same as D'Orbigny's *N. communis,* Ann. Sc. Nat. vii. p. 294, no. 20, and For. Foss. Vien. pl. 5. f. 7, 8. Ann. N. H. ser. 3. v. p. 102.

24. Nonionina incrassata, *F.* & *M.* sp. Page 293, no. 6. An umbonate subvariety of *N. asterizans.* Ann. N. H. ser. 3. v. p. 101.

25. Nonionina pompilioides, *F.* & *M.* sp. Page 294, no. 15. A subglobose form of *N. asterizans.* Ann. N. H. ser. 3. v. p. 102.

26. Nonionina striatopunctata, *F.* & *M.* sp. Page 294, no. 21. This is a link between *Polystomella* proper and its feeble member *Nonionina.* Ann. N. H. ser. 3. v. p. 102.

27. Nummulina complanata, *Lamarck,* sp. Page 296, no. 3. This is a good representative of the "sinuate" group of *Nummulinæ*: it ranges from Western Europe into Africa and Asia, and is one of the largest known. Lamarck had his specimens from Soissons, apparently. This is the *Camerina nummularia* of Bruguière, 1792. Ann. N. H. ser. 3. v. p. 296, & viii. p. 234.

28. Nummulina lævigata, *Bruguière.* Page 295, no. 1. Typical of the "reticulate" *Nummulinæ,* and of wide range. Ann. N. H. ser. 3. v. p. 290, viii. p. 232.

29. Nummulina globularia, *Lamarck,* sp. Page 296, no. 2. A variety of *N. lævigata,* Brug. Ann. N. H. ser. 3. v. p. 296.

30. Nummulina lenticularis, *F.* & *M.* sp. Page 296, no. 5. This is the var. β of Fichtel and Moll's "Nautilus lenticularis," and is regarded by D'Archiac and Haime as the same as *Nummulina Lucasana,* Defrance, sp. Ann. N. H. ser. 3. v. pp. 108, 110.

31. Nummulina perforata, *Montfort,* sp. Page 296, no. 7. "Nautilus lenticularis," var. ϵ, of Fichtel and Moll. The adult *N. perforata* is the same as *N. obtusa,* Sow., and is a good type of the "sinuate" Nummulites, and probably of the *Nummulinæ* generally. Ann. N. H. ser. 3. v. p. 108, & vi. p. 342.

32. Nummulina planulata, *Lamarck,* sp. Page 296, no. 4. Modèle no. 87, young specimen. A type of the "radiate" or "sinuo-radiate" group of *Nummulinæ.* Ann. N. H. ser. 3. v. p. 295.

33. Nummulina radiata ?, *Montfort,* sp. Page 296, no. 6. "Nautilus lenticularis, var. δ," of Fichtel and Moll: regarded by D'Archiac and Haime as the same as *N. Biaritzensis,* D'Arch. Ann. N. H. ser. 3. v. p. 111, & vi. p. 342.

34. Nummulina rotulata, *Lamarck,* sp. Page 296, no. 8. This is *Cristellaria rotulata,* Lam. sp. Ann. N. H. ser. 3. v. p. 296. D'Orbigny correctly placed this form under *Cristellaria* in his memoir on the Foraminifera of the White Chalk of Paris (Mém. Soc. Géol. France, 1840, iv. p. 26).

35. Orbiculina numismalis, *Lamarck.* Page 305, no. 1, pl. 17. f. 8–10. Modèle no. 20. This is *Orbiculina adunca,* F. & M. sp., including its modifications or varieties *angulata* and *Orbiculus.* Ann. N. H. ser. 3. v. p. 181.

36. Operculina complanata, *Defrance,* sp. (Erroneously referred to "Basterot" by D'Orbigny.) Page 281, no. 1, pl. 14. f. 7–10. Modèle no. 80. The history of *Operculina* and its relationship to *Nummulina* are treated of in Ann. N. H. ser. 3. viii. p. 229. See also Carpenter's 'Introd. Foram.' p. 247.

37. Peneroplis opercularis, *Lamarck,* sp. Page 286, no. 6. *Renulites* of Lamarck; misplaced in *Peneroplis* by D'Orbigny; and really a peculiar modification of *Vertebralina.* In Annals N. H. ser. 3. v. p. 471, we treated of it as *V. striata,* D'Orb., var. *opercularis.* See also Carpenter's 'Introd. Foram.' p. 74, pl. 5. f. 18.

38. Peneroplis planatus, *F.* & *M.* sp. Page 285, no. 1. Modèles nos. 16 & 48. Ann. N. H. ser. 3. v. p. 179; and Carpenter's 'Introd. Foram.' p. 84.

39. Planularia Auris, *Defrance.* Page 260, no. 5. Ann. N. H. ser. 3. xii. p. 215. *Planularia* is a noticeable member of the Cristellarian subgroup; and, for convenience-sake, several of the Planularian forms are recorded binomially. The form under notice may, however, be regarded as a very thin outspread variety of *Cristellaria Cymba,* D'Orb.

40. Planularia Crepidula, *F.* & *M.* sp. Page 260, no. 6. Ann. N. H. ser. 3. v. p. 114. Though really only a delicate, elongate, flattened *Cristellaria,* yet, like some others of the group, this pretty form enjoys a special name, for the convenience of collectors and others.

41. Polystomella ambigua, *F.* & *M.* sp. Page 285, no. 10. A flattish and crenulate variety of *P. crispa.* Ann. N. H. ser. 3. v. p. 103.

42. Polystomella craticulata, *F.* & *M.* sp. Page 284, no. 3. See Ann. N. H. ser. 3. v. p. 105, and Carpenter's 'Introd. Foram.' p. 279, for an account of this very thick, largely umbonate, and frequently gigantic *Polystomella.*

43. Polystomella crispa, *Linn.* sp. Page 283, no. 1. Modèle no. 45. Ann. N. H. ser. 3. v. p. 105, and Carpenter's 'Introd. Foram.' p. 278.

44. Polystomella strigillata, *F.* & *M.* sp. Page 284, no. 4. With Fichtel and Moll's two varieties of *P. strigillata,* D'Or-

bigny here unites their two varieties of *P. macella*. These are all more or less compressed forms of *P. crispa*. Ann. N. H. ser. 3. v. p. 105.

45. Quinqueloculina birostris, *Lamarck*, sp. Page 301, no. 2. A feeble variety of *Miliola* (*Saxorum* ?). Ann. N. H. ser. 3. v. p. 471.

46. Quinqueloculina Saxorum, *Lamarck*, sp. Page 301, no. 1, pl. 16. f. 10–14. Modèle no. 33. A peculiar *Miliola*, a link with the subgroup *Hauerina*. Ann. N. H. ser. 3. v. p. 470.

47. Quinqueloculina Seminulum, *Linn.* sp. Page 303, no. 44. The typical *Miliola*. Ann. N. H. ser. iii. p. 480.

48. Quinqueloculina subrotunda, *Montagu*, sp. Page 302, no. 36. A feeble variety of *Miliola Seminulum*, Linn. sp. Ann. N. H. ser. 3. iv. pp. 336, 344.

49. Robulina Calcar, *Linn.* sp. Page 289, no. 12. *Robulina* is the same as *Cristellaria* with a triangular aperture—an unimportant variable feature. *C. Calcar* is a well-developed symmetrical form, with a more or less dentate keel, and typifies the Cristellarian subgroup of the genus *Nodosarina*. Ann. N. H. ser. 3. iii. p. 476; v. p. 112; & vi. p. 343.

50. Robulina costata, *F.* & *M.* sp. Page 289, no. 13. An important subvariety of *Cristellaria Calcar*. Ann. N. H. ser. 3. iii. p. 113.

51. Robulina cultrata, *Montf.* sp. Page 287, no. 1. Modèle no. 82. This is one of the most common of the whole-keeled varieties of the Nautiloid *Cristellariæ*: it often has a triangular aperture; but this is a feature of extreme variability, and insufficient for the differentiation of *Robulina* from *Cristellaria*. The keel itself, also, is a variable feature, sometimes reduced to a minimum. Ann. N. H. ser. 3. v. p. 112; & vi. p. 343.

52. Robulina Vortex, *F.* & *M.* sp. Page 288, no. 4. *Cristellaria Vortex* (Ann. N. H. ser. 3. v. p. 113): its chambers are very narrow and much curved.

53. Rotalia trochidiformis, *Lamarck*. Page 272, no. 1. This is *Discorbina Turbo*, D'Orb. sp., var. *trochidiformis*. See Ann. N. H. ser. 3. v. p. 294; and Carpenter's 'Introd. Foram.' p. 204.

54. Rotalia (Turbinulina) Beccarii, *Linn.* sp. Page 275, no. 42. Modèle no. 74. The common *Rotalia Beccarii*, Linn. sp. This is the same as D'Orbigny's *Turbinulina tortuosa* (*loc. cit.* no. 40), for which name he erroneously quotes Fischer as the authority. G. Fischer de Waldheim, in the 'Mém. Soc. Nat. Moscou,' 1817, vol. v. p. 449, pl. 13. f. 5 *a, b*, and in his 'Adversaria Zoologica'*, p. 75, amongst his "Cephalopoda conchylifera," has "Streblus (à στρεβλὸς, *tortuosus*), tab. 13 [pl. iii.]. fig. 5, *a b*," and pro-

* Fasc. I. et II. (Ex parte ex Actis Soc. Nat. Scrut. extractus.) Cum vii. tabulis æneis. Mosquæ, 1819.

ceeds to note that it comes from the Mediterranean, and is known to many authors, referring to the figures and descriptions given by Gualtieri, Linné, Gmelin, and Martini of *Ammonia* (*Nautilus*) *Beccarii.* Fischer therefore proposed a new generic name only, not a specific name, for this *Rotalia,* which was Linné's *Nautilus Beccarii* in 1758, and Lamarck's *Rotalia Discorbula* in 1804.

55. Siderolina calcitrapoides, *Lamarck,* sp. Page 297, no. 1. Essentially the same as *Calcarina Spengleri,* Gmelin, sp. Prof. Reuss prefers to keep these apart (Sitzungsber. Akad. Wien, 1861, xliv. p. 315). Ann. N. H. ser. 3. v. p. 65, & vi. p. 341. See also *Calcarina Spengleri,* above.

56. Spirolina cylindracea, *Lamarck.* Page 286, no. 1. Modèle no. 24. This is a very narrow *Peneroplis planatus,* F. & M. sp. Ann. N. H. ser. 3. v. p. 466.

57. Spirolina depressa, *Lamarck.* Page 287, no. 3. The same as *Peneroplis planatus,* F. &. M. sp. Ann. N. H. ser. 3. v. p. 466.

58. Spirolina nautiloides, *Lamarck.* Page 287, no. 6. This is very distinct from the other "Spirolinæ" (*Peneroplides*) ; it is a *Lituola* (*L. nautiloidea,* Lam.), as is also *Spirolina agglutinans,* D'Orb. For. Foss. Vien. p. 137, pl. 7. figs. 10–12. The misplacement of this species as a "Spirolina" was corrected by Defrance. See also Ann. N. H. ser. 2. xix. p. 301 ; & ser. 3. v. p. 297.

59. Textularia Sagittula, *Defrance.* Page 263, no. 20. According to our view of the relationships of the *Textulariæ,* this is *T. agglutinans,* D'Orb., var. *Sagittula.* Ann. N. H. ser. 3. xii. p. 218.

60. Triloculina oblonga, *Montagu,* sp. Page 300, no. 16. Modèle no. 95. A very common modification of *Miliola Seminulum* ; often it is rather a contracted ill-grown *Quinqueloculina* than a true *Triloculina.* Ann. N. H. ser. 3. iv. p. 343.

61. Triloculina trigonula, *Lamarck,* sp. Page 299, no. 1, pl. 16. f. 5–9. Modèle no 93. Ann. N. H. ser. 3. v. p. 470.

62. Truncatulina refulgens, *Montfort,* sp. Page 279, no. 5, pl. 13. f. 8–11. Modèle no. 77. We have given some particulars of this interesting variety of *Planorbulina farcta,* F. & M., in Ann. N. H. ser. 3. vi. p. 340.

63. Vaginulina Legumen, *Linn.* sp. Page 257, no. 2. See Ann. N. H. ser. 3. iii. p. 479.

I*. *The following Forms, already illustrated by Figures given by older authors (not including Soldani), received names from D'Orbigny, in the 'Annales des Sc. Nat.'* vii. 1826.

1. Alveolina oblonga. Page 306, no. 4. Fossil at Soissons.

This was figured by Parkinson (Org. Rem. 1811, pl. 10. f. 28–31). It is one of the elongate-oval varieties (such as *A. ovoïdea,* D'Orb. Ann. Sc. N. vii. p. 306, no. 3) of *A. Melo,* F. & M. sp. Ann. N. H. ser. 3. viii. p. 165.

2. Nodosaria Rapa. Page 253, no. 27. Wrongly referred to by D'Orbigny as a Lamarckian species. D'Orbigny applied this term to the straight form of *N. Raphanus,* Linn. sp., and indicated its Marginuline condition by the name of *Marginulina Raphanus,* Ann. Sc. N. vii. p. 258, no. 1. See Ann. N. H. ser. 3. xii. p. 213, and above, p. 432.

3. Robulina aculeata. Page 289, no. 14. Under this name D'Orbigny grouped some more or less rowelled forms of *Cristellaria Calcar**, Linn. sp., figured by Fichtel and Moll,—namely, their *Nautilus Calcar,* Linn., var. *a* (pl. 11. f. *a–c*), keeled and rowelled (the type of this subspecies); var. θ (pl. 12. f. *i, k*), keelless, slightly rowelled; var. κ (pl. 13. f. *c, d*), keel slight, with some teeth (a specimen of *C. Calcar* developed but faintly in its several features); and var. μ (pl. 13. f. *h, i*), sharply rowelled. See Ann. N. H. ser. 3. v. p. 112.

4. Rotalia (Turbinulina) tortuosa. Page 275, no. 40. Modèle no. 74. For this name D'Orbigny erroneously quotes Fischer (who gives a figure of it under the name of *Streblus Beccarii*) as the authority. See above, "Rotalia (Turbinulina) Beccarii," p. 436.

II. *Species of Foraminifera illustrated by D'Orbigny in the Plates* 10–17 *of the 'Annales des Sc. Nat.'* vol. vii. 1826.

1. Amphistegina Lessonii, D'Orb. Ann. Sc. N. vii. p. 304, no. 3, pl. 17. f. 1–4. Modèle no. 98. From the Isle of France. This differs from *A. vulgaris,* D'Orb., *ibid.* p. 305, no. 8, Modèle no. 40, in an exaggerated convexity of its faces; and although it stands before *A. vulgaris* in the 'Tabl. Méth.', yet the latter, being foremost in the Models, and being the better type, may well take precedence and bear the specific name. In 1825, Defrance noticed an *Amphistegina* (fossil near Pisa and elsewhere) as *Nummulites* ? *Lenticula,* which is not essentially distinct from *A. vulgaris,* D'Orb. (Ann. N. H. ser. 3. xii. p. 211). For a full account of *Amphistegina,* see Carpenter's 'Introd. Foram.' p. 241, &c.

2. Anomalina punctulata, *D'Orb.* Ann. des Sc. Nat. vii. p. 282, no. 1, pl. 15. f. 1–3 *bis.* From the Isle of France. With some exceptions, D'Orbigny's *Anomalinæ* are somewhat biconvex Truncatuline *Planorbulinæ* (*Truncatulina* being a term useful in indicating the arrested, few-chambered thickish plano-convex mem-

* D'Orbigny refers *C. Calcar,* Linn. sp., to *C. Cassis,* F. & M. sp. (Ann. Sc. N. vii. p. 291) as well as to *Robulina Calcar,* Linn. sp. (*op. cit.* p. 289).

bers of the Planorbuline genus), and *A. punctulata* is one of these subsymmetrical, bun-shaped arrested varieties of *Planorbulina farcta*, F. & M. sp. See Carpenter's 'Introd. Foram.' p. 208.

3. Bigenerina Nodosaria, *D'Orb.* Ann. Sc. N. vii. p. 261, no. 1, pl. 11. f. 9–12. Modèle no. 57. From the Adriatic. A dimorphous *Textularia.* Ann. N. H. ser. 3. xi. p. 97.

4. Biloculina bulloides, *D'Orb.* Ann. Sc. N. vii. p. 297, no. 1, pl. 16. f. 1–4. Modèle no. 90. From the Adriatic; and fossil near Paris and Bordeaux. The same as *B. lævis*, Defrance, sp. A *Miliola.*

5. Bulimina marginata, *D'Orb.* Ann. Sc. N. vii. p. 269, no. 4, pl. 12. f. 10–12. From the Adriatic. This is one of the Bulimine varieties that have sharp edges to the chambers, sometimes produced into prickles (as in *B. aculeata*, D'Orb. Ann. Sc. N. vii. p. 269, no. 7). The best type of *Bulimina* is the form figured and described by Reuss as *B. Preslii*, Verst. Böhm. Kreid. 1846, pl. 13, f. 72.

6. Calcarina Defrancii, *D'Orb.* Ann. Sc. N. vii. p. 276, no. 3, pl. 13. f. 5–7 *bis.* From the Red Sea. This is a variety of *C. Spengleri.* Ann. N. H. ser. 3. iii. p. 481.

7. Cassidulina lævigata, *D'Orb.* Ann. Sc. N. vii. p. 282, no. 1, pl. 15. f. 4, 5 *bis.* Modèle no. 41. From a ballast-sand. See Carpenter's 'Introd. Foram.' p. 197.

8. Clavulina angularis, *D'Orb.* Ann. Sc. N. vii. p. 268, no. 2, pl. 12. f. 7. From the coast of Corsica. A dimorphous modification of *Valvulina triangularis*, D'Orb. It is the same as *Clavulina tricarinata*, D'Orb. For. Cuba, pl. 2. f. 16–18; and shows more triserial chambers in its first-formed portion than *Valvulina triangularis*, var. *Clavulus*, does. Ann. N. H. ser. 3. v. pp. 467–8.

9. Dendritina Arbuscula, *D'Orb.* Ann. Sc. N. vii. p. 285, no. 1, pl. 15. f. 6, 7 *bis.* Modèle no. 21. Fossil from Bordeaux. This arrested Nautiloid form of *Peneroplis planatus*, F. & M. sp., is not uncommon in warm seas. See Carpenter's 'Introd. Foram.' p. 89.

10. Fabularia Discolithus, *Defrance*, Ann. Sc. N. viii. p. 307, no. 1, pl. 17. f. 14–17. Modèle no. 100. See above, p. 432.

11. Marginulina Raphanus, *D'Orb.* Ann. Sc. N. vii. p. 258, no. 1, pl. 10. f. 7, 8. Modèle no. 6. Marginuline condition of *N. Raphanus*, Linn. sp. From the Adriatic, and fossil at Castel-Arquato, Italy. See above, p. 432.

12. Nodosaria (Glandulina) lævigata, *D'Orb.* Ann. Sc. N. vii. p. 252, no. 1, pl. 10. f. 1–3. A short, acute-oval, smooth *Nodosaria*, from the Adriatic, and found fossil at Sienna. It is abundant also in the Lias and other strata, and is not rare in various parts of the existing seas.

13. Nodosaria lamellosa, *D'Orb.* Ann. Sc. N. vii. p. 253, no. 17, pl. 10. f. 4–6. From the Adriatic. A neat sharp-ribbed *N. Raphanus,* Linn. sp.

14. Nonionina umbilicata, D'Orb. Ann. Sc. N. vii. p. 293, no. 5, pl. 15. f. 10–12. Modèle no. 86. From the Adriatic and Mediterranean, and fossil at Bordeaux and Sienna. A variety of *N. asterizans,* F. & M. sp., closely related to *N. pompilioides,* F. & M. sp., *N. Soldanii,* D'Orb., and several other modifications of the Nonionine subtype of the genus *Polystomella.* See Ann. N. H. ser. 3. v. pp. 101 *et seq.*

15. Operculina complanata, *Defrance,* sp. Ann. Sc. N. vii. p. 281, no. 1, pl. 14. f. 7–10. Modèle no. 80. See above, p. 435.

16. Pavonia flabelliformis, *D'Orb.* Ann. Sc. N. vii. p. 260, no. 1, pl. 10. f. 10–12. From Madagascar. We do not know this Foraminifer; possibly it is a symmetrical *Peneroplis;* more probably a semidiscoidal modification of *Orbitolites.*

17. Planorbulina Mediterranensis, *D'Orb.* Ann. Sc. N. vii. p. 280, no. 2, pl. 14. f. 4–6 *bis.* Modèle no. 79. From the Mediterranean; parasitic. A delicate scale-like variety of *Pl. farcta,* F. & M. sp., having *Pl. nitida,* D'Orb., between it and the type; whilst *Pl. vulgaris,* D'Orb., stands next beyond it in divergence from *Pl. farcta.* Ann. N. H. ser. 3. v. p. 178.

18. Planularia Cymba, *D'Orb.* Ann. Sc. N. vii. p. 260, no. 4, pl. 10. f. 9. Modèle no. 27. A flattened, elongate, ribbed Cristellarian form, of variable width, standing between *Vaginulina* and *Cristellaria* proper. See above, p. 435.

19. Planulina Ariminensis, *D'Orb.* Ann. Sc. N. vii. p. 280, no. 1, pl. 14. f. 1–3 *bis.* Modèle no. 49. From the Adriatic. This is a flattened, limbate, and subsymmetrical variety of *Planorbulina farcta,* F. & M. sp. Ann. N. H. ser. 3. v. p. 178.

20. Polymorphina (Guttulina) communis, *D'Orb.* Ann. Sc. N. vii. p. 266, no. 15, pl. 12. f. 1–4. Modèle no. 62. From the Adriatic Sea; and fossil in the Tertiary beds of Paris, Bordeaux, and Castel-Arquato. A well-developed form of *P. lactea,* Walker & Jacob, sp., which has interminable degrees of size and shape.

21. Polymorphina (Pyrulina) Gutta, *D'Orb.* Ann. Sc. N. vii. p. 267, no. 28, pl. 12. f. 5, 6. Modèle no. 30. Fossil at Castel-Arquato. An elongate form, with the chambers more closely packed than in the common *P. lactea,* W. & J. sp.

22. Quinqueloculina Saxorum, *Lamarck,* sp. Ann. Sc. N. vii. p. 301, no. 1, pl. 16. f. 10–14. Modèle no. 33. Fossil near Paris. A *Miliola.* See above, p. 436.

23. Robulina orbicularis, *D'Orb.* Ann. Sc. N. vii. p. 288, no. 2, pl. 15. f. 8, 9 *bis.* Fossil near Sienna. A *Cristellaria*

nearly identical with *C. Vortex,* F. & M. sp. Ann. N. H. ser. 3. v. p. 113.

24. Rosalina globularis, *D'Orb.* Ann. Sc. N. vii. p. 271, no. 1, pl. 13. f. 1–4. Modèle no. 69. Widely distributed, fixed to seaweeds and corals. This is a variety of *Discorbina Turbo,* D'Orb. sp. Prof. Williamson figures it in his 'Monograph Brit. Rec. Foram.' pl. 4. f. 104, 105, as "*Rotalina concamerata,* young," and refers (p. 52) D'Orbigny's *Rosalina globularis* to *R. concamerata,* Montagu, sp.; but we believe that Montagu's *Serpula concamerata* is a variety of *Planorbulina farcta,* and that Williamson's adult *R. concamerata* (f. 101–103) is *Pulvinulina repanda.*

25. Textularia aciculata, *D'Orb.* Ann. Sc. N. vii. p. 263, no. 15, pl. 11. f. 1–4. From the Adriatic. The same as *T. pygmæa,* D'Orb., *ibid.* p. 263, no. 13; and Modèle no. 7.

26. Triloculina trigonula, *Lamarck,* sp. Ann. Sc. N. vii. p. 299, no. 1, pl. 16. f. 5–9. Modèle no. 93. Fossil near Paris, Soissons, and Valognes. A *Miliola* of not uncommon occurrence.

27. Truncatulina refulgens, *Montfort,* sp. Ann. Sc. N. vii. p. 279, no. 5, pl. 13. f. 8–11. Modèle no. 77. This is *Planorbulina farcta,* F. & M. sp., var. *refulgens.* See above, p. 437.

28. Uvigerina pygmæa, *D'Orb.* Ann. Sc. N. vii. p. 269, no. 2, pl. 12. f. 8, 9. Modèle no. 67. Fossil near Sienna. The typical form of *Uvigerina*: its home may be said to be at about 100–300 fathoms in warm seas; smaller individuals are abundant in shallower as well as in deeper water: the ribbed shells, as here figured, are more abundant in shallow than in abyssal water.

29. Vulvulina Capreolus, *D'Orb.* Ann. Sc. N. vii. p. 264, no. 1, pl. 11. f. 5–8. Modèle no. 57. From the Adriatic. A Textularian form. Ann. N. H. ser. 3. xi. p. 93, &c.

XLV.—*On new Species of Fishes from the Essequibo.* By Dr. Albert Günther.

A collection of freshwater fishes made in Guiana by Mr. Ehrhardt for the British Museum contained so many duplicate specimens, that probably a portion of them will reach other collections before the part of the 'Catalogue of Fishes' containing their descriptions will be published; therefore I add diagnoses to the names under which the new species are deposited in the British Museum, referring for detailed descriptions to the forthcoming parts of that work.

Acara punctulata.

D. $\frac{16}{9}$. A. $\frac{3}{8}$. L. lat. 26. L. transv. 3/8.

Three series of scales on the cheek. The height of the body is two-fifths of the total length (without caudal), the length of the head two-sevenths; the greatest width of the head is two-fifths of its length. The spinous dorsal fin is rather elevated, the length of the posterior spines being somewhat more than one-half of that of the head. Young specimens have the middle soft rays of the dorsal and anal produced into a filament. Yellowish brown, each scale with a brown central dot and brown margin; a blackish band along the middle of the side, continued on the caudal fin, where it encloses numerous round white spots; no black spot on the tail. Upper side of the head with numerous brown dots; a blackish, white-edged band between the eye and the cleft of the mouth; another blackish band descends from the eye to the angle of the præoperculum, and is more distinct in young examples than in old ones; an orange-coloured spot behind the eve. Dorsal fin blackish, with numerous small whitish spots.

The largest specimen is 4 inches long.

Pimelodus holomelas.

D. 1/6. A. 9–10. P. 1/8. V. 6.

Head covered with skin above; occipital process triangular, considerably longer than broad, not reaching the basal bone of the dorsal spine. Adipous fin very long, its length being contained twice and a fourth or twice and a fifth in the total (without caudal); it commences at a short distance from the dorsal. Maxillary barbels extending beyond the commencement or to the middle of the adipous fin, the outer ones of the mandible to the middle of the pectoral.

The height of the body is contained five times and a half or five times and two-thirds in the total length (without caudal), the length of the head four times. The lower jaw is distinctly shorter than the upper; the band of intermaxillary teeth is seven times as broad as long. The diameter of the eye is one-half of the width of the interorbital space. No porus axillaris. Dorsal fin with the spine very feeble, scarcely higher than long. Pectoral spine serrated along both edges, as long as the head without snout. Caudal fin cleft to the base. Uniform black, with a brownish shade, somewhat lighter on the belly.

Auchenipterus obscurus.

D. 1/5. A. 19–20. P. 7–8. V. 9.

The bones of the head and neck are rather coarsely granulated; a small, round groove between the frontals, surrounded by bone. Lower jaw rather longer than the upper; the maxillary and the hinder mandibulary barbels extend to, or somewhat beyond, the extremity of the humeral process; the anterior mandibulary barbels are twice or thrice as long as the eye. The numeral process extends backwards beyond the middle of the pectoral spine. Dorsal and pectoral spines serrated, the former along its anterior edge, the latter along both edges; the dorsal spine is considerably shorter than that of the pectoral fin, the latter being as long as the head, and one-fourth of the total length (without caudal). Caudal fin slightly emarginate, the upper lobe being scarcely longer than the lower. Lateral line irregularly undulated. Uniform brownish black.

Helogenes (Siluridæ).

Adipous fin very small; dorsal fin very short, without pungent spine, inserted behind the ventrals; anal very long. The upper jaw is a little longer than the lower. Barbels six. A band of small teeth in the jaws, and two patches on the vomer. No dermal bones. Eye very small, covered over by the skin. Gill-openings very wide, the gill-membranes being entirely separate. Pectorals without pungent spine; ventrals six-rayed.

Helogenes marmoratus.

B. 13. D. 5. A. 42. P. 8. V. 6.

Only three inches and a half long.

Crenuchus (Characinidæ).

Adipous fin none; dorsal fin of moderate length, above the ventrals; anal short; scales of moderate size; abdomen rounded; head and body rather compressed, of moderate length. Intermaxillary and mandible with a single series of tricuspid teeth; maxillary and palate without teeth; canine teeth none. Mouth of moderate width.

Crenuchus spilurus.

D. 17. A. 11. V. 8. L. lat. 30.

Dorsal and anal rays somewhat prolonged; a round, black spot near the root of the caudal fin.

Leporinus megalepis.

D. 12. A. 12. L. lat. 33. L. trans. 5/5.

Body with large blackish spots, arranged in two or three series; fins red.

Xiphorhamphus ferox.

D. 11. A. 25–26. V. 8. L. lat. 95.

A large blackish blotch on the shoulder; the inner caudal rays red, with a black spot in the middle.

XLVI.—*On the Fossil Red Deer of Ireland: Observations founded on the Skeletons found at Bohoe, in the County Fermanagh, in* 1863. By the Rev. SAMUEL HAUGHTON, M.D., Fellow of Trinity College, Dublin.

DURING the spring of the present year, in the drainage of a small lake near Bohoe, in Fermanagh, a number of bones of Red Deer, with those of some other animals, were discovered in the sludge that underlay the bog through which the drainage operations were being carried on. These bones were secured by the Rev. William Steele of Portora, and were by him presented to the Geological Museum of Trinity College.

The following list contains an enumeration of the bones found:—

Red Deer.

2 lower jaws.
2 heads, with antlers. } Five individuals.
2 heads without horns, and 1 fragment of upper jaw.
3 atlantes.
3 axes.
15 other cervical vertebræ.
66 dorsal and lumbar vertebræ.
4 sacra.
4 pelves.
91 ribs.
6 scapulæ; 3 right and 3 left.
9 humeri; 5 right and 4 left.
8 radii and ulnæ; 4 right and 4 left.
8 femora; 4 right and 4 left.
10 fibulæ and tibiæ; 6 right and 4 left. (Six individuals).
6 metatarsal bones.
8 metacarpal bones.
7 sternal bones.
3 ossa calcis.
6 phalanges and 2 hoofs.
18 small tarsal and carpal bones.
25 fragments of other bones.

In addition to these bones, which were all those of the fossil Red Deer, there were found the following:—

1 right humerus of a young pig.
1 left femur of a calf (?).

These fossils were all found in marl underlying bog, in the same situation, geologically speaking, as that in which the *Cervus megaceros* has been always found in Ireland.

One of the ribs had been broken and repaired during life, with the production of bony spiculæ, which must have caused the unfortunate brute much pleurodynia during the process of healing.

I was fortunate enough to be able to demonstrate the existence, among these bones, of two complete spinal columns, from an examination of which it became evident that the fossil Red Deer of Fermanagh had 14 ribs; so that its vertebræ, as compared with the living Red Deer, are as follows :—

Fossil Red Deer.	*Recent Red Deer.*
7 cervical.	7 cervical.
14 dorsal.	13 dorsal.
5 lumbar.	6 lumbar.
26	26

On examining the teeth, I found the posterior molars trilobate, while those of the recent Red Deer are, at least sometimes, only bilobate; however, on examining for me an excellent skeleton of the recent Red Deer preserved in the Museum of the Royal Dublin Society, Dr. A. Carte found the posterior molar of one side bilobate, and that of the other side trilobate—thus demonstrating the trivial character of the lobation of the molars. Two of the tarsal bones, also, were soldered together in both legs, while they are separate in the recent Red Deer; but upon this character I am not disposed to lay much stress, as it frequently occurs in the *Cervus megaceros,* and is probably the result either of old age or of rheumatic disease of the ankle-joint.

It will be observed, from the list of bones, that six individuals, at least, contributed their remains to the "find" of the Bohoe bones.

These bones are considerably larger than those of the only two skeletons of Red Deer to which I have had access, and are also larger than the corresponding bones of the fossil Reindeer in the Royal Dublin Society's Museum. This fact and the presence, in two specimens, of 14 instead of 13 dorsal vertebræ indicate a considerable difference between the fossil Red Deer of Ireland and the existing Red Deer, and may justify the name by which the fossil Red Deer is known in many parts of Ireland —viz. *the Marsh Deer,* which is considered to be like, but not the same as, the Red Deer.

The restored skeletons of the Fermanagh Red Deer are preserved in the Museums of Trinity College and of the Royal Dublin Society, and are well worthy of the examination of anatomists.

I believe that we are entitled to consider our fossil Red Deer as a well-marked variety, and would propose for it the provisional name of *Cervus elaphus,* var. *fossilis Hibernica.*

In addition to the bones described above, the skull of a pig was found; and the animal to which it had belonged had evidently been killed by a blow on the forehead, that had broken the skull. This circumstance shows that the bones of the Red Deer, Pig, &c., belong to the human, and probably historical, period, to which also, I believe, in common with Irish antiquarians, the remains of the *Cervus megaceros* belong.

XLVII.—*Observations on Raphides and Sphæraphides.* By George Gulliver, F.R.S.

[Continued from p. 367.]

Balsaminaceæ.—We have already incidentally mentioned this as a raphis-bearing order (Annals, Sept. 1863), and will now compare it with its relations. In our Flora they stand thus:—

Linaceæ. Geraniaceæ.	Balsaminaceæ.	Oxalidaceæ. Celastraceæ.

And Balsaminaceæ is not more plainly isolated and distinguished here in print than in the type of nature as a raphidiferous order. All the plants belonging to it which I have examined (to wit, *Impatiens glandulifera,* two other exotic species, and numerous varieties of the common greenhouse Balsam) abound in raphides, while the other orders, allies of Balsaminaceæ, are not so characterized.

But these other orders afford, in the leaves and other parts, sphæraphides instead, and sometimes so beautifully in the form of sphæraphid-tissue as to exhibit a better example of it than that depicted in *Lythrum salicaria* (Annals, Sept. 1863). In the sepals of *Geranium striatum* and *G. sanguineum,* for instance, this is very remarkable—a tissue of cells, each cell containing a distinct nucleus of sphæraphides. Doubtless John Quekett saw the same thing as an isolated fact in this genus (Lindley's Elem. Bot. 1849, p. 17). The leaves and other parts of Oxalidaceæ abound in sphæraphides, like those of Polygonaceæ.

How completely such functions of plant-life are dependent on the species itself, rather than either on the soil, food, or situation, is as well shown by these examples as by those formerly described in Onagraceæ and Lythraceæ, and in the different species of *Lemna.* The two Geraniums above-named and Balsams have been growing close together in my garden, and yet each plant always afforded its peculiar crystals—constantly sphæraphides in the first- and as constantly raphides in the last-named plants.

In short, this is not merely an incidental or artificial distinction, but a regular and natural difference—by no means a trivial or minor fact, but a central and comprehensive phenomenon.

And we have seen how well the same remarks are applicable to such raphis-bearing orders as Rubiaceæ and Onagraceæ.

Haloragaceæ.—In the stem of *Myriophyllum* many sphæraphides occur. They are about $\frac{1}{1200}$th of an inch in diameter, remarkably distinct, globular, and with sharp angular asperities on the surface, formed by the individual crystals. The sphæraphides are most abundant on the surface of the medullary rays, as admirably figured, about a quarter of a century ago, by Unger. The sphæraphides are scanty or obscure in the leaves, but sometimes plainly seen within delicate cells in the tissue of the stem.

Ficoideæ.—Six species were examined, including *Mesembryanthemum crystallinum* and *M. rubrocinctum,* and all found to abound in raphides.

Crassulaceæ.—Several of these were compared with the foregoing, but found to be regularly destitute of raphides. There were examined *Sempervivum tectorum, Cotyledon umbilicus, Echeveria secunda,* and six British species of *Sedum.*

Vitaceæ.—This order affords good examples of raphides and sphæraphides in the same plant. Raphides are plentiful in the leaves of *Ampelopsis hederacea* and *Vitis vinifera.* The pulp of the berry and the fruit-stalks of *Ampelopsis* abound both in raphides and sphæraphides. The raphides often appear naked, and sometimes in a cell like that of the Fuchsia-berry, depicted in the last Number of the 'Annals.' The sphæraphides occur in the testa, and in the fruit-stalk present a distinct sphæraphid tissue—each of the sphæraphides, about $\frac{1}{1600}$th of an inch in diameter, forming the nucleus of a delicate cell, these cells being arranged in lines along the outside of the vessels. In the grape-berry the raphides are less abundant than in the leaves, but it contains many sphæraphides as well, which occur also, together with the raphides, in the leaves.

Urticaceæ.—I have not found raphides in this order; but it abounds in sphæraphides, fine examples of which, about $\frac{1}{532}$nd of an inch in diameter, may be seen, in the form of pale pellucid dots, in the young leaves of *Urtica dioica.* They are also very plain in *Parietaria.* Meyen discovered such objects, with their pedicel and cell, in *Ficus*; and their presence in many other plants of the order was remarked by Payen. Weddell called them cystoliths, and observed that they afford a valuable diagnostic character.

Edenbridge, Oct. 24, 1863.

[To be continued.]

XLVIII.—*Further Observations on the Distinctive Characters, Habits, and Reproductive Phenomena of the Amœban Rhizopods.* By G. C. Wallich, M.D., F.L.S., &c.

[Plate VIII.]

In order to show the fallacy of regarding mere external modifications of the sarcode-substance as indicative of specific individuality amongst the Amœban Rhizopods, attention was directed in my previous papers to the intimate relation existing between such modifications and the varying nature of the conditions by which most of these lower forms of animal life are surrounded. I have now to offer the following observations in support of this view.

Whilst describing the singular phase in the history of *Amœba* whereby, in common with many of the more highly organized Protozoa, it survives the contingencies to which it is exposed through the drying up or deterioration of the medium it inhabits, I mentioned having detected, amongst certain confervoid matter, an abundant brood of this organism, and that in it were embodied the collective characters of numerous forms whose specific distinctness had been based almost entirely on the characters of their pseudopodia. The specimens alluded to, in conjunction with some obtained from other sources, afford excellent illustrations of the incidental nature of these varieties, and seem to furnish conclusive evidence not only that the figure assumed by the pseudopodia is subject to such a degree of variation as to become valueless as a distinction between the Amœban species, but that the extent of the variation is so great as even to invalidate the boundary-line between *Amœba* and *Actinophrys,* in so far as it depends on the character in question.

This view may, at first sight, appear overstrained; for I confess that, in my own case, nothing short of the constant repetition of the appearances through an extended series of specimens could have induced me to entertain it. It is true, moreover, that the transition from the form of pseudopodium said to be typical of *Amœba* to that held to be typical of *Actinophrys* had not previously been noticed by me with anything like the same distinctness. But, in the material under notice, the specimens exhibiting the transitionary characters were so numerous, the alternation of the characters so frequent, and the type assumed so well sustained, that, should the case be deemed exceptional, it ought certainly to be regarded as one of those very important exceptions that disturb the established rule. And hence, admitting the accuracy of the facts recorded, namely that, under any circumstances whatever, a true *Amœba* possesses the power of projecting from its surface the tapering and pointed pseudopodia of *Actinophrys*—that these pseudopodia are for a time rigid—that occasionally they are bent at an angle, and again straightened—that sometimes, though rarely, they coalesce with each other—that they are retractile into the parent mass—that, within a period ranging from a few minutes to a few hours, the whole of these pseudopodia may vanish and give place to the lobose and polymorphous pseudopodia of *Amœba*—and, lastly, that the organism is stamped as a true *Amœba* by the presence of the villous appendage, the characters of the nucleus and contractile vesicle, and the definite differentiation into an anterior and posterior portion—I say, admitting the accuracy of these facts, it is impossible to regard characters based on the figure of the pseudopodia as of distinctive value either in the case of species or of genera, in default of other and more important structural peculiarities.

The following are the more detailed particulars of the transition in question. In the 'Annals' for June last, a figure was given of a specimen of *Actinophrys* under distention by a large *Pinnularia* (see Annals, June, Pl. X. fig. 4)—a remark being appended to the effect that it would be difficult to distinguish this form from an *Amœba* on the retraction of the pseudopodia. No contractile vesicle was noted, but oil-globules were present within the protoplasm of the diatom. For reasons to be given hereafter, it is most probable that the figure is really that of an *Amœba* in the state preparatory to encystation, and that the specimen was of a similar nature to the one figured in the plate appended to this paper (Pl. VIII. fig. 12), inasmuch as the pool in which it occurred, like the pool in which my recent specimens were found, was being rapidly dried up.

But by far the most striking examples of *Amœba* assuming temporarily the external characters of *Actinophrys* were detected recently. Whilst I write, they are still plentiful. They are of small size, rarely exceeding in length $\frac{1}{600}$th of an inch. Before the transition from their normal state begins, they exhibit every character of a small-sized but fully developed specimen of *Amœba villosa*—that is to say, a distinct villous tuft, a spherical nucleus enclosed within a hyaline zone, one or more active contractile vesicles, crystalloids, granules, and the usual lobose pseudopodia of the species. But from one portion of the surface we now see projected a group of short, tapering, pointed pseudopodia, which rarely curve, but bend freely on their axes like the spines of *Echinus*, although, of course, without a vestige of special structure. In short, they closely resemble the short ciliary appendages of *Plœsconia* or *Kerona*, without serving, as the latter do, for locomotion (Annals, April 1863, p. 290).

The pseudopodia, however, soon begin to extend, and finally cover the greater portion of the surface. As they increase in number, the power of locomotion and projection of the ordinary pseudopodia ceases; and ultimately the structure seems to undergo a period of nearly complete quiescence, during which the pseudocyclosis does not continue, and the alternating action of the contractile vesicle is very slowly carried on without removal from the villous region. (See Plate VIII. fig. 11.)

Lastly, after varying periods, these Actinophryan pseudopodia are, one by one, retracted into the substance of the body; locomotion recommences in the usual manner, and with it the pseudocyclosis; and we have again presented to us the entire characteristics of *Amœba villosa*.

Whether the transition between *Amœba* and *Actinophrys* is ever of a permanent nature there are no means of determining in the present state of our knowledge. But, although unable to perceive any valid ground for doubting its possibility, I would observe that the line of demarcation between the two genera is sufficiently marked to render it available for purposes of classification. In short, whilst the shape, dimension, and number of the pseudopodial processes appears to be determined, in a great measure, by accidental and varying conditions of the medium by which they are surrounded, their physiological characters remain nearly unaltered.

The prehensile faculty in *Amœba* and *Actinophrys* is very differently brought about in the two genera. In *Actinophrys* it is similar in kind, but far superior in extent, to that present in the Foraminifera and Polycystina, and is principally dependent on the adhesive viscidity of the ectosarc. In *Amœba*, the ectosarc possesses little or no adhesive power, except in the villous region, and an object is held or dragged towards the body simply by being encircled and then subject to the contractile action of the sarcode. Hence it is evident that the ectosarc of the villous appendage of *Amœba*, in which a powerful prehensile power resides, is not differentiated to the same degree as that of the rest of the surface. This fact, which analogy would lead us to expect (since it is only at the villous region that the contractile vesicle discharges itself, and effete matters are extruded), is strengthened by the near approach in character of the villi themselves to the ciliary legs of *Plœsconia* and *Kerona*, inasmuch as the latter organs are the only portions of these creatures in which the tendency to sudden solution of continuity is observable.

It is deserving of special notice, moreover, that the facility with which coalescence takes place between the pseudopodia, and the adhesive faculty of the ectosarc, are such mutually dependent conditions as to be inseparable. In *Lieberkuhnia*, the Foraminifera, and the Polycystina these characters are at a maximum; in *Amœba* they are at a minimum, and consequently denote the closeness of the relation existing between the degree of differentiation, as *thus* manifested, and the presence or absence of a nucleus and contractile vesicle.

The higher the degree of differentiation, or, in other words, the higher the grade of the organism, the more completely does amœbasis take place in it. In *Amœba,* which occupies the highest position amongst the true Rhizopods, the distinction between the external and internal portions of the sarcode-substance is at a maximum, and hence there exists an opposite condition to that present amongst the Herpnemata or lowest order (see 'Annals' for June, p. 439), and we meet with the smallest amount of inclination to coalescence and the least degree of adhesive viscidity of the ectosarc.

Lastly. And equally deserving of notice is the fact that the lower the degree of differentiation of the sarcode-substance, the more distinctly is the pseudocyclosis of granules observable, and the more completely does it approach and even involve the immediate surface of the pseudopodia—being dependent, as already shown by me (Annals, November, p. 332), not on a vital tendency to circulate inherent in the protoplasm or its granules, but on the inherent contractile power of sarcode, by means of which a constant interchange takes place between the interior mass and the external layer, and an equable distribution of nutritive material is secured in the bodies of the most rudimentary and testaceous types. When it is borne in mind that in none of the families of Rhizopods is the circulation uninterrupted, but that it not only continually varies in rate, but very frequently ceases altogether for a time, it will, I think, be allowed that any analogy between the phenomena and a special circulatory force is altogether discountenanced; whilst we further discern that the stoppage of a circulating granule, its occasional transfer from one pseudopodium to another, and its subsequent advance or retrogression towards the parent body (on which so much stress has been laid by those who advocate the operation of a special and true cyclosis) are ordinary mechanical results depending, in the first place, on the coalescence of adjoining pseudopodia, and, in the second, on slight inequalities in the rates at which the efferent and refluent streams of protoplasm are moving (see Annals, November 1863, p. 332)—the granule being, of course, borne along by the pseudopodium in which that rate is the greatest, without any reference to its direction.

Without embarking in a vain attempt to determine whether the actions of the Rhizopods are dictated by instinct or are to be regarded merely as the outward manifestations of a natural law impelling the animal organism to sustain existence and reproduce its kind, as it does the vegetable, I beg to direct attention to some singular facts, which throw light on the subject at the same time that they serve the more practical purpose of denoting the true characters of the phenomena to which they relate—premising that it will be a fitting period to discuss the question of instinct when we shall have become sufficiently acquainted with these lower forms to state, with any approach to accuracy, the relations and limits of those vital and physical forces whereby their functions are governed.

Both *Amœba* and *Actinophrys*, undoubtedly possess discriminative power in the selection of their food; that is to say, they do not incept every particle that happens to come in their way, organic and inorganic alike, but, generally speaking, only such substances as are best fitted for their nourishment, whilst they reject those that are not so fitted. It is true that inorganic objects are frequently present in the body of *Amœba*, which there is reason to believe have gained ingress accidentally. But, in most cases, the minute size of these objects, as compared with the organic food-particles associated with them, testifies to their having been admitted along with the latter, and not in lieu of them, or to their having been forced into the interior of the plastic mass of the creature whilst moving, as it constantly does, amongst organic and inorganic débris. The discriminative faculty, however, is exemplified in the most remarkable manner when one *Amœba* comes in contact with another, or with an *Actinophrys*.

Amongst the numerous instances in which I have seen *Amœbæ* come into contact with each other—whether in the course of their own movements or through any manipulatory effort on my part—it has not been my lot to witness the coalescence or fusion of two individuals, which has been regarded by some observers as a "zygotic" or reproductive process. On the contrary, such individuals, after remaining for a time in contact, have invariably "sheered off" from each other, under circumstances which proved that they were not inconvenienced by the restraint to which they were subject. In like manner, I have never seen the re-amalgamation of two or more portions of a divided *Amœba*. This is the more remarkable, since this phenomenon unquestionably takes place in *Actinophrys*; for, although the more viscid and adhesive quality of the ectosarc of the latter genus may, to some extent, account for the apparent anomaly, it can hardly be accepted as a satisfactory explanation of it.

In *Actinophrys*, the coalescence of two individuals, which is by no means of rare occurrence, has been repeatedly watched by me from beginning to end; and, with a view to ascertain whether the process was followed by any modification in the appearance of the sarcode-substance generally or the nucleus, specimens in which fusion had taken place, and which, owing to their very large size and hyaline nature, were admirably adapted for exhibiting any change, were kept carefully isolated in shallow glass cells for several days. In these examples, however, there was no other change observable than the increase in bulk, which dated, of course, from the time that fusion was complete.

Those who have watched the behaviour of *Actinophrys* when in search of food, are aware with what stolid but unfailing energy it frequently drags into its interior organisms not only superior to it in type, but in activity of movement. Yet, withal, it succumbs to *Amœba*. It is possible that the more rapid locomotive power of *Amœba* may serve in some degree to give it the mastery; but, on the other hand, there is evidently some other obstacle to an *Amœba* becoming a prey to *Actinophrys*, inasmuch as the largest specimens of the latter generally decline all contest with *Amœbæ*, even when sufficiently small to ensure their destruction were it a mere question of strength. When, by accident, the two organisms come into collision, the *Amœba* seems to be forthwith aroused to an unwonted degree of activity, and an effort is made by it to envelope the *Actinophrys* with the folds of its pseudopodia. Failing, however, in the attempt to secure the entire mass, the *Amœba* now employs its pseudopodia in tearing out portions of its adversary; and these are in due course consigned to vacuolar cavities. On one occasion I saw nearly half of a large *Actinophrys* transferred piecemeal, after this fashion, into the interior of its captor—the several fragments torn out (not simultaneously, but by a series of consecutive efforts) becoming rapidly absorbed under the digestive action to which they were immediately subjected (see Pl. VIII. fig. 18). In so far, therefore, as it is legitimate to draw conclusions from appearances and the behaviour of the organisms in question, instead of confirming the opinion as to their betokening a reproductive act, they tend rather to show that, between the so-called zygosis of two specimens of *Actinophrys* and the inception of an *Actinophrys* by an *Amœba*, there is but this difference—that in the one case the act is akin to cannibalism, whereas in the other it is not so.

In tracing the development of the young *Amœba*, either from the free sarcoblasts or large mulberry-shaped masses that resemble acapsular nuclei, the different steps are essentially similar. They would seem, in the first place, to be associated with an increase of the more fluid hyaline protoplasm within which the granules of these bodies are suspended, and which may increase to any extent without any alteration taking place in its initial character. The sarcoblast and mulberry-mass alike have no capsular investiture, but are supported by the layer of ectosarc into which the surface of the protoplasm is differentiated. But, prior to the first stage of development about to be described, amœbasis does not take place; that is to say, the outer layer is consolidated by mere contact with the medium around, but the reciprocal interchange between it and the endosarc has not as yet received its first impulse. This impulse consists in the evolution of one or more contractile vesicles, which make their appearance in the interior, but whether at any definite point I am unable to determine. At first extremely minute, the contractile vesicles gradually increase in size, causing the entire body to enlarge materially, but without as yet impairing its perfectly globular figure (Pl. VIII. figs. 1 to 3, 6 & 7). In some cases two or even three of these vesicles appear; but, as the increase in the protoplasmic substance is uninfluenced by that of the vesicles, it frequently happens that the latter constitute as much as four-fifths or five-sixths of the contents of the spherule. It is during this distention that the minute nucleus, previously absent or obscured by the closely compacted nature of the granules in the sarcoblast or mulberry-mass, may be seen. Of course, up to this point the young *Amœba* is motionless, and without the faintest trace of internal circulation, except in so far as the gradual distention of the contractile vesicles causes the granules of the protoplasm to shift their positions. In short, the organism consists essentially of a quiescent spherical globule of sarcode containing granules, a contractile vesicle, and a nucleus.

The second and most important stage now commences. The tension to which the ectosarc is subjected by the endosmotic enlargement of the contractile vesicle, causes it to yield at a certain point; the spherical outline is at once destroyed by the projecting portion of the vesicle (Pl. VIII. fig. 4). The latter bursts, for the first time, through the ectosare, leaving behind a minute mammilliform projection which constitutes the first rudiment of the villous appendage*. Should more than one contractile vesicle be present, it is invariably urged, by the contractile effort now made, towards the same point to discharge itself; and from this time the discharge occurs only in this region. But polymorphism has now set in. The little machine has been put in motion,

* In the 'Annals' for June (Plate X. fig. 8), I figured a minute spherical *Amœba*—one of the few I had then seen, and regarded by me as a "gemmule." I had not witnessed the detachment of these from the parent mass. This specimen exhibits a "mammilliform process" at one portion of its periphery, which was evidently the site of discharge of the contractile vesicle, although not recognized by me as being of this nature.

as it were, by the artificial impulse received on the discharge of the contractile vesicle; pseudopodia are projected and withdrawn, and, as a necessary consequence of these movements, pseudocyclosis goes on; food-particles are incepted, effete matter extruded at the point of *least* resistance—namely, in the midst of the villous organ; and, following as a natural result from these combined changes and the more subtle actions they involve within the body, the phenomena of amœbasis are established (see Plate VIII. figs. 4 & 5).

Although it would appear, at the first glance, that the villous appendage constitutes the most highly differentiated portion of the Amœban structure, since the contractile vesicle invariably discharges, and all effete objects are extruded, in its midst, the reverse is probably the case, inasmuch as, the continuity of the endosarc in this region being constantly disturbed by the causes just named, time is not allowed it to attain the same degree of consolidation that is attained by the rest of the surface. It must be borne in mind that the coalescence of the pseudopodia is rare in *Amœba*. Indeed it hardly ever takes place except under an effort to envelope some living object, or when the surface is broken, and a portion of the ectosarc driven back along with it into the interior of the body*, by the admission of some large food-particle.

But inasmuch as inception of food is only an occasional act, the disturbance of the ectosarc, which is its necessary consequence, must also be occasional. On the other hand, the contractile vesicle is constantly discharging itself at a single spot, namely, in the midst of the villous appendage; and it is here that the effete residue of every object incepted, either for food or by accident, is extruded. Moreover, whilst the inception of a food-particle can very rarely take place twice consecutively at the same spot, every act of extrusion does so; and this being the case, it is easy to perceive why the consolidation of the external layer of sarcode (ectosarc), being the result of contact with water, and dependent in degree on the period of exposure, should be greater in every other part of the body than in the villous region.

Again, it thus becomes easy to understand why the contractile vesicle discharges itself, and effete matters are extruded, in the villous region. It has been shown that the circulation of the contents of the sarcode-body is not a special vital act, but due to its polymorphism. Now contractility is the inherent property

* On two occasions I have seen a full-grown *Arcella* so incepted, not through an *aperture* extemporized, but evidently in the same way that a small object, if pressed against an inflated caoutchouc capsule, would push before it a portion of the wall.

of sarcode, but not till it has become consolidated to a certain extent; and this consolidation does not take place within the substance, but only at the surface. If we take the example of an ordinary contractile substance, the process is to all intents the same. Thus caoutchouc, when oozing from the parent tree, is not contractile, but a semifluid adhesive mass. So is the sarcode of the interior of an *Amœba.* But as soon as the action of the atmosphere causes coagulation or consolidation of the caoutchouc tears, the innate contractility becomes at once manifest. A precisely similar effect is produced by the contact between the endosarc and water.

It is quite evident that in the case of caoutchouc, the consolidation once produced, there is no return to the previous condition. Why? simply because its vitality ceased with its extrusion. But even here the analogy is not altogether destroyed; for the contractility of the caoutchouc may be materially diminished by heat, and it may again become an adhesive semifluid mass, capable of permanently assuming any figure. Yet, on reduction of the temperature, again consolidation takes place, and with it the mass resumes its elasticity. So that, assuming sarcode to be endowed with vitality—a fact, I presume, not admitting of denial—and also that it is contractile, we have not only all the conditions that place the phenomena observed in the light of simple cause and effect, but it appears to me obviously impossible to account for them in any other rational way.

In the 'Annals' for June (p. 451) a cursory allusion was made to two varieties of the common *Difflugia proteiformis,* which were present in the Hampstead pools. These varieties afforded good illustrations of the tendency of the test to undergo considerable modifications in shape and likewise in the disposition of the extraneously derived materials of which it is for the most part built up. It was stated that whereas the basal substance, with which the sandy particles commonly present in the test are cemented together, is secreted by, or, to speak more correctly, is an exudation from, the animal, examples are frequently met with in which there is no readily appreciable intermixture of mineral particles, and the entire test would seem to be composed of almost colourless pellets, differing only from those seen in the tubes of *Melicerta* in their shape and freedom from colouring matters. These pellets are minute cylinders having rounded ends. They are occasionally straight, occasionally more or less curved, and vary in length from $\frac{1}{5000}$th to $\frac{1}{3000}$th of an inch, whilst their diameter varies from $\frac{1}{20000}$th to $\frac{1}{10000}$th of an inch. They are distributed over the surface in a single layer, the larger and smaller pellets being made to fit to each other. Some specimens, however, are built up partly of these pellets and partly of sandy particles combined; whilst others appear to have one portion of the test built entirely of pellets and the other entirely of sandy particles. But the polariscope enables us to perceive that in nearly every specimen the basal layer of chitinous matter is strengthened by delicate films of mica, and that the external wall, whether formed of coarse sandy particles or pellets, is superimposed upon it. This structure of the test is to be traced in the curious variety of *Difflugia proteiformis* alluded to by me in the 'Annals' for June (p. 451, pl. 10. fig. 12) as being remarkable on account of the development of a septum between the main cavity of the test and its broad tubular neck, which causes it to resemble the two earliest chambers of the shell in *Miliola*. But one and all of these modifications, as before stated, are manifestly confined to the test, and in no appreciable manner associated with equivalent differences in the animal mass.

During the past summer and autumn, the same forms have been met with by me very generally in boggy pools—merging, on the one hand, into the "pyriform" variety, both with and without the little apical appendage of the test, and, on the other, passing into the equally common subglobular variety.

I have now to notice two still more aberrant forms recently obtained from the Hampstead pools. Of the first of these, only a single specimen has as yet presented itself from that locality. I had previously, however, met with one or two nearly similar specimens in a boggy streamlet on the west coast of Greenland*. Owing to the extraordinary transparency of the Hampstead specimen, which was still alive when examined under the microscope, it afforded a good opportunity for the detection of any novel characters within the sarcode-mass, had these existed. The pseudopodia were finely granular, free from incepted matters, and more or less cylindrical and lobose as in the ordinary *Difflugiæ*; the sarcode-substance charged with variously coloured food-particles; the nucleus spherical, apparently homogeneous throughout, and sustained in the usual hyaline cavity towards the fundus of the test; whilst the contractile vesicle was single, and, although partaking in the movements within the test dependent on the protrusion and retraction of the pseudopodial processes, returned to discharge itself, as in *Amœba*, at the posterior portion of the body. So that the characters are identical with those of *Difflugia proteiformis*, although, owing to the irregular structure of the test in that species, they are observable with much greater difficulty, and hardly ever simultaneously as in the present example.

* A figure of the Greenland *Difflugia* may be seen on reference to Part I. of 'The North Atlantic Sea-bed' (pl. 4. fig. 17).

It is in the configuration of the test, however, that the most striking peculiarity occurs. In figure it is like that of the pyriform variety of *D. proteiformis*; but, instead of being built up of irregular mineral particles, so as to present a rugged outline exteriorly, it was entirely composed of hyaline rectangular plates, arranged with the greatest regularity in consecutive transverse and longitudinal series—the smaller plates being disposed at the two extremities, whilst the larger ones occupied the central and widest portion of the structure. This specimen is represented, in its mounted state, in the plate appended to this paper (fig. 16), under the name of *D. proteiformis*, var. *symmetrica*.

Of the chemical composition of these remarkable rectangular plates I am as yet unable to give any definite account. But there is some reason to believe they are crystalline and siliceous in their nature,—in the first place, from the perfectness of the angles and their resisting the effects of the heat to which the specimen was subjected during mounting in balsam; and in the second, from their exhibiting no coloration when seen with the aid of the polariscope.

The second aberrant form, however, involves not the test, but the animal inhabiting it, at least so far as the preponderance of evidence goes, and is in fact but an example of the transition, in a testaceous Rhizopod (namely, *Difflugia proteiformis*, var. *acuminata*), of the typically lobose pseudopodia into those of an *Euglypha* or *Gromia**.

In the specimen under notice, the large and coarse sandy particles entering into the formation of the test completely precluded observation of the characters of the soft parts within. But it is almost unnecessary to point out that, whatever these may have been, if betokening a *Gromia*, the test must be regarded as abnormal; if a *Difflugia*, the pseudopodia must be so.

It is well known that the *Amœbæ* are generally to be found in shallow pools or streamlets, more or less charged with disintegrating organic matter, and liable to stagnate, or to become altogether dried up, by periodical failure of the water-supply. I say, charged more or less with organic matter *undergoing* disintegration, because it is an error to suppose that the *Amœbæ*, or indeed any of the Rhizopods, are able to continue existence long in water which has parted with its oxygen to the extent of be-

* I may repeat in this place the statement made in a former communication (Annals, August, p. 123), that I had detected a distinct nucleus in *Gromia oviformis*, and at a later period, but only once, an equally distinct contractile vesicle. But, until further opportunities present themselves of determining whether or not these organs occur universally amongst all the members of the genus, I would reserve my final opinion on the subject.

coming putrescent. The decadence of every Rhizopod dates from the commencement of this process; and there seems reason to believe that the putrescence of the medium in which they live is the only condition against which nature has furnished them with no safeguard—in short, that the entire extermination of the brood takes place whenever such putrescence has become fairly established.

Some of the aspects under which the *Amœbæ* resist partial, if not complete, desiccation have already been noticed. The following additional example, however, has a twofold interest; for, on the one hand, it illustrates the nature of the relation between the animal and the state of the medium by which it is surrounded, and, on the other, serves to explain what has long been regarded by myself, and probably by many other observers, as a very anomalous occasional condition of the Diatomaceæ.

Some Diatoms would seem to be endowed with an increased motile power, to assume a deeper colour from the inordinate thickening of the endochrome-layer, and to generate an undue quantity of oily matter, as soon as the water sustaining them begins to be putrescent. Their healthy growth and multiplication are inseparably associated with an abundant supply of oxygen and light. In common with the rest of the lower Algæ, they are frequently to be found in the same localities as the Amœban Rhizopods; and, like the latter, they are provided with special means for resisting the extinction of their kind to which they are consequently liable. But at a certain point, although by no means so readily as the Rhizopods, they succumb in like manner to the action of putrescence; and it seems probable that the increased motile power and accumulation of endochrome referred to are evidences of an expiring effort to tide-over this condition, should it prove of a transitory nature.

Some species certainly resist decomposition more successfully than others; but there is no ground for supposing that this increase of power signifies anything more than habituation to conditions to which other species, or the same species when inhabiting localities uninfluenced by such conditions, are not amenable. The genus *Pinnularia* affords a notable example of the kind, both from the circumstance of its occurring in the same habitats as the Amœban Rhizopods, and from its being frequently of a size to render it admirably fitted for observation.

The appearances about to be described have been seen by me, not only in this country, but in the tropics and sub-Arctic regions, always, however, in streamlets and pools such as those referred to, and in connexion with Naviculoid Diatoms, as for example, *Pinnularia, Epithemia, Navicula, Stauroneis,* and more recently *Nitzschia*; so that they are by no means uncommon. I allude to the enclosure of one or more of these Diatoms within a distinct capsule, which it has been customary to regard as indicative of encystation, connected either with the production of its sporangium or with some heretofore unrecognized reproductive process.

The frustules, when simply surrounded by this capsule, and nearly altogether deprived of their soft and coloured contents, could hardly convey any other impression than that they are undergoing one or other of these processes; for there are no characters discernible in the capsular investiture whereby its real source and function could be determined. And, coupling the undoubted faculty possessed by the Diatomaceæ, of occasionally secreting in augmented quantity the gelatinous film by which they are normally surrounded at all times, with the occasional imprisonment of more than one frustule, it is only necessary to assume that the external layer of this film becomes consolidated, and the appearances would seem to be sufficiently accounted for. But wherever the distinct capsular investiture is present, for reasons now about to be adduced, such an explanation would appear to be erroneous, and the condition described to be dependent on animal, and not on vegetable, agency. In short, an *Amœba* has become encysted, and not a Diatom*.

In the course of some experiments on feeding freshwater Rhizopods by artificial means, towards the close of last month (October) my attention was particularly drawn to this subject on perceiving that in some of the Hampstead material then freshly procured, but nevertheless presenting traces of disintegrative decay, a large proportion of the *Amœbæ* were distended (as in the case of some of the specimens referred to in my paper of April last) with frustules of *Pinnularia,* and that, whilst these *Amœbæ* were rapidly ridding themselves of the rest of their extraneous contents, they appeared to select and retain those frustules which were most copiously charged with endochrome and oil-globules, and to be gradually assuming a consolidated investing layer.

The artificial food employed consisted of weak solutions of gum and gelatine. Deeming it possible, however, that the intermixture of these substances with the water containing the *Amœbæ* might have something to do with the encysting process

* In speaking of the solitary example of an encysted *Amœba* recognized by me at the time my observations contained in the 'Annals' for May (p. 368) were written, I was unaware that Schneider had pointed out the occurrence of a "resting-stage" in the history of *Amœba*. This writer distinctly refers to the formation of a membranous sac, although he failed to trace the encysting process beyond this point. My observations on this head, in the last Number of the 'Annals' (p. 334), ought, therefore, to be regarded as supplementary to and confirmatory of his.

and the singular features the specimens assumed, a fresh supply was obtained from the same locality. This was retained in its natural state, and on examination was found to contain specimens in every respect similar to those described as occurring in the mixed material. The encysting process was thus shown to be in no way dependent on conditions artificially produced, but to be the result of an effort on the part of the creature to furnish itself with nutritive matter during the development of the sarcoblasts into which the sarcode-mass is destined, under these circumstances, to resolve itself*.

The first step, as already stated, consisted in the extrusion of all foreign particles besides the diatom-frustules—the vacuolar cavities in which the latter were enclosed being, for a time, distinctly visible and often of great size (see Pl. VIII. figs. 12 & 13), but gradually disappearing as their fluid contents became absorbed. Finally, all trace of pseudopodia, nucleus, contractile vesicle and villous organ vanished; all motion to and fro, and the pseudocyclosis dependent on it, ceased; and the diatoms seemed to be merely surrounded by a layer of coarsely granular but otherwise homogeneous sarcode, the outline of which was preserved by a distinct capsular wall, whilst its shape was dependent on the disposition and number of the enclosed frustules.

It may be remembered that (in the 'Annals' for June, p. 435) it was stated that the bodies to which I had given the name of sarcoblasts, and described as being "distinctly granular, nearly homogeneous throughout, and devoid of cell-wall," in all probability "perform some important part in the process of reproduction, and are identical in all save colour with those of the Foraminifera, Polycystina, Thalassicollidæ, and some other pelagic families;" whilst in a still more recent paper ('Annals,' August, p. 125) I mentioned that "in the earliest recognizable condition in which I had found the Polycystina and Acanthometrina occurring as independent free-floating organisms, their rudimentary shell or framework had invariably been enveloped in bodies precisely resembling the sarcoblasts of the mature forms," and that to this extent their share in the reproductive process had been traced out.

The views then expressed receive the most complete verification from what takes place in these *Amœbæ*. The movements both

* It is worthy of record that no organisms but Diatoms have been found by me in these *Amœba*-cysts, notwithstanding the circumstance that, when decomposition was commencing in the pools, many of the lower vegetable forms, such as *Closterium, Volvox, Gonium,* and the host of minute phytospores that have so erroneously been regarded as mature *Desmidiaceæ* were in profusion.

within and without their bodies, although energetic when the encystation commenced, are succeeded by a state of complete quiescence afterwards. But, even at this stage, clear proof of vitality is afforded by the gradual segregation of the granular particles into masses, which ultimately become spherical and apparently identical with the sarcoblasts (Pl. VIII. fig. 14). Of course, if identical, my view as to these bodies being formed from the granular particles of the endosarc generally, rather than from the repetitive subdivision of the nucleus and its capsule, receives confirmation*. But, under any circumstances, it is now manifest that the sarcoblasts are true reproductive bodies, inasmuch as, although I have not hitherto detected the passage of a sarcoblast into a young *Amœba* whilst yet within the *Amœba*-cyst above referred to, or within the frustule of the diatom (where the sarcoblasts also occur under certain conditions to be detailed immediately), I have traced the development of the young *Amœba* from bodies identical with them in appearance, and occurring in a free state in the same medium and at the same time.

But to return to the history of the sarcoblasts whilst yet within the *Amœba*-cyst. When fairly formed, only a few isolated granules are to be seen associated with them—the endochrome of the diatom having become shrivelled and discoloured, and nothing remaining to indicate the true origin or office of the capsule.

The most remarkable feature, however, has yet to be noticed. The *Amœba* occasionally seems to obtain an entrance into the interior of the diatom-frustule, either during or after the appropriation of its contents—but probably after, for reasons which will presently appear. As already stated, sarcoblasts are occasionally to be met with within the frustular cavity. When this happens, ingress has not been effected through any normal apertures that exist in the structure, but through the partial dehiscence of the two valves at one extremity; whilst the dehiscence is, in all probability, connected with the presence of the *Amœba* to this extent only, that on the protoplasmic substance being abstracted which serves as a support for the valves and connecting zones, these fall asunder, and an opening is thus established (Pl. VIII. fig. 15).

The greatest number of sarcoblasts seen by me within an *Amœba*-cyst was eight; but generally it did not exceed half that

* It is possible that the granules entering into the formation of the nucleus, and which are undistinguishable, when isolated, from those of the sarcoblasts, under any circumstances may have become diffused through the endosarc generally. Hence my view as to the mode of formation of the sarcoblasts and their non-investiture by a capsule receives corroboration.

number; whilst within the frustule I have not seen more than four.

In directing attention to these facts, I would lay great stress on their bearing upon the question as to whether true *Amœbæ* are ever developed within the cells of the confervoid Algæ. For, although I have hitherto failed to trace the passage of the sarcoblasts into a young *Amœba* whilst yet within the interior of the diatom-frustule, it is evident that if the granular bodies, within and without the frustule, are identical in origin (and I see no reason for questioning it), the actual witnessing of the process is a mere matter of time and patience; and it must be obvious that, in the absence of a previous knowledge of the origin of the intrafrustular *Amœbæ*, the great error would in all likelihood be perpetrated of regarding them as having been generated from the gonidia of the Protophyte, instead of from the sarcoblast of the Rhizopod.

It is necessary to mention that the mere occurrence of a few more or less colourless granular corpuscles within a capsular cavity affords no evidence either as to their origin or their nature. Such bodies are produced both in the animal and vegetable kingdoms, and may constantly be detected within the effete tests or skins of Infusoria, Rotifera, Entomostraca, and confervoid Algæ. In most cases, their presence is purely accidental, or at all events unconnected with the reproduction of the organism within whose test or cell-wall they are found. So that the establishment of the fact I have just recorded teaches us how great a degree of caution is requisite before we pronounce vegetable products, found within the bodies of the lower forms of animal life, to have been evolved there; whilst, on the other hand, it exemplifies how subtle are the means whereby animal germs may find their way into, and hence simulate, vegetable products.

Here then we have presented one phase, at least, of the encystation of *Amœba*, from its commencement to its completion. The supplementary phenomena—namely, those dating from the partial desiccation of the granular bodies now formed, to the period at which they become developed into young *Amœbæ*, have been traced in my last paper on the subject (Annals, Nov. 1863). In interpreting the appearances, I have only to add that the abundance of the specimens, and the successive stages of the process observed, render it tolerably certain, on the one hand, that the protoplasm of the diatom furnishes nutritive material to the Rhizopod during the period of quiescence attendant on its encystation; on the other hand, that the occasional enclosure of frustules belonging to distinct genera—as, for example, a *Pinnularia* with a *Stauroneis* or a *Navicula*—

renders it certain that the presence of the diatoms is in no manner connected with *their* encystation or reproductive processes.

Assuming then, as I believe there is every reason for doing, that the Amœban Rhizopods are hermaphrodite, but leaving for future and much more extended research the determination of the male and female elements, with the precise method in which the impregnation of the latter is effected, I think we are fully warranted in recognizing the operation of no less than three apparently distinct modes in which a new brood may be developed, and in regarding this singular feature in their history as a provision for the perpetuation of the species, without reference to the stage of development at which the parent may have arrived when it happens to be destroyed.

The following are the three modes of *reproduction* in question:—

I. By extrusion from the body of the parent of a minute individual already perfect as regards the essential characters of the species.

II. By development, singly, from one of the sarcoblasts, or acapsular nuclear masses, which are formed within the body of the parent either prior to or during the process of encystation.

III. By development, singly, from each of the granules of the acapsular nuclear masses, on the disruption of the latter.

Whilst the *multiplication* of the individual, or, to speak more correctly, the vegetative repetition of the species, may be brought about,

I. By the disruption of the parent body into two or more parts, each capable of maintaining an independent existence.

II. By gemmation, or the evolution, from some portion of the surface of the parent, of a "gemmule," destined ultimately to assume the characters of the species. This last process I am unable to vouch for on my own authority, except as regards *Actinophrys.*

Assuming, then, that the evidence adduced throughout the previous and present communication establishes the fact that the differentiation into ectosarc and endosarc is of the kind indicated—that is to say, a process involving the increased consolidation of the external layer by the operation of physical agencies on living sarcode, whilst the reconversion of this external layer, and the constant interchange taking place between it and the more fluid mass within, coupled with its inherent contractility and extensibility, are the essential attributes of this substance—is it possible to account for the appearances attending the inception and extrusion of foreign matter, the formation of vacuolar cavities, the multiplication of the contractile vesicles, their division, reunion, circulation through the body, and invariable discharge in the midst of a definite and very limited area, under these circumstances? The answer of those best able to judge will, I hope and believe, be in the affirmative. At the same time I am fully prepared to encounter the opposition to my views regarding the nature and properties of sarcode which is inseparable from preconceived notions handed down from writer to writer, as it were traditionally, and by many persons accepted without question, in defiance of their inexplicable character *; for it is but requisite to look attentively into the statements that have been put forward on the subject, to discern that they involve agencies and effects not only exceptional as regards the lower forms of animal life, but exceptional as regards the known laws of matter, whether organic or inorganic †. On the other hand, I again submit that the explanation here offered is not a bare hypothesis, the accuracy or fallacy of which there are no means of testing, but one following legitimately on the recognition of causes that contravene no established laws, and are reconcilable with the phenomena observed in the particular class of structures it has been my endeavour to describe.

Note.—It is necessary to state that, whilst the figures appended to the present and previous papers are copies of sketches taken, by the side of the microscope, during actual observations (and I guarantee them to be as accurate as it is possible to make figures that represent living and moving microscopic structures), the facts recorded are the result of examinations occupying from four to seven hours daily, and continued for a period of eight months. I mention this solely for the information of those who are not well versed in tracing out the physiological phenomena of organisms that reveal their workings so capriciously as the Rhizopods. But although the first detection of such phenomena could hardly accrue without this labour, their re-detection may be secured much more readily. No expenditure of time, however, devoted to the exploration of a field so rich, and so fitted to assist us in arriving at a better knowledge of the higher forms of life, can be too great.

Kensington, November 20, 1863.

* One of the most distinguished of the Continental writers on microscopical anatomy (Kölliker) does not hesitate to declare that the method in which *Actinophrys* incepts and rejects food is "almost a miracle."

† The most singular feature in the discussion on the properties of sarcode is, that those observers who insist most strongly on *a definite and permanent membranous* ectosarc in *Amœbæ* find no difficulty in reconciling its existence with the constant lesions it must of necessity be subject to through the above-mentioned inceptions and rejections

Postscript.

The experiment about to be recorded was brought to a close after the preceding pages were sent to press.

On the 27th of last month, a small quantity of the confervoid material, which had previously been kept in water for several weeks, and contained living *Amœbæ* in abundance, was placed on a plate of glass, covered by a bell-glass, and permitted to dry within doors by evaporation. On the 29th ult. all trace of moisture had vanished, the mass forming a dark-coloured hardened film, which it was difficult to remove. On the 18th of the present month—that is to say, after having been subject to complete desiccation for twenty-one days—the plate of glass was placed in a saucer and covered to the depth of half an inch with distilled water. It remained in this till last evening, when, on examination under the microscope, the confervoid substance was found to contain numerous minute *Amœbæ* just evolved from sarcoblasts and becoming polymorphous. All the mature forms were killed, not only of *Amœba*, but of the *Nitzschia* associated with them. On the other hand, the sarcoblasts were numerous. Hence the fact, that the latter are able to undergo perfect and long-continued desiccation without destruction of their vitality, is conclusively established.

EXPLANATION OF PLATE VIII.

The letters *c* and *n* respectively denote the contractile vesicle and nucleus in all the figures in which these organs are present.

Figs. 1 to 5 represent successive stages in the development of the young *Amœba* from a free sarcoblast.

Fig. 1. First stage, which dates from the evolution of the contractile vesicle *c*. The nucleus, if present at this period, is wholly obscured within the granular sarcoblast.

Fig. 2. Second stage, in which the sarcoblast has become considerably enlarged, chiefly through the dilation of the contractile vesicle, *c*. The nucleus, *n*, is now distinctly visible. Diameter of sarcoblast about $\frac{1}{1100}$th of an inch; of nuclear mass about $\frac{1}{9000}$th of an inch.

Fig. 3. Sarcoblast further enlarged, a second contractile vesicle, *c''*, adding greatly to its distention.

Fig. 4. Third stage. This marks the transition from the sarcoblast to the Amœban form. The spherical outline is now lost, owing to inordinate distention; and the primary contractile vesicle, *c*, performs its discharge for the first time.

Fig. 5. Fourth stage. Polymorphism has now commenced, and the villous appendage becomes rapidly formed by the repeated discharges of the contractile vesicles. Longest diameter of specimen about $\frac{1}{750}$th of an inch.

Fig. 6. The first stage in the development of the young *Amœba* from a free acapsular nucleus; contractile vesicle, *c*, just showing itself as in fig. 1. Diameter of mass $\frac{1}{1000}$th of an inch. No nuclear body visible within the body. Average diameter of component granules $\frac{1}{12000}$th of an inch.

Fig. 7. The same specimen as seen after the completion of the fourth stage of its development. The character of the acapsular nucleus is now entirely lost, through the diffusion of its component granules and the increase of the more hyaline protoplasm. Contractile vesicles (*c*) now in constant action. A nucleus, similar in all respects to that seen in the former specimens, is also present. Size now variable, and dependent on form assumed for the time being. When globular, about $\frac{1}{650}$th of an inch.

Fig. 8. An occasional variety of the kind shown in the last figure, in which the original acapsular nuclear mass (*n*) remains nearly entire, the ordinary minute encapsuled nucleus not being hitherto observable. *h*, a number of the large hexahedral crystalloids, varying from $\frac{1}{5500}$th to $\frac{1}{4500}$th of an inch in length. These crystalloids, however, are not confined to the specimens exhibiting the peculiar condition of the primary acapsular nucleus, but are occasionally to be met with in the ordinary young *Amœbæ*. Length of specimen about $\frac{1}{625}$th of an inch.

Fig. 9. A frequent form, in which the normal condition of the nucleus is shown, but the pseudopodia have temporarily assumed the tapering and pointed shape.

Fig. 10. *Amœba*-cyst from damp confervoid growths liable to desiccation, shown as it appears after immersion in water. Contractile vesicle (*c*) dilated, but unable to discharge in the usual manner. *s s*, sarcoblasts; *d*, an effete frustule of a diatom (*Nitzschia amphioxys*). Diameter of cyst about $\frac{1}{200}$th of an inch.

Fig. 11. Remarkable quiescent state of *Amœba villosa*, in which the surface is covered with more or less rigid, short, tapering pseudopodia of an Actinophryan character. Length, as seen in figure, about $\frac{1}{700}$th of an inch. Diameter of nuclear capsule $\frac{1}{3330}$th of an inch; of nucleus $\frac{1}{4500}$th.

Figs. 12 to 15 represent successive stages in the encystation of *Amœba*.

Fig. 12. A specimen becoming quiescent, after having incepted a large *Pinnularia* and thrown off all other extraneous substances,—the nucleus and its capsule being either absorbed, rendered invisible amongst the granules, or entering partly into the composition of the granular mass, of which the entire body now seems to consist. Some large oil-globules are shown within the diatom-frustule; *c*, minute contractile vesicles, the action of which is almost wholly suspended.

Fig. 13. The same form, showing the Actinophryan pseudopodia retracted, and the margin of the body rapidly becoming smooth and oblong.

Fig. 14. The membranous *Amœba*-cyst now complete, the granular particles of which the substance of the body was composed having become segregated into masses which take the form of sarcoblasts.

Fig. 15. The contents of the *Amœba*-cyst have now almost entirely disappeared, but within the dehiscent valves of the diatoms are to be seen the sarcoblasts. This last condition is, comparatively, of rare occurrence. The average length of the four specimens here delineated was about $\frac{1}{250}$th of an inch.

Fig. 16. Test of *Difflugia pyriformis*, var. *symmetrica* (Wall.), showing symmetrical arrangement of the crystalline plates.

Fig. 17. Group of minute *Amœba*, each developed from a single granule of a disrupted acapsular nucleus, and under no circumstances ciliated. In each is to be seen a villous appendage, contractile vesicle, and nuclear spot. Length from $\frac{1}{3330}$th to $\frac{1}{1660}$th of an inch.

Fig. 18. *Amœba* engaged in tearing pieces out of an *Actinophrys* by means of its pseudopodia. *f, v*, food-vacuole containing a mass so torn off.

N.B.—These figures, although originally drawn to one uniform scale, are only uniform here as regards the relative proportions of the structure in each example, since it became necessary to modify the size of the various figures in order to accommodate them in a single plate. I would avail myself of the opportunity, however, to express my conviction that variation in the dimensions of the Rhizopods generally is so great, and so dependent on purely accidental conditions—that is to say, on conditions involving no physiological difference in the animal—that they ought to be allowed no greater weight in an attempt at classification than the variation in the length of a blade of grass or the height of a thistle.

Erratum in Dr. Wallich's paper contained in the November Number of 'The Annals.'

Page 335, fifteenth line from bottom, for "*Chilodontes*" read "Chilodons."

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Feb. 24, 1863.—E. W. H. Holdsworth, Esq., in the Chair.

On a New Genus and Species of Leaf-nosed Bats in the Museum at Fort Pitt. By Robert F. Tomes.

In a collection of Bats preserved in spirit, and forming part of the Museum at Fort Pitt, Chatham, which has been submitted to my examination by Dr. Sclater, is one which constitutes a new and well-marked genus of the *Phyllostomidæ*, or Leaf-nosed Bats of the New World. It is more nearly allied to the genus *Macrotis* than to any other; but differs from it, among other respects, in having its lance-shaped nose-leaf developed to an enormous extent. I characterize and name it as follows:—

Lonchorhina, gen. nov.

Top of the head somewhat elevated; face depressed; facial crests complicated, consisting of a very long and pointed posterior leaf, in front of which are two pits, more or less surrounded by prominent fleshy excrescences; lower lip with a smooth triangular space in front; ears long and broad; longest finger with four phalanges; wing-membrane extending to the distal extremity of the tibia, and attached to the os calcis*; tail extending to the whole length of the interfemoral membrane, as in the genera* Macrotis *and* Vespertilio.

The posterior lanceolate facial leaf is in this Bat of great length, being fully as long as the head of the animal; it is pointed, and has a very distinct midrib. In front of this leaf is a deep pit, which is divided into two by a ridge which is continuous with the central rib of the leaf; in the bottom of the pits thus formed are the nostrils, which are small and ovoid. The septum between them is produced anteriorly, and developed into a prominent and trifoliate fleshy excrescence, which almost conceals the pits behind; it has a central or upright lobe, exhibiting outwardly a rounded footstalk surmounted by a flattened top, the edge of the flattened summit being directed upwards and having five very slightly prominent, but very distinct, denticulations. Besides this central lobe there are two lateral ones, which present a thin edge externally, and are continuous with each other across the bottom of the central one. Where this horizontal ridge runs across the central lobe, it is produced into a distinct point or tubercle. On each side of the pits, behind the trifoliate leaf, is a prominent, acutely conical, vertical projection about a line in length. Below the trifoliate leaf is a transverse hollow, divided vertically by a faintly marked septum, and below this is another transverse leaf, forming the lower boundary of the hollow; this leaf is but slightly prominent, and has its ends curved upwards and terminating in two warty excrescences contiguous to the two acute projections near the nostrils. Below this is a flat space, constituting the upper lip.

The lower lip has a large central space of a triangular form, which is naked, and bounded laterally by a broad, smooth, and somewhat elevated margin; at its inferior point is a single small wart, and in the middle, forming the front of the lip, is an enclosed granulated space.

The ears are as long as the head, broad and pointed, with the lobular parts much developed, and extending forward almost to the corner of the mouth. Tragus more than half the length of the ear, tapering evenly to a subacute point; near the base, externally, is a prominent though somewhat obtuse angle, and above this a notch, forming another angle, more acute, but less prominent, than the other; above the notch there is no angle, but a rounded and slightly prominent part, and from this to the tip the tragus tapers pretty evenly. The auditory opening is partly surrounded (posteriorly) by a prominent fleshy ridge of a lobular form, which will fold forward and completely close the opening.

The longest finger is composed, as in all the Phyllostomidæ, of four phalanges; the thumb has the two phalanges of nearly equal length. The wing-membrane extends barely to the distal extremity of the tibia, which it crosses over, in front, and is attached to the base of the *os calcis*, somewhat as in the genus *Natalus*.

The tail is long, but composed of only nine joints, and extends the whole length of the interfemoral membrane, as in the genus *Vespertilio*. The feet are large, with the toes of equal length, and the claws long and hooked.

The skull in its general outline bears considerable resemblance to that of *Macrotis*; but the cerebral region is more elevated, and the facial part more depressed. It is so much depressed just at the posterior boundary of the nasal bones as to occasion a deep hollow or longitudinal pit. The nasal bones are very differently formed to those of *Macrotis*, being very much arched from the fore to the hinder part. The maxillary bones are considerably inflated between the nasal opening and the orbits. All the facial part of the skull is much less compressed than in *Macrotis*.

Dentition:—Inc. $\frac{4}{4}$; Can. $\frac{1-1}{1-1}$; Premol. $\frac{2-2}{2-2}$; Mol. $\frac{3-3}{3-3}=\frac{16}{16}=32$.

The middle *upper* incisors are large, flat, and somewhat pointed; the lateral ones minute and pointed, and with a posterior lobe near the base; the canines are rather small and acute; the first premolar is very small, roundish, and with two cusps, the anterior one being the most prominent; the second premolar is very prominent, and has the same carnassial form which is so common in the Chiroptera.

The lower incisors are symmetrically arranged, rather small, and flat, with their edges somewhat lobated; the canines are slender, straight, and with a distinct cingulum; the first premolar is smaller than the second, conical, acute, and with a slightly projecting posterior lobe near the root; the second premolar is rather long, angular, and acute, with a well-marked cingulum.

The tongue is thick and short, with six well-marked, transverse, curved ridges, which are most distinct on the front part; and behind these are indications of others. All the upper surface of the tongue is clothed with fine points, which are directed backward, like those on the tongue of the *Felidæ*.

LONCHORHINA AURITA, n. s.

Nearly the whole of the face is hairy, the hair having the same quality and colour as that of the back; the nose-leaf and fleshy excrescences are naked, but a few hairs spring from the edges of the former near the base; ears hairy behind for three-fourths of their length; inside they have a distinct band of hairs on the inner margin, which does not extend further than three-fourths of their length from the base; and there is another, but smaller, band of hairs inside the lobular parts.

The fur of the upper parts is nearly confined to the body; but there is a little scattered on the humerus and the contiguous end of the forearm. Beneath, there is a little whitish hair powdered on the membrane near the flanks and forearms.

All the upper parts are light reddish brown, the fur nearly unicolor; beneath similar, but duller in colour, and paler on the pubes. Cutaneous system dark reddish brown.

	″	‴
Length of the head and body	2	3
——— of the tail	1	9
——— of the head	0	9¾
——— of the ears	0	8¾
——— of the tragus	0	7
Breadth of the ears	0	8
——— of the tragus, at its widest part	0	3
Length of the forearm	1	11½
——— of the longest finger	3	10

	"	'''
Length of the fourth finger	2	6½
——— of the thumb	0	4
——— of the tibia	0	9½
——— of the foot and claws	0	7
——— of the *os calcis*, about	0	6
Expanse of wings	13	4
Length of the nose-leaf, taken behind	0	9½
Total length of the skull, from front of nasal bones	0	8¾
Breadth across the orbits	0	5
Length from the point of the middle upper incisor to the posterior edge of the last molar	0	4
Length of the lower jaw	0	6

Hab. The bottle from which this specimen was taken contained several West Indian species, in which the *Mormops Blainvillii* and the *Chilonycteris gymnonota* of Wagner were conspicuous. The latter is distinguished from other species of the genus by having the wing-membranes springing from the middle of the back, instead of the sides of the body; and there can be but little doubt that it is the *Pteronotus Davyi* of Dr. Gray. Of course Dr. Gray's specific name will take precedence of that given much later by M. Wagner, and the name of *Pteronotus* may be conveniently used to distinguish the species as a subgenus of *Chilonycteris*. It is probable that the specimen from which I have taken the foregoing description may have been received from the same locality as the *Mormops* and *Pteronotus*.

Obs.—Since the above was written, I have made a careful comparison of the skull of this singular Bat with that of several other species hitherto doubtfully placed with the Phyllostomidæ. The following are the results:—The genus *Schizostoma*, which is rather intimately allied to *Vampyrus*, bears also considerable resemblance to the genus *Macrotis* in the general conformation of the cranium and the lower jaw, and also in the very great similarity in the dentition. The form and size of the ears, too, in these genera are very similar. *Macrotis*, again, bears in several particulars an intimate relationship to the present genus *Lonchorhina*. More especially may be mentioned the length of the tail, which extends in both genera to the whole length of the interfemoral membrane, as in the genus *Vespertilio*, the considerable development of the ears, the size and freedom of the feet, and, perhaps more than all, the general contour of the cranium.

Pursuing the comparison, we find that *Lonchorhina* bears very considerable resemblance to *Chilonycteris* in the form of the anterior part of the cranium, in the number and relative size of the teeth of both jaws, and in the form of the lower jaw. Passing on from *Chilonycteris* to *Mormops*, the skull of the latter is seen to be an exaggeration of the former, having the facial part still more depressed, and the cerebral part still more elevated. The upper teeth in both these genera are very similar; and those of the lower jaw do not present any essential differences, the chief one being that in *Chilonycteris* the middle premolar is very much smaller than the corresponding one in *Mormops*, which, although smaller than those on either side of it, is not minute. All the above-mentioned genera agree with each other in the presence of a fourth joint to the longest digit of the wing, and in fact must be said to bear considerable resemblance to each other in most particulars, saving in the degree of development of the tail and the existence or absence of a hastate nose-leaf. However, it may be said that those species which have not a nose-leaf resembling that of the ordinary *Phyllostomidæ* have nevertheless some cutaneous development about the face, nose, or mouth, and cannot be properly called simple-nosed species.

There is another very singular genus, of which I have before spoken in communications to the Society, and which I have regarded as allied to *Molossus*, but I have mentioned that it possesses four phalanges in the longest finger. I allude to the genus *Mystacina*, which has hitherto been found only in New Zealand. When preparing my paper on the Bats of that country, I had not examined either *Mormops* or *Chilonycteris*, but, on afterwards working out some West Indian Bats, was at once struck with certain resemblances between the latter and *Mystacina*. Without at present alluding to the details of structure which have induced me to arrive at this conclusion, I take this opportunity of stating that I now regard *Mystacina* as an aberrant form of *Phyllostomidæ*, coming after the several genera which have been compared above, but differing more from them than they do from each other.

MISCELLANEOUS.

On the Pith-Cells of Juncaceæ. By George Gulliver, F.R.S.

[Plate VII. figs. 13, 14.]

There are at least two kinds of pith-cells in Rushes. The pith may be either an actinenchyma or an ovenchyma; and these two forms are alone sufficient to distinguish some species, if not sections, of the order from others.

The pith-cells are branched, like the spokes of a wheel, in *Juncus effusus*, *J. conglomeratus*, and *J. glaucus*; while in *J. acutiflorus*, *J. squarrosus*, and *J. bufonius* the pith-cells are more or less rounded, commonly oval, and without any approach to the stellate form.

These observations are from my notes of 1860, which I hoped to have extended to more species; but, as an opportunity of doing so has not occurred, I have lately verified the observations anew on the plants above-named, and now give a sketch of the outlines of the cells, in the hope of directing attention to the difference in question, which is so remarkable, regular, and constant, that it may afford a good and easily recognized character.

Plate VII. fig. 13. Pith-cells of *Juncus effusus*.
„ „ fig. 14. Pith-cells of *J. bufonius*.

Edenbridge, Oct. 19, 1863.

On the Development of the Bothriocephalus latus. By M. Bertolus.

The egg of the *Bothriocephalus* requires for its complete development a residence of from six to eight months in running water or water frequently renewed. At the moment of the rupture of the ovisac, the egg is composed of a dark brown, resistant, ovoid shell, exactly filled with an amorphous granular mass. Within a month this vitellus divides into cells of 0·015 millim. in diameter; soon afterwards a transparent spot (embryonal spot) makes its appearance in the centre, and is slowly developed at the expense of the vitellus, the latter at the same time contracting, so as to leave a space between it and the capsule.

In six months the embryonal spot has invaded the whole vitelline mass; at this time the embryonic hooklets make their appearance, and the embryo already manifests some movements of contraction. Lastly, at the end of seven or eight months a sort of operculum separates from the small extremity of the capsule, and furnishes a passage for the embryo.

The embryo consists of two spherical bodies, one within the other. The external body has the form of a hollow sphere 0·045–0·05 millim. in diameter; its wall is about 0·01 millim. in thickness, formed of large prismatic cells pressed against each other, and clothed externally with a quantity of large vibratile flagella of extreme tenuity, very flexible, and 0·010–0·015 millim. in length. By the impulsion of this vibratile apparatus the whole embryonal mass swims rapidly at the moment of its exclusion, turning upon itself; but in a few hours the movement slackens, ceases soon afterwards, and the ciliary coat seems to disappear.

Within this hollow sphere is another body, likewise of a spheroidal form, moving freely in its envelope, and armed towards one of its poles with three pairs of hooklets perfectly analogous to the six hooklets characteristic of the embryos of *Tænia*. This inner body, formed of very pale nucleated cells (0·005 by 0·003 millim.) measures from 0·035–0·04 millim. in diameter.

The hooklets, which are apparently similar in the three pairs, attain a total length of 0·013 millim.; the blade, which is but slightly curved, is about one-third of the total length; the haft, which is straight and very slender, is 0·009 millim. in length; the dental process projects considerably (0·0028 millim.).

The analogy presented by this embryo on the one hand with the embryos of the digenetic Trematoda, and on the other with those of the *Tæniæ*, seems to indicate clearly that this young parasite is destined to become encysted in the parenchyma of some aquatic animal for its further development.

In connexion with the latter, the author calls the attention of zoologists to a parasitic worm which he considers will prove to be the scolex of the *Bothriocephalus latus*. This is the *Ligula nodosa* of Rudolphi, which lives encysted in the conjunctive tissue of various species of the genus *Salmo*, with regard to which he states that he has ascertained it to be a scolex, of which the so-called cephalic portion, which is deeply invaginated in a very narrow caudal portion, presents a complete analogy of form and dimensions with the apparatus of fixation of the *Bothriocephalus.—Comptes Rendus*, Sept. 21, 1863, p. 569.

On the Structure of the Nervous System in the Gasteropodous Mollusca. By SALVATORE TRINCHESE.

The types investigated by the author are *Helix pomatia, Arion rufus*, and *Lymnæus stagnalis.*

In all the nervous centres of these animals there are—

1. Round or pyriform cells, of variable dimensions, enveloped by a thick sheath of conjunctive tissue.

2. Small cells, of irregularly triangular form, round which no envelope is perceived.

3. Free nuclei like those met with in the grey substance of the cephalorachidian system in the Vertebrata.

In these animals there are no apolar or unipolar cells, and bipolar cells are rare. The cells usually present four prolongations. Each cell emits a prolongation to each of the cells surrounding it, whilst other processes pass between the latter to other cells at a greater or less distance.

The nervous cells generally occupy the periphery of the ganglia. The central portion of the latter is occupied only by nervous fibres and conjunctive tissue. The nervous cells of one ganglion are never all of the same dimensions or of the same form. The largest cells generally form the stratum nearest the periphery, and the cells diminish in size towards the centre of the ganglion. The deepest stratum is formed of very small cells and free nuclei. This arrangement shows that these elements are in a state of continual development.

The two cerebroid ganglia are formed, in their upper part, of large round cells and of pyriform cells. These elements, which are arranged in groups, all emit processes which go to form nerves. The large round cells are placed at nearly equal distances from each other. In the intervals between the round cells there are constantly pyriform cells, of which the processes cross. In the lower region of the two cerebroid masses, very small triangular cells are observed.

At the anterior part of these masses there are, in *Helix* and *Arion*, four small ganglia, of the nature of those which have been described under the name of *accessory cerebroid ganglia.* These are concealed beneath the envelopes of the cerebrum, and can only be seen when the latter are rendered transparent by reagents and the organ is slightly magnified. Of these ganglia the two outer ones must be called *optic ganglia*, as they give origin to the optic nerves. They consist of free nuclei and of nervous fibres proceeding from the anterior part of the cerebroid masses. The free nuclei alone occupy the outer portion of the ganglion, and the nervous fibres the inner part; the line of separation is very distinct. The two inner ganglia are composed of voluminous cells pressed against each other.

On the course of the nerves connecting the cerebroid masses with the pedal ganglion there is a small ganglion composed of cells united in groups, the arrangement of which recalls that of the compartments of an orange.

In the pedal or abdominal ganglion, which is composed of several medullary nuclei, there are likewise very marked differences of structure. In a longitudinal section of one of the sides of the ganglion (in the *Helix*) four groups of pyriform cells are seen occupying all the upper and posterior region. In the lower region there is a group of small round cells. If a transverse section be made in the upper region, these groups of cells are seen separated by thick partitions of conjunctive tissue. Of these groups, the two lateral consist of small round cells, all communicating by numerous cylindraxes. The median groups are composed of cells three or four times as large as the preceding, and form a very regular circle. At the centre of this circle there is a cell, the diameter of which is three or four times that of those forming the circumference; to the latter it sends off numerous processes.

The peripheral nerves are formed of very delicate tubes, having in their walls nuclei similar to those which are observed in the higher animals in the embryonal state. The mode of their termination in the muscles is remarkable. The nervous element, on arriving at the muscular fibre, loses its proper wall, and the cylindraxis alone penetrates the muscle, dividing into two very slender filaments. These take opposite directions, each traversing one-half of the muscular fibre, on arriving at the extremities of which they terminate in very fine points.

To show the cylindraxis in the interior of the muscular fibre, and prove that it does not creep along its surface, the author made transverse sections of muscular bundles, and ascertained that the cylindraxis occupies the centre of each fibre. In some, two cylindraxes are observed, one of which is finer than the other.—*Comptes Rendus*, Oct. 12, 1863, p. 629.

On the Chanco or Golden Wolf (Canis Chanco). By Dr. J. E. Gray, F.R.S., &c.

Lady Augustus Hervey has kindly presented to the British Museum a fine specimen of the skin of a Wolf, which was shot by her brother, Lieut. W. P. Hodnell, of H.M.'s 54th Regiment, in Chinese Tartary. It is a very showy animal, rather larger than the common European Wolf.

Fur fulvous, on the back longer, rigid, with intermixed black and grey hairs; the throat, chest, belly, and inside of the legs pure white; head pale grey-brown; forehead grizzled with short black and grey hairs.

Hab. Chinese Tartary. Called *Chanco*.

The skull is very like, and has the same teeth as, the European Wolf (*C. Lupus*). The animal is very like a Common Wolf, but rather shorter in the legs; and the ears, the sides of the body, and outside of the limbs are covered with short pale fulvous hairs.

The length of its head and body is 42 inches; tail 15 inches.—*Proc. Zool. Soc.* March 24, 1863.

INDEX TO VOL. XII.

END OF THE TWELFTH VOLUME.

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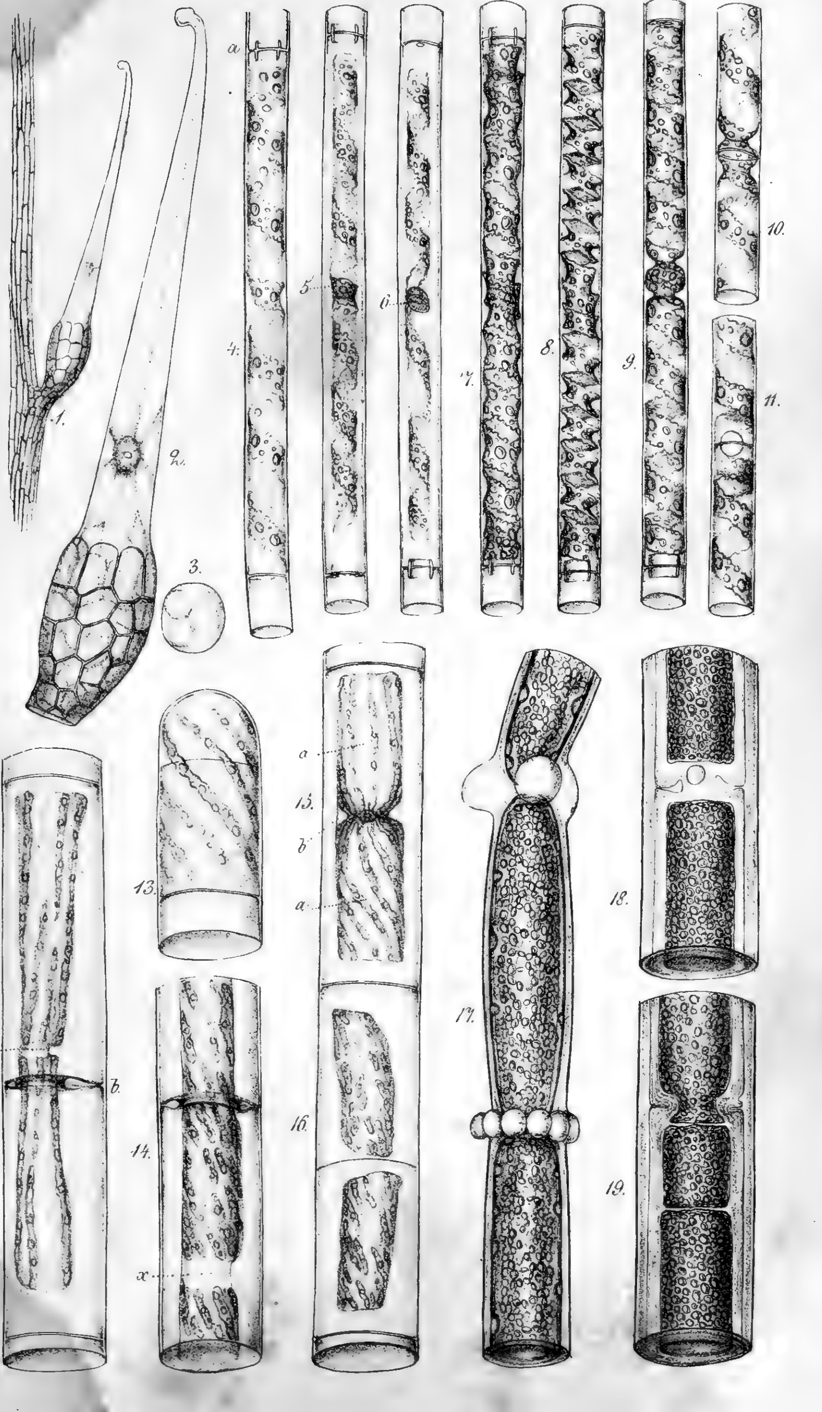
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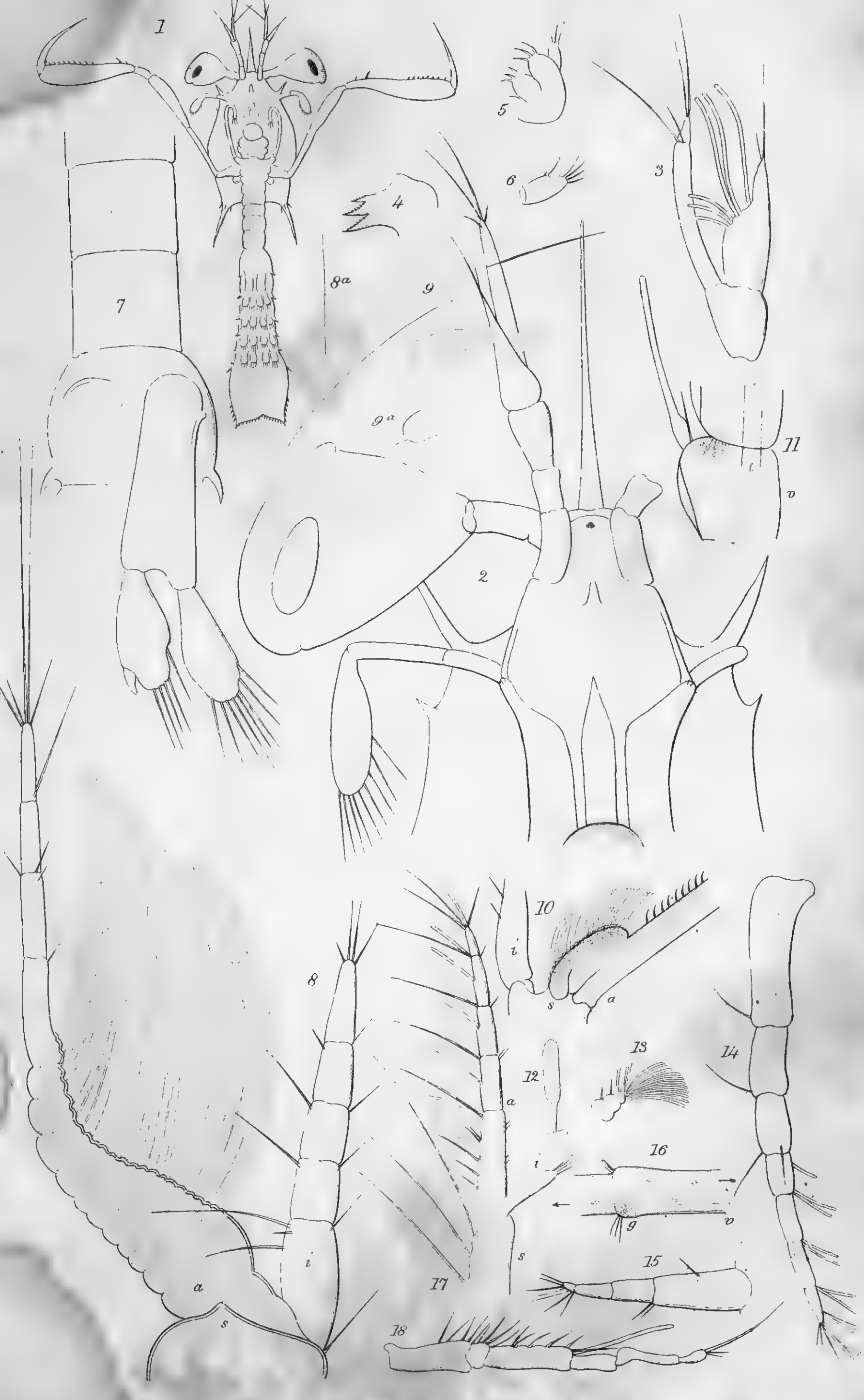
x



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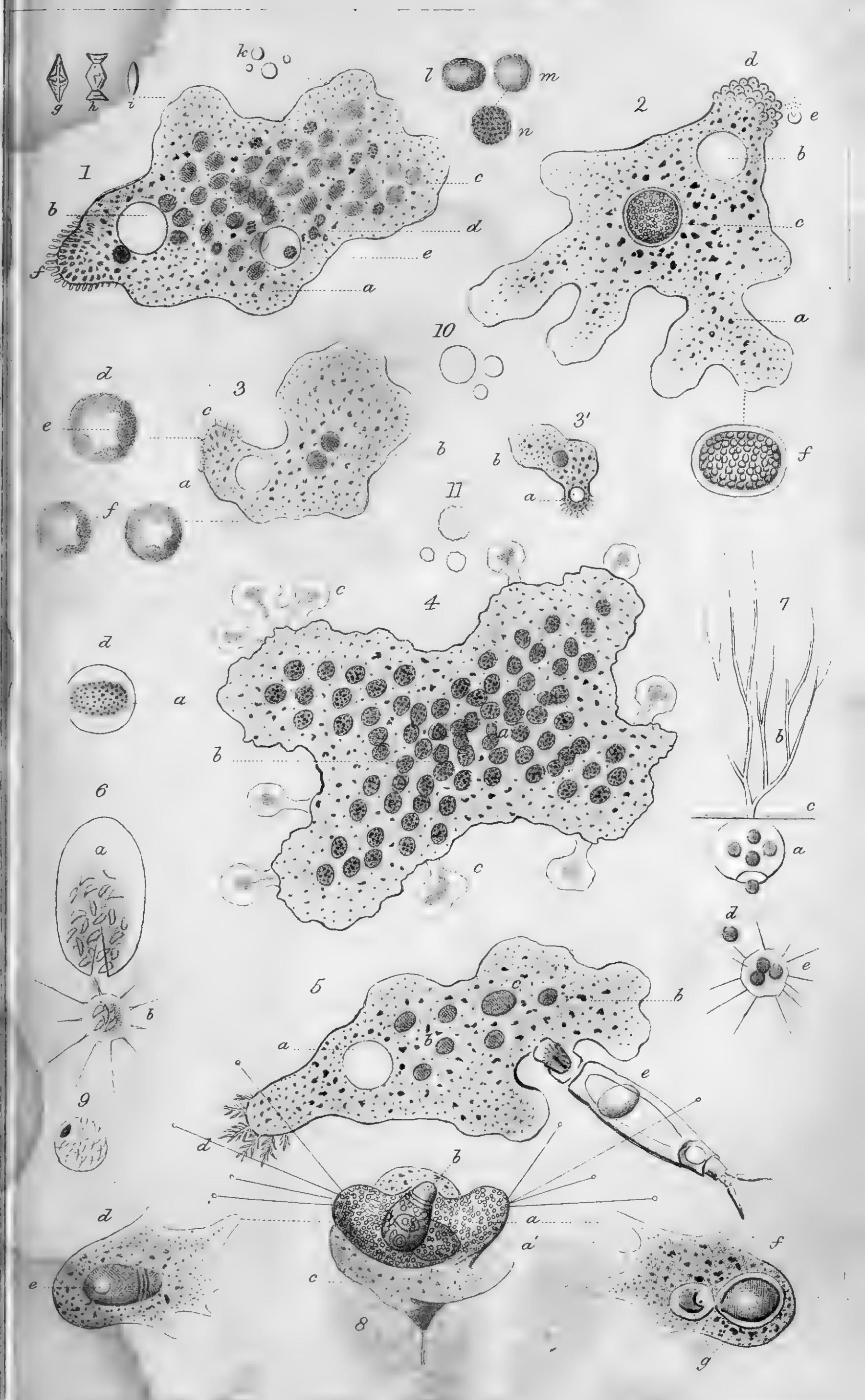

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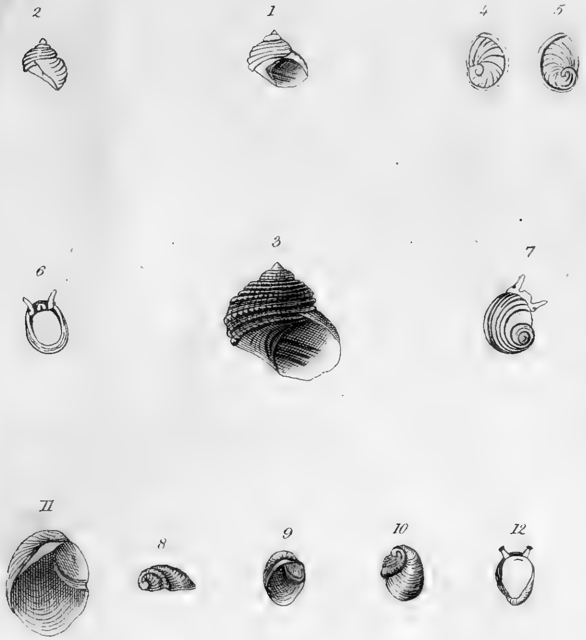
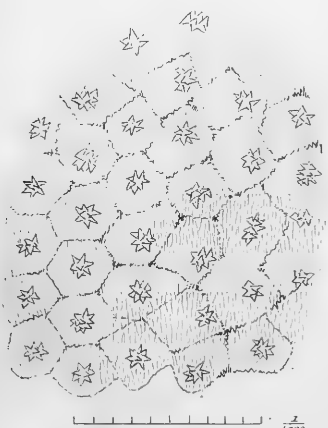


13



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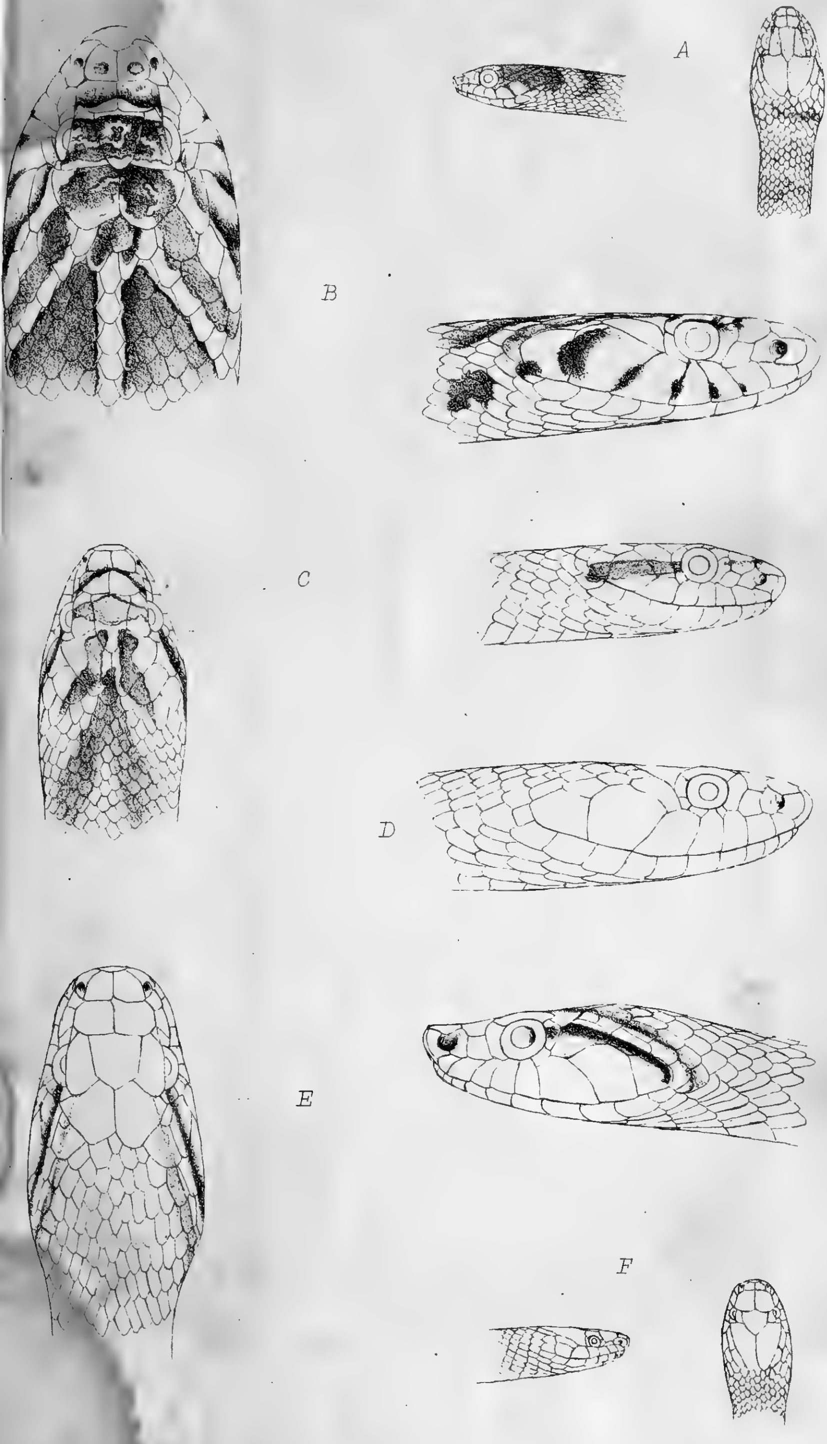

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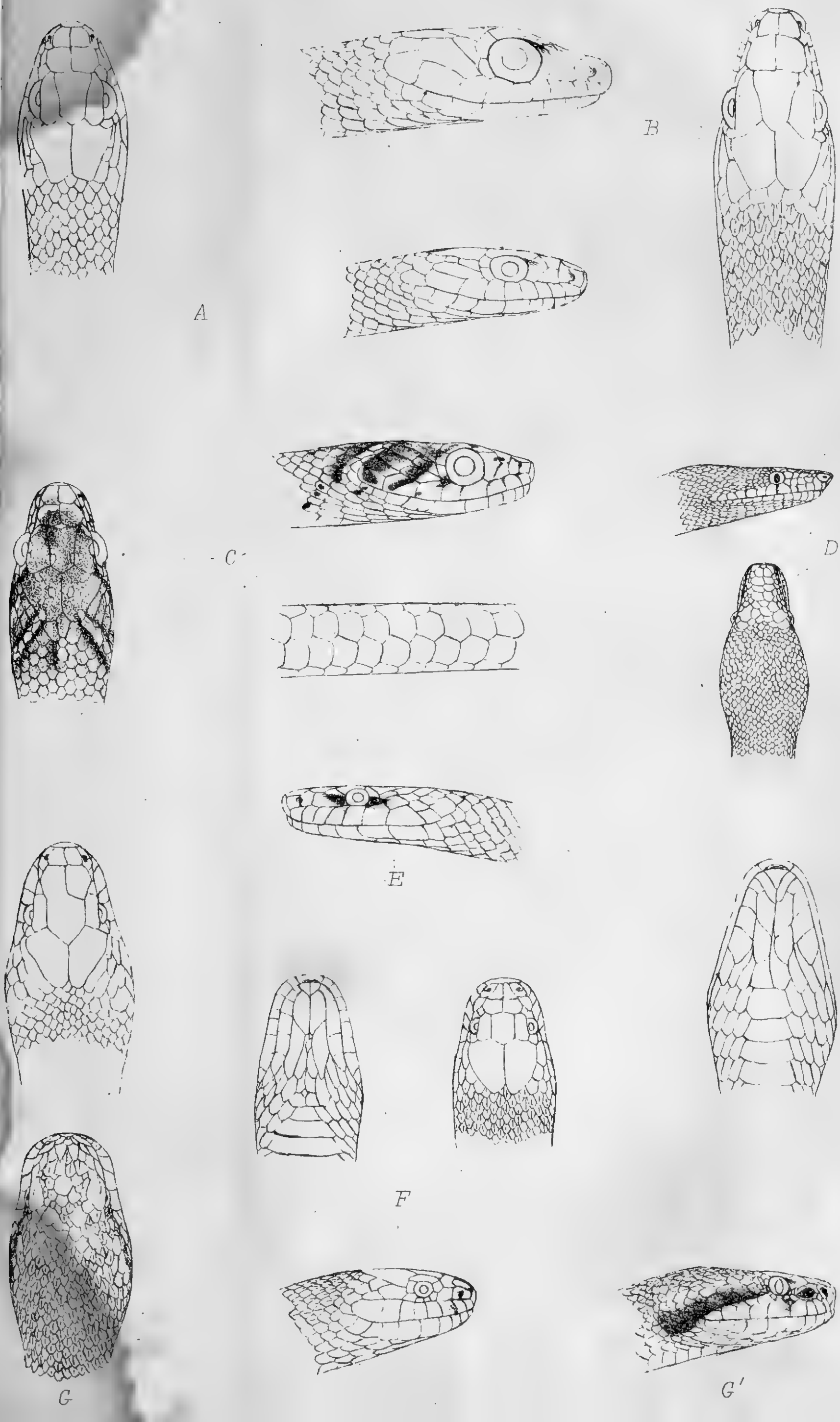
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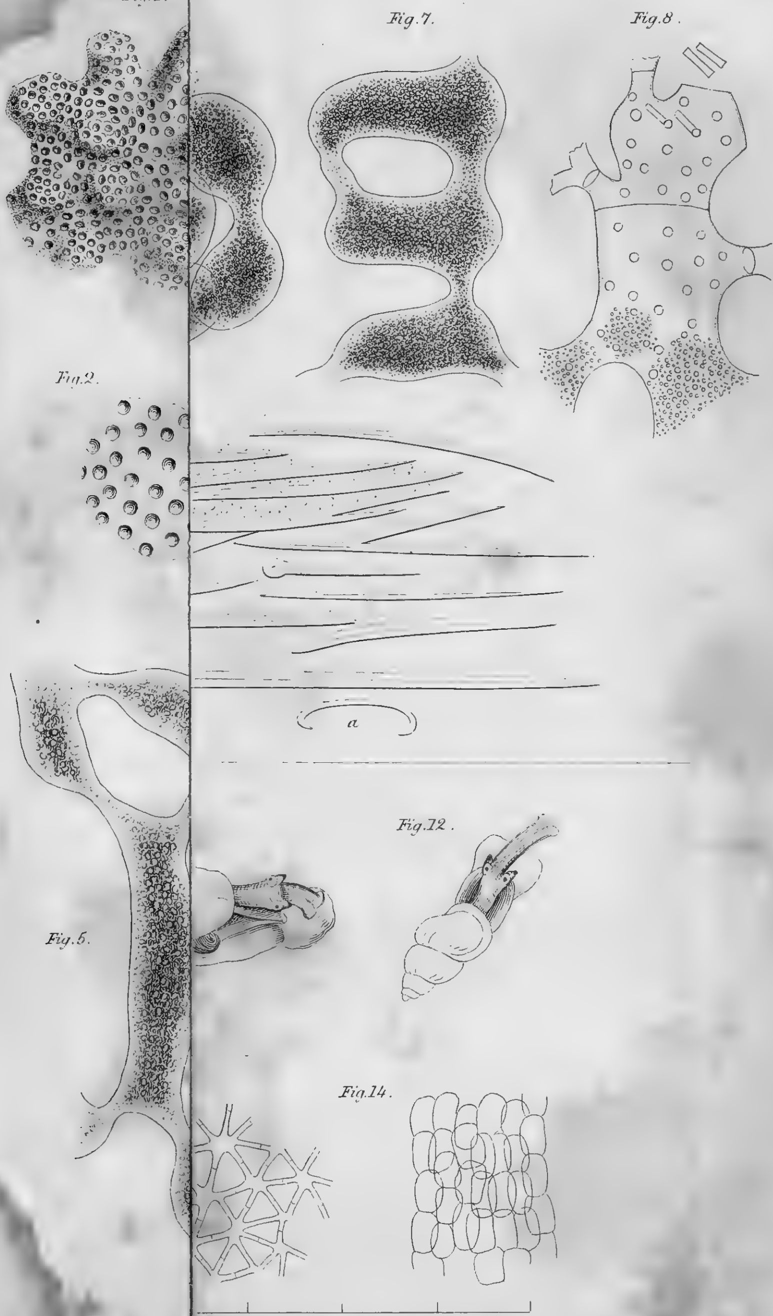

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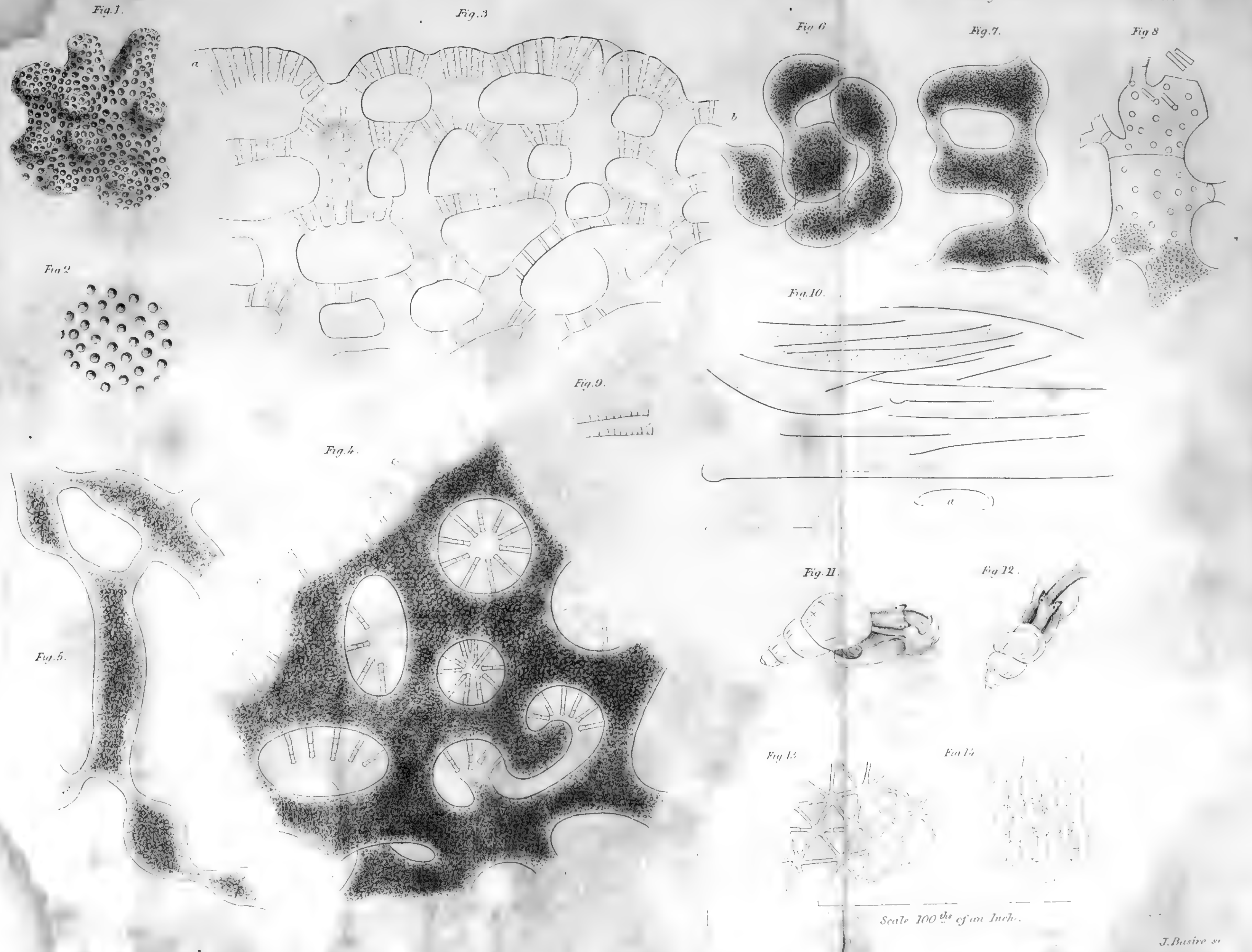

Fig. 1.
Fig. 2
Fig. 3
a
b
Fig. 4.
Fig. 5.
Fig. 6
Fig. 7.
Fig. 8
Fig. 9.
Fig. 10.
a
Fig. 11.
Fig. 12.
Fig. 13
Fig. 14
Scale 100ths of an Inch.
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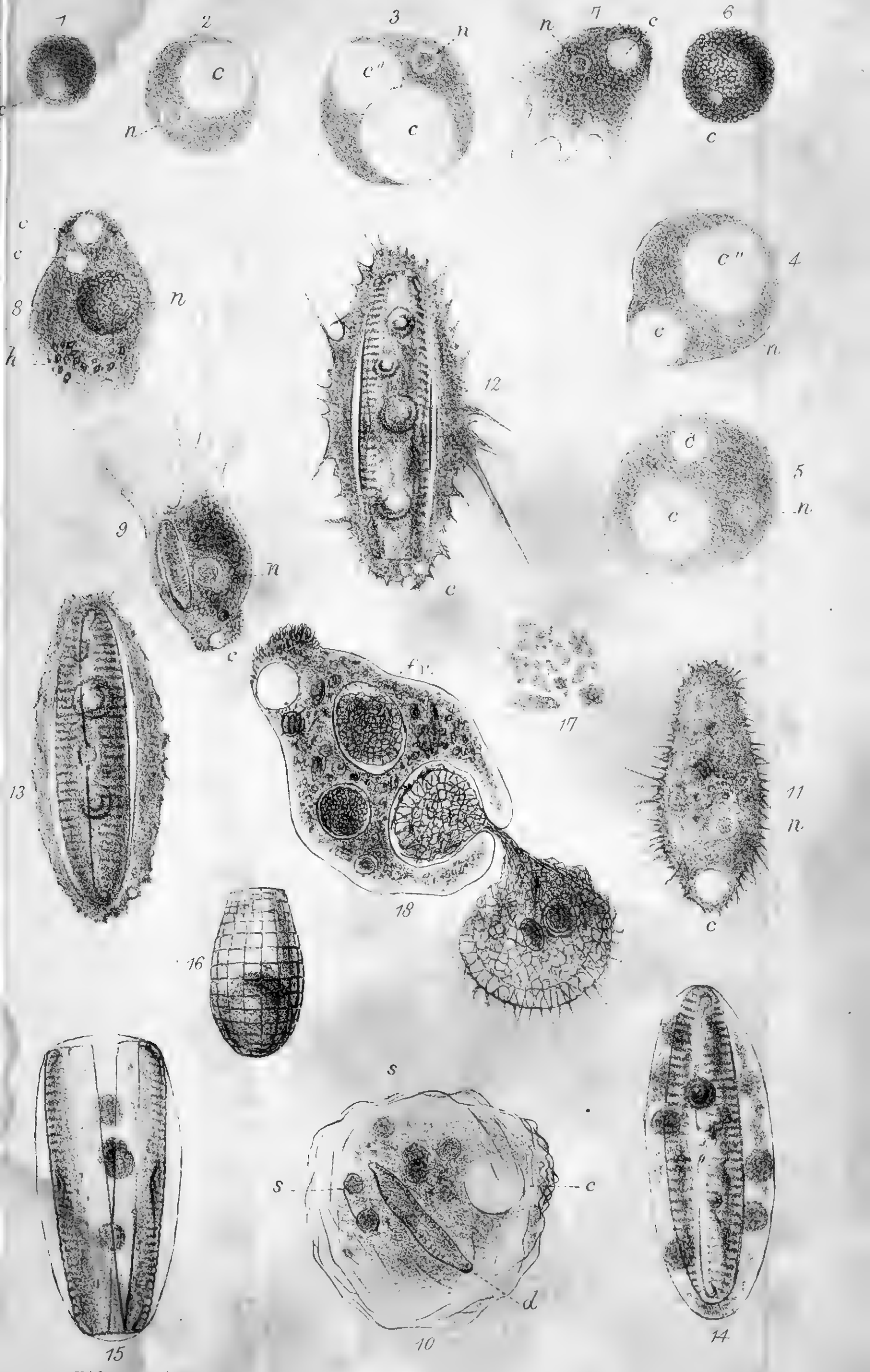

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