THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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VOL. VII.—FOURTH SERIES.

LONDON:
PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.
SOLD BY LONGMANS, GREEN, READER, AND DYER; SIMPKIN, MARSHALL, AND CO.; KENT AND CO.; BAILLIÈRE, REGENT STREET, AND PARIS: MACLACHLAN AND STEWART, EDINBURGH: HODGES AND SMITH, DUBLIN: AND ASHER, BERLIN.
1871.

"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.

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# THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH 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. 37. JANUARY 1871.

I.—*A Descriptive Account of three Pachytragous Sponges growing on the Rocks of the South Coast of Devon.* By H. J. Carter, F.R.S. &c.

[Plate IV.]

The term applied by Aristotle to those compact sponges which were "very hard and rough," and grew upon the rocks near the shore, was τράγοι. Hence the term "pachytragous" in the title of this communication—a word which I should not have introduced had there been any other previously employed to designate generally the order to which the three sponges about to be described belong.

Under the head of "Pachytragiæ" I would include for the present all the "Corticatæ" of Dr. Oscar Schmidt (Die Spong. Adriat. Meeres, 1862, p. 81) and all those designated Tethyadæ and Sphærospongia respectively by Dr. Gray ("Notes on the Arrangement of Sponges," Proc. Zool. Soc. Lond. 1867, p. 540 &c.).

It may be questioned hereafter how far the chondroid species of which *Tethya lyncurium* is a type, together with its repent or incrusting allies, should not be grouped together with Schmidt's *Chondrilla nucula*, &c.; but as regards the term "Sphærospongia," of which *Pachymatisma Johnstonia* is the first example in Dr. Gray's "Notes," recent observations on the habitat of this sponge seem undoubtedly to point out the necessity of its suppression altogether.

Thus I find that it is only when a portion of *Pachymatisma* is torn from its natural place of growth, and becomes free in the sea, that it assumes a spheroidal form. Spreading horizontally in its natural habitat, on inclined surfaces, in the most sheltered bowers of the shore-rocks, it rises more or less into obtusely rounded eminences, which give to its surface a deeply undulated form. This surface, too, as is well known, is incrusted with a cortical layer or zone of globular crystalloids, which, although thickest on its free side, is nevertheless continued *all* round the sponge, and frequently extends some distance into the mouths of the larger exhalant apertures or oscules; while the exhalant system of canals is also more or less horizontally developed, and not radiating, in accordance with the mode of growth of the sponge. Hence, when a portion becomes detached from its natural habitat and free in the sea, it soon surrounds itself entirely with the thick incrustation; while, its excretory canal-system and general structure continuing as before internally, it can have no radiated arrangement of the latter, however much its form may become spheroidal externally. The same applies to the Tethyadæ, of which *T. cranium* is the type. Thus it may be observed, in my description and illustrations of *T. arabica* (Annals, vol. iv. p. 1, 1869), that I found specimens of this species growing in a fixed hemispherical and in a free subspherous form respectively. But, as the fixed form has a radiating structure, so, when a portion has been detached from the rock (for it may be assumed always to commence life in a fixed form), it retains this radiated structure in the spheroidal one. Then, as the spheroidal form is accidental in both the free specimens of *Pachymatisma Johnstonia* and *Tethya arabica*, we cannot properly call them "subspherous sponges." This, too, may be the case with the Geodidæ and Tethyadæ generally.

The only true instance of a spheroidal sponge is seen in *Tethya lyncurium* and the like, where the sponge grows into this form on a pedicel,—and here not always, as some of the specimens of this sponge which grow on the rocks of this place demonstrate. At the same time it should be remembered that this is not a *Tethya*, if we are to regard *T. cranium* as typical of the Tethyadæ; and hence Dr. Gray has very properly adopted Nardo's name of "*Donatia*" for this genus (*l. c.* p. 541).

Still it may be asked how it is that the spheroidal specimens of *Tethya lyncurium*, when cast upon the shore, always present a facet from which the pedicel has been broken off, while no such indication of previous attachment appears on the subspherous specimens of *Tethya* proper, *Geodia*, and *Pachymatisma* (see my illustrations, 'Annals,' *l. c.*).

This, it seems to me, may be explained in the following way, viz.:—the heavy chondroid nature of *Tethya lyncurium*, and the rapidity with which the chondroid material is produced (for when two or three living specimens are placed in sea-water in contact, they become so firmly united together in twenty-four hours that force is required to tear them asunder), might cause the *Tethya*, when broken off from its pedicel, to sink to the bottom directly, and at the same time to quickly unite itself to the first fixed rock with which it might come into contact, while the lighter nature of the Tethyadæ proper and the Geodidæ, together with their inability to unite themselves so quickly to foreign objects, might lead to their drifting about in the sea, until they render themselves independent of their position by fortifying themselves all round with their peculiar structures, and finally assume the subspherous form.

Again, the specimens of *Tethya lyncurium* only come on shore in heavy storms, when these have occurred at spring-tides, and thus the waves at low water have wrenched them off their pedicels; for it is only towards dead low-water mark that I have yet found them growing on the rocks. They therefore, from their tough chondroid nature, probably hold on when portions of *Pachymatisma* give way, and thus, only yielding to the heaviest gales, come on shore directly after they have become separated from their attachments, even before they have time to sink into still water and become united again to some fixed object.

Such observations may account for the presence of the facet of attachment in *Tethya lyncurium*, and for its absence in the subspherous forms of the Tethyadæ proper and the Geodidæ.

Lastly, I would take this opportunity of noticing that my description and illustrations of *T. lyncurium* (Annals, *l. c.*) are wholly fallacious where they point out the existence of interlobular grooves on the surface, except for the dead state, since, in some specimens which I kept alive for a few days in sea-water, the chondroid substance increased to such an extent on the surface as not only to efface all the interlobular grooves, but, if any thing, to leave depressions over the centre of the lobules themselves, just in the opposite position to that which they have in the dried specimens. So much for describing objects of natural history in the dead state; let us now direct our attention to the description of the three pachytragous sponges to which I have alluded in the *living* one.

Dercitus niger, mihi, n. var. Pl. IV. fig. 1.

Massive, spreading, fixed, variable in thickness, following the sinuosities of the rock on which it grows; compact, hard, tough, resistant. Surface undulating, smooth, soot- or bottle-black, shining, puckered towards projecting points of the rock beneath. Dermal layer (figs. 1 *a*, 2 *a*) thin, colourless, transparent, rugose, charged with minute bacillar spinous spicules; presenting here and there large exhalant apertures (oscules), singly or in groups, with raised margin, crateriform, also minute inhalant apertures (pores) generally all over the surface of the sponge, amidst the projecting points of the large spicules of the interior, and numerous circular, papillary eminences of a lighter colour, caused by the projection of certain cells (beyond others) of the subjacent celluliferous layer. Celluliferous layer (*b*) cortical, thick, continuous all round the sponge, and often for a short distance into the mouths of the larger oscules, much thicker on the free surface than at any other part; covered by the dermal layer above, in contact with the next or spiculiferous layer internally; composed of cells imbedded in a kind of sarcodal trama; cell (fig. 6) globular or oval, consisting of a cell-wall in which is contained a large transparent nuclear (?) body (*a*) and a small nucleolar (?) one (*b*), together with a great number of free cellules (*c*), in each of which is one or more black granules (*d*), the black granules collectively giving a black colour to the cell, and an intense black colour to the layer composed of them (fig. 1 *b*). Spiculiferous layer (fig. 2 *c*) thin, composed of the large trifid spicules of the sponge densely packed together; in contact with the celluliferous layer externally, and with the body-substance of the sponge internally. Body-substance (figs. 1 *c*, 2 *d*) composed of more or less areolar sarcode, which is in direct connexion with the pores, and traversed by the branches of the excretory canal-system, which, uniting together, finally terminate in their respective oscules; charged more or less with the spicules about to be described, and a great number of the black cells (fig. 3 *c*), which thus give it a dark tint, although always much lighter than that of the black cortical celluliferous layer. Spicules of three kinds:—1, trifid (fig. 3), large, stout, consisting of a straight, smooth, pointed shaft and three expanded arms, so much like a quadriradiate spicule, from the rays being so much like each other, that, but for the shaft being a little longer and straight, while the arms are slightly flexuous, the difference would be inappreciable; 2, minute bacilliform or fusiform spicule (figs. 3 *a*, 4), covered with spines, which are vertical in the centre, but become more inclined towards the extremities of the shaft; 3, minute tricurvate or bow-shaped spicule (figs. 3 *b*, 5), of hair-like thinness and equal in size throughout, except at the ends, which are slightly pointed and slightly turned up. The large trifid spicules are scattered throughout the sponge, but chiefly brought together in the spiculiferous layer; the minute spinous one also, but chiefly confined to the dermal layer, and the tricurvate spicule confined to the body-substance.

Size variable; largest specimens found, about 4 inches in diameter and a little under an inch in thickness. Black cells variable, largest about 1-170th of an inch in diameter. Shaft of largest spicules about 1-80th inch long. Spinous spicule about 1-1200th inch long; tricurvate about 1-300th inch long.

Loc. Budleigh-Salterton, south coast of Devon, Straight Point.

Hab. Fine red-sandstone conglomerate rocks of the New Red Sandstone series. About two-thirds below high-water mark and downwards; on inclined surfaces, deep in under the bowers of the rocks, never pendent from their under surfaces.

Obs. This sponge, if not the same, is closely allied to *Hymeniacidon Bucklandi*, Bowerbank (Brit. Spong. vol. ii. p. 226), but wrongly classed, as conjectured by the author in the following passage at the end of his description, viz.:—

"This sponge varies so widely from the ordinary structure of *Hymeniacidon* that I doubt much whether it should not be made the type of a new genus."

Now there is no doubt in my mind about the matter, nor could there have been in Dr. Gray's when he proposed a place for this sponge among his Tethyadæ (Notes, &c. *l. c.* p. 542, 1867) under the new name of "*Dercitus*." Schmidt subsequently (Spong. Algier, p. 15, 1868) proposed the name of "*Pachastrella*" for this genus in his Compagineæ, finally placing it among his Corticatæ, *i. e.* under Ancorinidæ, in 1870 (Spong. Faun. Atlantisch. p. 64); but he errs in his note to Dr. Bowerbank's synonymy (p. 76), where he considers the presence of the tricurvate spicule "accidental," as may be seen by my description and illustrations; nor is Schmidt right in stating that this kind of spicule belongs to the character of his Desmacidinæ, if this remark means exclusively; for he himself has figured a tricurvate spicule as partly characteristic of his *Pachastrella connectens* (Spong. Faun. Atlantisch. Taf. vi. fig. 5). Dr. Gray's arrangement therefore claims priority; and hence the name of "*Dercitus*" for this genus.

The dried specimen, from Guernsey, which was sent to and described by Dr. Bowerbank under the name of *Hymeniacidon Bucklandi* was of a "dark purple colour" externally, and internally "light brown;" and all that is stated of the specimen that was sent to him, preserved in salt and water, from Torbay is that it was "almost as solid as a piece of boiled bullock's liver." Now, assuming, in accordance with Dr. Bowerbank's experience, that this is the best way to preserve sponges for description, we can hardly think that the colours of the wet were different from those of the dried specimen; or this would have been noticed.

Hence, as the species which I have been describing is jet-black when dry, and the body or internal substance inclining, if any thing, to dirty green, while the same colours are presented by the portions which have been preserved in spirit and water, I cannot but infer that at least, as before stated, the black sponge which I have designated by the specific name of "*niger*" is a variety of *Dercitus Bucklandi*, and therefore deserving of this separate denomination.

But whether the reader chooses to admit this or not, he can hardly fail to see that, *cæt. par.*, there is a vast difference between the description of a sponge from "the life," and that of one which the author has only seen after death.

It is not difficult to find this sponge, because it does not grow, like many, on the under surface of the rock, but grows on its sides in deep bowers, sought for apparently by the sponge for protection from the waves. Then, its black-velvet-looking appearance strikes the eye immediately; but the difficulty of getting at it, except in a more or less horizontal position, and its toughness and firm adherence, rendering it necessary to take off a portion of the rock on which it grows with hammer and chisel to obtain the whole of the specimen, make its collection by no means an easy task for a stiff old collector.

Perhaps the most remarkable point, after all, about this sponge is the presence of the celluliferous cortical layer and the characters of the cells of which it is composed—since, by their accumulation here, and being scattered through the substance of the sponge, they, although totally different in composition, do occupy a position exactly like that of the globular crystalloids which form a crust round and are scattered generally through the substance of the Geodidæ. But of this more under "General Observations."

The puckered state of this sponge on the surface, while *in situ*, seems to arise from contraction occasioned by the falling of the tide, or absence of water, when its substance becomes drawn towards the more prominent points of the rugged portion of rock beneath, over which it may be growing. But, whether this explanation be correct or not, the puckered radiating lines from particular points on the surface of the sponge are remarkable.

It is also worthy of remark that, although the sponges of this order usually possess a large, acerate, long fusiform spicule in addition to the rest, there is none in *Dercitus niger*.

Stelletta aspera, mihi, n. sp. Pl. IV. fig. 7.

Massive, spreading, fixed, variable in thickness, following the sinuosities of the rock over which it grows; compact, rough, and resistant. Surface undulating, even, asperous, of a light grey tint, sometimes cream-colour, occasionally green. Dermal layer (Pl. IV. figs. 7 *a*, 8 *a*) colourless, thin, transparent, charged with minute, spinous, sub-bistellate spicules, presenting here and there, though mostly in sheltered parts, groups of large exhalant apertures (oscules) of different sizes, whose orifices are not bordered by an elevated margin, but more or less contracted by a circular expansion of the dermal sarcode extended inwards like the so-called "diaphragm" in *Pachymatisma*; also minute inhalant apertures (pores) scattered over the surface generally, but most evident in the vicinity of the oscules, amidst the projecting ends of the large spicules, which have the peculiarity of lying almost horizontally on the surface, and thus imparting to it the asperous character mentioned; in contact internally with the celluliferous layer. Celluliferous layer (figs. 7 *b*, 8 *b*) so thin as to be hardly perceptible, except under an inch compound power, when, in many parts of the surface, the cells of which it is composed may be seen to be arranged in a tessellated manner under the dermal layer; and when portions are torn to pieces and placed under a quarter-inch compound power, the cells are found to be imbedded in distinct cavities (fig. 14 *e*), in a kind of sarcodal trama (*d*) like that of *Dercitus niger*, and to correspond with them in composition in every particular but the black colour, those of the species under description being colourless. Cells (fig. 14) globular or oval, consisting of a cell-wall, in which is contained a large transparent nuclear (?) body (*a*) and a small nucleolar (?) one (*b*), itself apparently nucleated and attached to the larger one; also containing a great number of free cellules (*c*), each enclosing one or more colourless granules (*f*); cells not only congregated towards the surface, but scattered throughout the sponge generally, together with here and there a cell with black granules, or "black cell," precisely like those of *Dercitus niger*; celluliferous layer in contact with the dermal sarcode externally, and internally continuous with the body-substance of the sponge. Body-substance (figs. 7 *c*, 8 *c*) cream-coloured, densely charged with large, long, acerate spicules, which so project, when it is torn to pieces, as to give it an echinated appearance and equally asperous feel; composed of more or less areolar sarcode, which is in direct connexion with the pores, and traversed by the branches of the excretory canal-system, which, uniting together, finally terminate in their respective oscules; charged more or less with the spicules about to be described. Spicules of four kinds:—1, the largest (fig. 9), smooth, fusiform, acerate, slightly curved; 2, smooth, trifid (figs. 10 & 11), with shaft pointed at one end and furnished with three arms at the other, spreading horizontally in the opposite direction, slightly inclined forwards towards the long axis of the shaft, vase-like, each terminated by bifurcation, which extends to a variable degree down the arm; 3, minute spinous spicule (fig. 12), sub-bistellate—that is, where the spines are chiefly confined to the ends of the short shaft; 4, minute stellate spicule (fig. 13), a little larger than the latter, with small body and long arms, which are incipiently spinous. The large acerate spicules are very numerous and scattered equally throughout the sponge; the trifurcate spicules chiefly confined to the surface, where, with the former, they lie almost horizontally (fig. 8); the minute sub-bistellate spicules are chiefly confined to the dermal layer, and the stellate spicules to the body-substance of the sponge.

Size variable; largest specimens found about 4 inches in diameter and about an inch thick. Cells variable, the largest about 1-170th of an inch in diameter. Largest acerate spicule about 1-10th inch long; longest shaft of trifid spicule about 1-30th inch; minute sub-bistellate spicule about 1-2000th inch long, and stellate about 1-1000th inch in diameter.

Loc. Budleigh-Salterton, south coast of Devon. Straight Point.

Hab. Same as the foregoing species, viz. *Dercitus niger*.

Obs. This sponge possesses the spicule-character of Schmidt's genus *Stelletta*, and has hence been so named; but the celluliferous layer has not, I think, been yet noticed or described, and hence it may be necessary hereafter to unite those sponges which possess it into a separate group, if not one also with a different appellation.

It answers somewhat to the description of *Ecionemia ponderosa*, Bowerbank (Brit. Spong. vol. ii. p. 56); but there is no "dark-purple" sarcode on the surface, nor is the surface "smooth;" nor are the furcated ends of the trifid spicule *recurved*, as stated in the text and shown in the representation of the type specimen (vol. i. pl. 28. fig. 355). Nor can it be his "*Tethya muricata*, MS.;" for there are no "skeleton fasciculi," the substance of the interior is all confused like that of *Pachymatisma*, and the minute dermal spicule sub-bistellate, not "elongo-attenuato-stellate," like that of Dr. Bowerbank's figure 35. Nor is there any spicular combination given by Schmidt like it.

It is frequently overgrown by other sponges, especially *Halichondria panicea* and *H. simulans*, Johnston. And in one specimen which I possess, where it has been overgrown by a *Microciona* (Bk.), the areolar structures of the two sponges have grown so much into each other, that a section represents the same condition between the two as that which would be seen in making a section of the union between a shoot of one tree and another on which it is grafted.

When preserved in spirit, this sponge assumes a lead-colour—and when dried, a very light brown or dirty white. In the latter state it is much less compact than *Dercitus niger*, owing to the more open condition of its areolar structure and the larger size of the excretory canals, which are therefore much more evident than in the more compact structures.

How far the horizontal position of the spicules may be owing to its shore habitat, where it is exposed to the beating influence of the waves, I am not prepared to say; nor can this be determined until a specimen of the same sponge is obtained from a deep-sea habitat, if any exist there, where it would be more at rest during development.

Nitric acid applied to the cell of the celluliferous layer, here as well as in *Dercitus niger*, causes the whole to contract slightly, and breaks down the cellules, but does not alter much the large nuclear (?) or small nucleolar (?) bodies.

Liquor potassæ causes the whole to expand, breaks down the cellules, and allows them to run together in the form of several globular masses of oleaginous or albuminous-looking matter.

Iodine breaks down the cellules, but does not render the nuclear and nucleolar bodies more evident.

Thus these agents do no more than render the nuclear and nucleolar bodies more evident by breaking down the cellules. Perhaps, too, the *nucleolus* under nitric acid becomes a little more consistent or opaque.

Stelletta lactea, mihi. Pl. IV. fig. 15.

Massive, spreading, fixed, following and filling the cavities of deciduous small boring shells (*Saxicavæ*) and Annelids, which confine themselves to the surface of the sandstone rock in which they live, almost entirely concealed by overgrowths of small Cirripedes and Fuci, and communicating with the exterior only through the openings of the cavities mentioned. Dermal layer (figs. 15 *b*, 16 *b*) thin, white, densely charged with minute stellates; agglutinating to its surface minute rounded grains of sand, amidst which are situated the exhalant apertures (oscules) *in* the layer, without a raised margin, also the inhalant apertures (pores), somewhat smaller, scattered generally throughout the exposed area; grains of sand (fig. 16 *a*) blackened by a pigmental layer, which also lines all the cavities occupied by the sponge; in direct contact with the body-substance of the sponge internally. Body-substance (figs. 15 *c*, 16 *d*) opalescent, soft, compact, composed of areolar sarcode traversed in all directions by the branches of the excretory canal-system, which, uniting, finally terminate in their respective oscules; charged more or less with the same kind of stellates as those in the dermal layer, together with minute sheaf-like bundles of acerate spicules (figs. 20 *a*, 22), which in certain directions reflect the light like the micaceous particles in granite. Spicules of five kinds:—1, the largest (fig. 17) smooth, acerate, fusiform, slightly curved; 2, smooth, trifid (figs. 18, 19), with shaft pointed at one end and provided with three arms at the other, spreading horizontally in the opposite direction, more or less inclined forwards towards the long axis of the shaft, vase-like, straight or slightly flexuous, smooth, pointed; 3, the same (fig. 19), with the ends of the arms more or less bifurcated; 4, stellate spicules, with large body (fig. 21, *a*) and short thick rays, or with long rays and hardly any body (*b*); 5, sheaf-like bundles of minute, smooth, acerate spicules lying parallel to each other (fig. 22). The large acerate spicules are more or less spread throughout the sponge; the trifid ones of both kinds chiefly confined to the surface, where they are arranged vertically with their heads towards the dermal layer and their shafts internally (fig. 16 *c*); the stellates, although most numerous and packed together crust-like in the dermal layer, are also scattered throughout the body-substance; while the sheaf-like bundles of minute acerate spicules are entirely confined to the latter.

Size variable, depending chiefly upon the size of the excavations, the largest of which are seldom more than half an inch long and a quarter of an inch in diameter. Largest acerate spicule a little less than 1-20th of an inch long; longest shaft of trifid spicules about 1-30th inch; stellates about 1-2000th inch in diameter, and sheaf-like bundles of acerate spicules about 1-1000th inch long.

Loc. Budleigh-Salterton, south coast of Devon. Straight Point.

Hab. Cavities of the surface of sandstone rock made by *Saxicavæ* and Annelids; communicating with the exterior through their openings, obscured by overgrowths of Cirripedes and Fuci; growing from two-thirds below high-water mark downwards.

Obs. I found this sponge by accident when chipping off a portion of the rock on which *Grantia nivea* was growing; otherwise I should have passed it over; for, living in the cavities and under the overgrowths mentioned, it is almost impossible to see it until the rock is broken. Having once found its habitat, it was very easy to procure specimens afterwards; for it is very abundant.

Although occupying the cavities of *Saxicavæ*, whose deciduous shells are frequently present in the midst of the sponge, I could never find any indication on them of its having bored into them after the manner of the Clionidæ.

On breaking open the rock, the contrast between the opalescent aspect of the sponge-substance and the black pigment that it secretes over the cavities which it occupies is very striking. By transmitted light, under the microscope, this pigment presents a dark brown colour, which to the unassisted eye is black; but the layer is never continued over the dermal sarcode, although the minute grains of sand and bits of shell agglutinated to it are thus more or less blackened. The dermal layer, therefore, is always white, and particularly so in the dried state, from the number of stellates which it contains, while the rest of the substance in drying shrinks up into a gum-like consistence and colour. In spirit and water, however, this retains its original bulk and compactness; but the opalescent aspect becomes changed to opaque lead-colour.

On account, perhaps, of its isolation and its existence in small portions while it remains *in situ* in the rock, when fractured, those portions which are not much injured live for several days afterwards; and thus, from their smallness, being easily brought under a high power of the microscope, the currents outward and inward of the oscules and pores respectively are as easily seen.

In the specimens which I have mounted in balsam, the variety of spicules is so great, and their abnormal forms so numerous, that it is not easy to find out those which are the staple ones. This variety, which is greater in some than in other specimens, I am inclined to think may be induced by the disturbing influence of the waves, from which the sponge seems to shelter itself as much as possible by growing solely in the excavations mentioned. Possibly, if it also grows in the deep sea, the quiet there may enable it to acquire larger dimensions, and to present a less variable development of the spicules.

It is desirable to add that in *Stelletta lactea* there are no cells like those of the "celluliferous layer" in the two sponges previously described.

General Observations.

The chief point of interest, perhaps, in the foregoing descriptions is the presence of the peculiar cells mentioned in *Dercitus niger* and *Stelletta aspera*, corresponding in multiplicity, position, and general distribution, though not in composition, to the globular crystalloids or little siliceous balls in the crust and body of the Geodidæ; add to this their contents, which render them so much like reproductive agents, and, lastly, their occurrence in the two sponges mentioned, and not at all in the third, viz. *Stelletta lactea*. Nor do they exist in *Pachymatisma Johnstonia*; but in the dried specimens of *Geodia gigas*, presented to the British Museum by Dr. Oscar Schmidt, there are similar cells in abundance, together with the globular crystalloids.

Although analogous in multiplicity, position, and distribution to the globular crystalloids in the Geodidæ, they not only differ from them, as just stated, in composition, by the former being cellular and albuminous, while the latter are solid and siliceous throughout (Annals, 1869, vol. iv. p. 16 &c., pls. 1 & 2. figs. 12 & 14), but also in size; for the largest crystalloids are three or four times as large as the largest cells, and the latter much larger than the smallest or youngest crystalloids, so that in these respects, viz. in composition and size, they cannot be confounded.

Formerly I thought that the colour of the sponges might be always sought for in the ampullaceous sacs ("Wimperkörbe," Schdt.), and therefore that the black cells of *Dercitus niger* might be ampullaceous sacs (Annals, 1870, vol. vi. p. 332); but the result of more particular examination subsequently, as given above, has caused me now to regard the latter more as reproductive agents.

I have also alluded (Annals, *l. c.*) to the presence of ampullaceous sacs in *Geodia gigas*, Schdt.; but on examining these also again, now that I have become more intimately acquainted with the composition of the cells in *Dercitus niger* &c., I am led to conjecture that they also may be of the same kind as the latter, in which case, should I be right, we shall have an instance in this sponge where both the globular crystalloids and the cells occur together, and thence have to seek for the ampullaceous sac under some other form than that in *Halichondria simulans* (see Annals, *l. c.*), not only in *Geodia gigas*, but in *Pachymatisma Johnstonia* and in *Stelletta lactea* &c., where there is nothing of the kind like the ampullaceous sac of the *Halichondria* mentioned, so far as the larger size of its cellules and peculiar grouping go. The ampullaceous sac with smaller and thus less-marked cellules may exist in all; but as yet I have not been able to substantiate this.

Of course, after having been dried, it is impossible to make out any thing in these cells so satisfactorily as in living ones; and hence, although such cells are present in great abundance in their contracted state in the dried specimens of *Geodia gigas* mentioned (measuring about a 1000th of an inch in diameter and filled with a number of cellules), liquor potassæ, although it causes the cellules to run together into one homogeneous mass, does not yield any satisfactory demonstration of a nucleus under the addition of nitric acid, nor is the cell-wall well marked—two points in which the cell of *Dercitus niger* differs distinctly from the ampullaceous sac.

Hence the desirableness of examining these cells of *G. gigas* in the recent state.

We too often content ourselves with describing sponges as well as other objects of natural history in their dried or dead condition; and although this is the only way in which they often come to us, yet we might as often repeat to ourselves as well as to others under such circumstance the words of Hamlet to Horatio:—

> "There are more things in heaven and earth, Horatio,
> Than are dreamt of in your philosophy."

Too often the living state of such objects is disregarded when we have the opportunity of adding this *sine quâ non* to their natural history. Describing the skeleton or dried specimen of a sponge only is little better than making it a matter of mere curiosity; and hence the want of general interest and comparatively little advancement which characterizes our knowledge of this more than any other division of the animal kingdom.

I am not, however, yet satisfied with my examination of the cells of *Dercitus niger* and *Stelletta aspera*, although partly made in the living state; for I cannot yet fully comprehend the nature of the nucleus in respect of its large size, resemblance to an aqueous cavity, and indisposition to change its appearance under the application of chemical agents.

In short, we have yet much to learn about this cell before we come to its real import; meanwhile its notice adds another feature to the Pachytragous Sponges, some of which possess analogous elements, as the globular crystalloids or little siliceous balls in the Geodidæ, akin to which are the siliceous disks of a like nature in *Stelletta discophora*, Schdt.; while others possess neither cells, globular crystalloids, nor disks, as *Stelletta lactea*.

EXPLANATION OF PLATE IV.

N.B. Figures 3, 9–11, and 17–19 are all drawn to the same scale, viz. 1-24th to 1-1800th of an inch; and figures 4, 5, 12, 13, 21, and 22, also to the same scale, viz. 1-6th to 1-6000th of an inch, to show their relative sizes respectively.

Fig. 1. *Dercitus niger*, n. var.: section of a portion, natural size, showing surface (*a*), black cortical layer (*b*), and body-substance (*c*) presenting truncated ends of excretory canals.

Fig. 2. The same, diagram section, much magnified, showing dermal layer charged with minute spinous spicules (*a*), black cortical layer composed of cells (*b*), layer of trifid spicules (*c*), body-substance (*d*) less densely charged with the trifid spicules, together with minute tricurvate or bow-like spicules, and black cells.

Fig. 3. The same, trifid spicule with minute dermal spinous (*a*) and tricurvate (*b*) ones, together with black cells (*c*), all relatively magnified.

Fig. 4. The same, dermal spicule, greatly magnified.

Fig. 5. The same, tricurvate spicule, greatly magnified, on the same scale.

Fig. 6. The same, black cell, still more magnified, showing large subcircular nuclear (?) body (*a*), small nucleolar (?) body (*b*), minute globular cellules (*c*), charged respectively with one or more black or dark-brown granules, which collectively give the dark colour to the cell, and the latter collectively the intense black colour to the cortical layer; *d*, separate cellule.

Fig. 7. *Stelletta aspera*, n. sp.: section of a portion, natural size, showing surface (*a*), cortical layer (*b*), and body-substance (*c*), presenting truncated ends of excretory canals.

Fig. 8. The same, diagram section, much magnified, showing dermal layer charged with minute sub-bistellate spicules (*a*), cortical layer of cells (*b*), body-substance (*c*) charged with large acerate, trifid, furcate, and minute stellate spicules, of which the former are most aggregated towards the surface, where they are inclined so much as to be almost horizontal.

Fig. 9. The same, large acerate fusiform spicule; viewed from above, straight; but slightly curved when viewed laterally: *a*, real length.

N.B. For convenience, this spicule has been drawn from that point of view in which it appears straight, as the curved form, when slight, is so difficult for an engraver to etch truthfully; also, to make this easier, its sides have been drawn with a rule, diminishing equally from the centre to the extremities, which is not the case with this nor, indeed, with most spicules, which diminish more abruptly towards the ends than in any other part. These observations will apply also to the representation of the large acerate spicule in the next species.

Fig. 10. The same, trifurcate spicule, lateral view: *a*, real length.

Fig. 11. The same, trifurcate head, of larger size, where the rays are more deeply furcated, end view: *a*, end of shaft; *b*, central canal, bifurcating like the arms.

Fig. 12. The same, dermal spicule, much more magnified.

Fig. 13. The same, stellate spicule of the body, magnified on the same scale.

Fig. 14. The same, three cells of the cortical layer, less magnified than fig. 6, the same as those of *Dercitus niger*, only colourless, showing large, transparent, subcircular, nuclear (?) body (*a*), small nucleolar (?) body (*b*), minute globular cellules charged with one or more colourless granules (*c*), sarcodal subfibrous trama in which the cells are imbedded (*d*), cavity of the same in which the cell is situated (*e*), separate cellule much more magnified (*f*).

N.B. This figure is taken from cells in a portion of the sponge which had been placed in spirit and water, where the cellules were much broken down and the nucleolar body appeared not only to be nucleated itself, but to be in contact with the nuclear body.

Fig. 15. *Stelletta lactea*, n. sp.: fragment of sandstone rock, showing three portions of the sponge in the excavations made by *Saxicavæ* respectively (*a a a*), natural size; dermal surface bearing minute grains of sand (*b*), body-substance (*c*), black pigment lining the cavities occupied by the sponge (*d*).

Fig. 16. The same, diagram section, much magnified, showing rounded grains of sand adhering to the dermal layer (*a*), dermal layer densely charged with minute stellates (*b*), zone of trifid and trifurcate spicules which have their heads in contact with the dermal layer (*c*), body-substance (*d*) charged with acerate, trifid, and stellate spicules, together with the sheaf-shaped bundles of minute acerate ones.

Fig. 17. The same, acerate fusiform spicule, straight in this point of view, but slightly curved when viewed laterally: *a*, real length.

Fig. 18. The same, trifid spicule, lateral view: *a*, real length.

Fig. 19. The same, trifid form with furcate extremities.

Fig. 20. The same, portion of body-substance greatly magnified, showing the stellates (*a*), the sheaf-like bundles of minute acerate spicules (*b*), and the large acerate fusiform spicules.

Fig. 21. The same, stellates of the dermal layer, much magnified: *a*, with large body and short rays; *b*, with small body and long rays.

Fig. 22. The same, sheaf-like bundle of minute acerate spicules of the body-substance, magnified, on the same scale.

II.—*Reply to* Dr. Sclater's *Paper in the 'Annals' on* Testudo chilensis *&c.* By Dr. J. E. Gray, F.R.S. &c.

In reply to Dr. Sclater on *Testudo chilensis* &c., in the 'Annals' for December 1870, p. 470, I have only to observe that for the accuracy of the habitat of the animals which I described as coming from the Zoological Society, I am solely dependent on the information which I obtained from that institution; and in the case of the tortoise, I took particular trouble, as the discovery of another tortoise in America was a matter of interest. This being the case, whatever inaccuracy there may be in the habitat is no fault of mine, but that of Dr. Sclater and his subordinates.

It is much to be regretted that an accurate record is not kept of every animal as it is received by the Society, stating how it was obtained, and giving the details of its habitat, which is open to the inspection of the Fellows of the Society and other scientific visitors, and should be communicated especially to the person who is asked to give the name to the animal to be inserted in the secretary's list of accessions published from time to time in the 'Proceedings.' As both I and others are asked to undertake this office, to save the secretary the trouble of determining for himself the names of the animals, I am often so dissatisfied with the habitat that I obtain with the specimen, that, when I have sent an account to the Society, I have more than once left a blank in the manuscript, that the history of how and where the specimen was obtained might be inserted by the secretary. All this uncertainty would be obviated if an accurate register, such as I have indicated, were to be seen at the Gardens. Such a register is kept of all the specimens received into the British Museum; and as it is made at the time, any inaccuracy must be occasioned by want of care on the part of the person who communicates the facts.

Dr. Sclater will perhaps allow me, as an original member of the Society, who has taken a great deal of interest in its management, to state that the history of the specimens was formerly much better recorded when the secretary of the Society was an honorary officer, and it could only have a claim to his leisure, than it is now when we have a liberally paid secretary with a number of paid subordinates under him.

I consider the above a sufficient answer to his note; but as his paper contains other observations, I will make a few further remarks.

Early in July there were brought to the Museum three species of tortoises to be named, as is the usual practice with animals of that class. They were particularly interesting to me, and I asked whence they came. On the 7th of July I sent to the Society a communication entitled "Notes on three Species of Tortoises living in the Society's Gardens," in which I stated that "there are at present living two species of land-tortoises and one of a more terrestrial Terrapin, which Mr. Bartlett assures me came direct from Chili." One would have thought that this statement would have exonerated me from the charge of giving a wrong habitat to these tortoises, as I received the account from a subordinate of Dr. Sclater, who, I was informed, was absent on the Continent. As the paper would not be read until its meeting in November, and as it contained a new species, I sent a short diagnosis of the species to the 'Annals,' that there might be no doubt as to the date of its publication, leaving the details of the paper to be read before the Society.

Near the end of October, happening to turn over the paper of Dr. Strauch on the distribution of tortoises, I observed, under *Testudo sulcata*, that that species was said to be found in various parts of South America by D'Orbigny, Burmeister, and others, and I had no doubt that they had obtained the tortoise which I had described as *Testudo chilensis*. I sent a short note stating how I had obtained the information, for insertion in the November Number of the 'Annals' (see vol. vi. p. 428). At the same time I sent the synonyma, with references to the works in which they were described, to the Secretary of the Society, with a request that it should be added to my paper which was to be read on the 1st of November. And there can be no doubt that it was from the paper sent to the Secretary of the Zoological Society and to the 'Annals' that Dr. Sclater obtained all the information which appears in his paper in the 'Annals' for December. And thus it was that he found out that the "new Chilian tortoise" had been "known to four or five previous writers," who by-the-by confounded it with a species with which it has no alliance, the one being a typical Old-World tortoise, and the other belonging to a group peculiar to the New World, which Agassiz considers a very distinct genus, under the name of *Xerobates*.

Upon the day (Nov. 30) that I received the 'Annals' containing Dr. Sclater's paper, I received from Dr. Sclater the proof of my communication of the 7th of July; so that if Dr. Sclater was only urged by "the special interest which he takes in the correct determination of the animals kept in the Gardens of the Zoological Society of London," he had the opportunity of correcting the erroneous information according to his idea, which was sent to me by one of his subordinates, in the original paper, either by informing me of the right habitat and history of the tortoises, to insert in the paper, which I would have thankfully acknowledged; or he could have made the correction in the form of a note from himself, as editor of the 'Proceedings,' communicated under his own name.

Scientific men ought to be much indebted to Dr. Sclater for the trouble he has taken in writing to Dr. Peters, Dr. Philippi, and others respecting the habitat of this tortoise, a kind of labour which he seems only to undertake after I or some other person have described the species. Unfortunately my occupations are so multitudinous that I cannot devote so much time to the determination of the habitat of a single species which has so extensive a distribution in South America; but in this case the trouble seems to have been thrown away; for instead of having only negative evidence, we have positive facts within reach (and, indeed, the following statement given me by Dr. Günther, which was communicated to Dr. Sclater at the meeting of the Zoological Society when the paper was read, and before Dr. Sclater's paper in the 'Annals' was put in type) proves that the tortoises were obtained near Santiago on the coast of Chili.

Dr. Günther states:—"Hr. Weisshaupt, who brought a collection of Chilian animals, stated that he was in the habit of collecting personally live specimens on or near the sea-shore, about twenty miles south of his place of residence, and that he obtained the tortoises brought by him on one of these excursions. He was asked by me to obtain more specimens, live or dead, together with lizards and frogs, which he may meet with at the same time. I mentioned this already at the meeting of the Zoological Society on November 1st."

These remarks apply equally well to the observations on *Ateles Bartlettii.* I have only to observe that I considered *Ateles variegatus* of Natterer, figured in Reichenbach's Atlas, figs. 15 & 16, to be the same as *Ateles melanochir* of Desmarest. But it is very difficult to make out the species of this genus from short descriptions, and I must leave the question to be settled by future zoologists; but I consider that I have done good service in figuring so fine a species—only remarking that it is the Secretary of the Society, and not I, that is responsible for the colouring of the plates, as they were not even submitted to my inspection before publication; but in this case it is very like the specimen: and Herr v. Pelzeln's observation shows that the *A. variegatus* of Natterer is a very variable species; for he says that in some specimens the yellow is continued over the upper surface of the limbs, of which there is not the slightest indication in the male which I described; and I could not procure from the Society any habitat for the female, which I am now informed came from the Hon. A. Gordon, who obtained it from the upper part of the Caura river, a southern confluent of the Orinoco.

In this case I am charged with two faults.

First. I have named as a new species a monkey which Dr. Sclater thinks was named and very briefly described thirty years ago, in a miserable compilation; but I do not think that he has proved his case: and surely he should not complain of a person giving a new name to a species already described; for in the very paper in which he makes the charge he has given a new name to a tortoise which I had described and named *T. chilensis*, because he has a theory, founded on negative evidence, that, though the specimen came from Santiago, it is not a native of Chili, and therefore he proposes to call it *T. argentina*, in case his theory should prove correct; and I think I have shown that there is no likelihood of the new name being required. He has given the "temporary denomination" of *Canis lateralis* to a jackal which is evidently the *Canis adusta* of Sundevall; he is even doubtful of this case himself, but fears that he may lose the opportunity of naming a species. Again, if the monkey is really *Ateles variegatus* of Natterer, why did not Dr. Sclater make the requisite correction when I described and figured it in the 'Proceedings' of the Society in 1867? especially as he says it was described, in 1842, in a "most ordinary book of reference."

Secondly. I have done wrong because, having received the specimen of *Ateles*, which agrees in all respects with the specimen described as *A. Bartlettii*, except in being white where that species was yellow, I did not name it as a new species, but, finding that one specimen was a male and the other a female, I was willing to believe that they were sexes of the same species, or at least to wait to consider it otherwise until more specimens were submitted to my examination. Dr. Sclater says that it is not like the female at Vienna, and therefore it is not a female of *A. Bartlettii*. Even if it is not, may it not be a variety of that sex? At any rate, I am not willing to give another name, which Dr. Sclater is perfectly at liberty to do if he thinks it necessary.

This rage for giving names to doubtful species is the great bane of what is called zoology, and is destroying the scientific part of the study, reducing it to mere names instead of knowledge of the things, and is liable to all manner of abuses. Thus one of the royal princes brought home a deer from that general *entrepôt* Singapore, and presented it to the Gardens; and Dr. Sclater, in great haste (not even waiting until the horns had been properly developed), has briefly described and named it *Cervus Alfredi*, in a genus already overloaded with nominal species. A shell-dealer has a large number of specimens of Cones, evidently the young of much larger species, which have not yet arrived at their proper form or colouring, which are not saleable, and describes them and other abnormal specimens of common shells as new species, thus rendering them valuable in the eyes of some collectors, as being the types of species described in the 'Proceedings of the Zoological Society,' they conceiving that the Society thereby gives authority to the assertion of their being new species.

Some day, and I hope soon, such species must be erased from our lists, which they now uselessly encumber, or they will render the science unworthy of the name

Dr. Sclater objects that in my short notice of the species I simply say "received" by the British Museum. As a Fellow of the Society, jealous of its scientific reputation, I thought it better than saying that "the British Museum has just purchased from the Zoological Society the dead body of an animal which was for some weeks living in their Gardens," which would have been the truthful statement; and it appears that Dr. Sclater was himself ashamed of this statement; for he says that it was "sent" to the British Museum, without saying that it was sent for its specific name to be determined, and for purchase. But all the animals which the Museum receives from the Zoological Society (established for the cultivation and extension of zoological science) are purchased; and when the Society was badly off for funds, this was a fair source of income, of which I do not complain.

III.—*Additional Evidence of the Structure of the Head in Ornithosaurs from the Cambridge Upper Greensand; being a Supplement to 'The Ornithosauria.'* By HARRY G. SEELEY, F.G.S., Assistant to Prof. Sedgwick in the Woodwardian Museum of the University of Cambridge *.

[Plates II. & III.]

To the anterior end of the snout and the back of the brain-case belong nearly all the fragments of Pterodactylian skulls hitherto collected from the Cambridge Upper Greensand; and although the snouts are numerous, they never extend backward beyond the denticulate part of the palate or to the narial apertures; while the back part of the head never reaches so far forward as to include the frontal bones; so that the great middle region of the skull, the seat of the orbits and nares, which transforms its characters with successive groups in reptiles, mammals, and birds, remains unknown. And before the general structure of the head can be illustrated by detailed comparisons in this Cretaceous Ornithocheiroid family, we must learn the condition and form of the bones called frontal, nasal, lachrymal, maxillary, malar, vomer, palatine, pterygoid, postfrontal, and the proximal end of the os quadratum. And if one were a believer in the old morphological doctrine that a like conformation of bone in extinct and living animals warrants the presumption of their having had a like grade of organization, it were hard, with these Ornithosaurian snouts before us, and all the vertebrate province assembled, for us to seek their similars from, to pronounce a sure judg-

* Communicated by the Author, being the first part of a paper read before the Cambridge Philosophical Society, May 30, 1870.

ment on their kindred; for there is no snout among living animals like the Pterodactyles'. Even the extinct animals which are already known manifest no signs of kindred. If among the Teleosauria a like progressive enlargement of the first three teeth and then a narrowing of the jaw is seen to show again a character of many Ornithocheiroid jaws, it is but a solitary resemblance; and the Teleosaur's snout, with its terminal single nostril, is in no other way a counterpart. If Ichthyosauria as invariably have the nostril far back from the end of the snout, it in no other way resembles Pterodactyles'; for the premaxillary bones are separate and dense in tissue, and have no sockets, but only a simple groove for teeth. If, in triangular dagger-shape and bone-texture, some of the species recall birds, still birds have no teeth, even the immature parrots showing but evanescent enamelled specks; while other species end their jaws in a bulbous truncate way, which among birds is never seen. And if we seek for a denticulate jaw among lizards, we shall not find the bird-like elongation of snout, or its Teleosaur-like widening or flattening of palate, and not typically socketed teeth. Yet to birds (and lizards) it approximates best, but in such obscure ways as to stand apart with an individual isolation which would admit of its kindred being reptiles, or mammals, or birds, without amazement to the osteologist. It is not a nose that leads.

Similarly, if only the back of the skull had been found, it would have been more a matter of scientific taste than of scientific fact to have said whether it showed stronger similitude to toothless birds like the heron, or a toothless mammal like *Myrmecophaga* or the fœtal *Orycteropus**. Therefore to one who would consider these Cambridge exuviæ in the old morphological way, estimating the affinities bone by bone and adding them together to get the total affinity, there is room for considerable doubt and justifiable difference of opinion about the restoration of the head and its resemblance to that of other animals.

I have now an opportunity of lessening that doubt by the discovery of the frontal bone. (Pl. II. fig. 1.)

The specimen is referred to an Ornithosaurian because it possesses the peculiar thin, dense, and smooth bone characteristic of the class, which has been found in no other fossils of the Cambridge Greensand; and it is identified as the frontal bone because it resembles the bone so named in certain reptiles, birds, and mammals, and is not like any other element of the skeleton. The fossil is broken both in front and be-

* The occipital condyles are not preserved with the adjacent bones in Cambridge fossils, and the auditory region is filled with phosphate of lime.

hind, but is free from investing phosphate, and so shows both the external and cerebral surfaces. Externally (fig. 1) the part preserved is straight from front to back, with a mesial groove which deepens as it extends anteriorly, so that the two lateral halves of the bone are convex, the anterior groove apparently existing to receive the nasals or premaxillary bone. The outermost lateral parts of the frontal are flattened and directed downward behind, where they widen so as to be inclined to each other at nearly a right angle; they look upward, outward, and slightly forward, rounding into the upper part of the bone. The extreme length of the specimen is $1\frac{1}{8}$ inch. Owing to breakage, its greatest width from side to side is at a quarter of an inch from the hinder termination of the bone, where it measures $\frac{3}{4}$ inch; and then it contracts from side to side in a parabolic curve, which in passing forward approximates nearer to the upper surface of the bone, till the width at the anterior breakage is $\frac{3}{8}$ inch; the bone is V-shaped at the broken end in transverse section.

The external surface shows two or three impressed lines parallel to the mesial groove.

Seen from the side (fig. 2), the slightly concave inferior longitudinal outline of the bone is nearly parallel with the straight superior longitudinal outline, the depth of the bone from above downward in front being more than $\frac{1}{4}$ inch, and the depth behind being $\frac{5}{16}$ inch. The concave lateral outline seen from above (already described) in this view runs diagonally from the front upper corner to the back lower corner of the bone. The long triangular posterior part above this line is the lateral region of the frontal already referred to as bent downward. The anterior subtriangular part below the line is concave from back to front, and concave from above downward in front, where the two sides of the bone meet at the base so as to form in transverse outline a V-like shape. In the anterior part of this concave area are two small oblong perforations for vessels.

Seen from below (fig. 3), the surface divides into three distinct portions:—(1) the two external concave strips last referred to, which widen and converge in front. Within these there is (2) a long triangular smooth area with slightly concave lateral margins. The area is slightly concave in length, and deeply concave from side to side. Anteriorly there are in it two large ovate perforations for the passage of vessels; posteriorly the lateral margins are flattened, so that the sharp lateral boundary is there obliterated. And (3) this median triangular area is excavated behind by two semicircular cavities, making it spear-shaped: the cavities are divided by a median smooth space more than $\frac{1}{8}$ inch wide; they extend some distance forward into the bone; one is excavated for $\frac{3}{8}$ inch; each measures $\frac{1}{4}$ inch from side to side. Seen from behind, their outlines are triangular; they are lined with smooth dense bone-tissue.

Such is this remarkable fossil. A fragment of a second specimen has been placed in my hands by the courtesy of M. R. Prior, Esq., of Trinity College; but as it displays no new structure, I merely mention that it indicates a bone twice as large as that just described, and is perforated on the underside by foramina which are enormously large in proportion, and which are accompanied by many small accessory foramina. On the underside of neither specimen is there any indication of division into separate frontal elements, though externally both show indications of median lateral division.

Now as to the significance of the bone. Its outline recalls the frontal bone of Crocodiles (Pl. II. fig. 4). I figure for comparison the frontal bone of a Crocodile from the upper part of the Tertiary series in the Isle of Wight, *Crocodilus Hastingiæ*. Externally the Greensand fossil differs in the deep median groove, in the smooth unpitted surface, and chiefly in the lateral parts being directed downward, while in Crocodiles the lateral parts are directed upward. In the Ornithosaur the bone is proportionally longer; and the cerebral part being broken, the resemblance is not so close as it seems to be.

On the interior aspect the concave lateral parts of the *Ornithocheirus* are seen to be represented by similar but deeper concave regions in the crocodile (Pl. II. fig. 4); for they are the upper and inner boundaries of the orbits. Between them is a similar triangular concave area, less well-defined anteriorly in the crocodile because the orbital margins do not converge and meet in front. But here the resemblance ends; for when the bones are compared posteriorly, the crocodile shows no sign of the remarkable excavations seen in the Ornithosaur*.

Among birds the form of the bone is approximated to more closely (Pl. II. fig. 5). There is externally the same smooth surface, the same sort of downward direction of the hinder lateral parts, sometimes the same antero-posterior straightness and mesial depression. These latter characters are not well seen in the common *Gallus domesticus*, and might be better matched in other birds; yet, as the most accessible type, I here contrast (Pl. II. fig. 5) the inner side of the frontal bones in that animal with what is seen in our fossil, premising that,

* In serpents the frontal covers in the cerebral hemispheres in front.

as the fossil is broken behind, this comparison does not determine *exactly* the resemblance and difference between the bones. The lateral orbital spaces are larger and better-marked in the bird, and similarly approximate mesially; but while in the bird the eyes abut against the front of the brain, in the Ornithosaur they are removed further forward, and consequently the triangular space which comes between and behind the orbits in Ornithosaurians is in front of them in birds; and in these animals the bone which I have previously named the ethmoid bone (the orbito-sphenoid of Prof. Owen) is of such shape as would fit on to that space. Finally, the frontal of the bird is largely excavated behind to cover the cerebrum. From the divergence of the excavations in the Ornithosaur frontal, it is clear that they are not for the cerebrum, but for the olfactory lobes in front of the cerebrum, which lobes, when developed, are commonly divided. And if any one will compare the figure of this bone here given with fig. 3, pl. 11 of my book on the Ornithosauria, where is shown the suture of the parietal bones from which the frontals have come away, it will be evident that a considerable piece is wanting from the back of this frontal bone, which, like the bird's frontal bone, is thereby proved, when perfect, to have partly, if not largely, covered the cerebrum. Here, then, with much and close resemblance to the bird, are substantial differences, in an enormous and unbirdlike development of olfactory lobes (with seemingly a covered channel for the olfactory nerve, rare among birds), in evidence of a largely developed and backwardly placed ethmoid and more anterior orbits. Still the resemblance to birds is a true coincidence of functional plan up to a certain point, and altogether different from the resemblance to the bone in the crocodile, which in this point is the most like of reptiles.

If the bone be compared with the frontal of mammals, probably the bird-like rodents, such as the guinea-pig or rabbit, offer the closest similarity of form: the rabbit is to be preferred for comparison. But here, though the general form of the bone would be sufficiently like to admit of comparison, it will be seen that the eye is situated altogether at the *side* of the fore part of the cerebrum and large olfactory lobes, which extend between the orbits; and then the condition of the softer parts of the ethmoid is very different from and not comparable with the condition of the ethmoid in birds, and unlike any known condition in Ornithosaurs. In the interior of the cranial cavity of the rabbit, the development of the olfactory lobes comes much nearer to the ornithosaurian than any thing seen in birds. Yet olfactory lobes are as much a feature of reptilia and lower animals as of mammals; only in the reptile* they are not closed-in in front by bone, while in mammals they are. But in no sense, except in form, can the olfactory lobes of this specimen be called mammalian; for they obviously never sent filaments direct to supply the olfactory sense, but apparently forwarded the olfactory nerve in a closed tube. Thus in not passing through the ethmoid, but through the frontals, the olfactory lobes approximate towards birds', but differ from all birds', so far as I am aware, in their great size.

I conclude, then, that the frontal bone under consideration is only closely comparable with birds', and that it diverges from birds' in ways which are not paralleled in other animals.

Elsewhere I have described and figured all the cranial structures of Ornithosaurians which the Woodwardian Museum contains†; and I propose now, with the notice of an additional imperfect bone which may be the maxillary, to point out exactly how much is known of the Ornithocheiroid brain and skull, and how they resemble and differ from those of other animals—only remarking that the results arrived at can be but of a general nature, since the specimens are few, imperfectly preserved, of different sizes, and obviously belong to two or more genera, each bone perhaps pertaining to a different species.

First, then, to reconstruct the brain. The materials are a transverse section of the brain-case in front of the optic lobes, a natural mould of the upper part of the brain showing the form of the cerebrum and part of the cerebellum, and an indication of the optic lobes on the under surface, an ethmosphenoid bone apparently closing in the brain in front, and part of a frontal bone closing the brain in above; so that, with very unimportant and small parts, the structure of the brain-case is now known.

I suppose the form of the brain-cavity to indicate with approximate accuracy the form of the brain, in which case the Pterodactyle's brain must have been very like what is here drawn (Pl. II. figs. 6, 7); for in only one or two points is there likelihood of error: the cerebellum may be here made too long, and the depth of the cerebrum may be made too little; for there is evidence that it is nearly as deep as it is long.

When the brain is seen from above (fig. 6), there is no difficulty in recognizing it as an evident modification of the avian outline, chiefly remarkable for the enormous size of the cerebral and olfactory lobes, and the small size of the cerebellum, by which

* Serpents not excepted. † 'The Ornithosauria.'

that organ shrinks away from the optic lobes. Still the differences are only of proportion of parts, and not peculiarities of arrangement. But when the brain is seen from the side, it shows characters which are altogether peculiar to it, in the development of the under part of the cerebrum, by which that part of the brain attains a larger size than any thing seen in birds, and more in accord with the highest mammals than with other animals. Here, of course, the question arises, Is it certain that the parts have been correctly determined (in dealing with such material the question is inevitable), and that what have been called optic lobes are not lateral lobes of the cerebrum, so that, after all, the animal may be a mammal? I can only reply that when the Pterodactyle's skull is compared with the bird's skull, the correspondence of the parts called optic lobes is very close. They are sunk deep into the alisphenoid and squamosal bones, so as to be covered by the thinnest possible film of bone externally, as in birds; a sharp bony ridge divides them from the cerebrum, as in birds; they are as prominent and subhemispherical as in birds, and they are situated almost as in birds; while I fail to find this bony definition of outline in the encasement of the similarly placed part of the mammalian cerebrum; so that I have no doubt at all that these parts of the brain are accurately described by the lettering in the description of Plate II. Every facility is offered at the Woodwardian Museum for the examination of the specimens.

And the conclusion which follows from the facts detailed is that these Ornithosauria, while having a brain moulded upon the bird-type, attained to a condition of cerebral development which would raise them, so far as evidence from the brain went, above birds. In fact, this brain, if brain-form is worth any thing in classification, proves that these animals must take rank immediately above birds, in the same natural group with them.

Now it will be attempted to reconstruct the Ornithocheiroid skull in which this brain was lodged*; and to this end follows a description of what may be regarded as the maxillary bone. (Pl. III. figs. 1, 2.)

Like all Pterodactyle bones, it is fractured. It is a subtriangular squamous bone, flat externally in antero-posterior direction, perfectly smooth, and very slightly convex from above downward, $1\frac{5}{8}$ inch long at the palatal border. Above this fractured border is an impressed area less than $\frac{1}{2}$ an inch

* The best general restoration of the Ornithosaurian skull is Prof. Owen's, given in pl. 27 of his memoir in the Palæontographical Society's volume for 1851.

wide, margined above by a convex line most impressed behind, and showing at intervals foramina like those seen on the maxillary bone of many of the lizards. In front is seemingly the lower and back part of a perforation which, on the hypothesis of the bone being maxillary, would be the left narial vacuity, showing on its inner side an impressed ovate space. On the upper part of the posterior lateral margin is an angular notch, which may be merely due to fracture or may be the anteorbital or middle hole of the skull. The least distance between these notches is about $\frac{7}{8}$ inch. Internally (fig. 2), between the sides, the bone is convex and rapidly thickens from little more than card-thickness at the palate to nearly $\frac{5}{8}$ inch at a height of $1\frac{1}{4}$ inch from the palate. Externally at about this height the bone rounds upward and inward for a quarter of an inch, and then is truncated, with a small piece of rough surface which looks obliquely outward and forward when the external surface is vertical. On this surface and on a truncated continuation upward of the narial boundary may have rested the nasal bone.

Putting the several known bones together, they appear to indicate a cranium of such a form as is here drawn (Pl. III. fig. 3), the light parts only being known, and the shaded parts put in to complete the outline. Certain black lines running through the shaded parts indicate possible boundaries of bones.

In completing the outlines I have rather followed the authority of German specimens than my own ideas. For instance, behind the orbit and between the frontal and squamosal is a four-cornered space, representing the region in which the postfrontal bone should be applied to the brain-case. The diminutive representative of this bone is apparently seen in many natatorial birds, such as the goose, between the frontal, squamosal, and alisphenoid bones; and in the immature struthious skull Mr. Parker's researches have made its existence evident. In birds the rudimentary bone has no other connexion; but in German Ornithosaurians it is usually of a triangular form, and sends one limb to the quadrato-jugal bone. And this is a point in which all birds differ from Ornithosaurians; for, from the downward direction of the quadrate bone in birds, the quadrato-jugal and malar bones are removed from all relation with the bones of the upper part of the head. Yet seeing that in the Cambridge Ornithosaur the quadrate bone had an articular connexion with the skull, it is inconceivable that the quadrato-jugal should have had a wide union with the postfrontal bone. But if the postfrontal bone is obliterated, and the quadrato-jugal and malar bones reduced to a rod which united the distal end of the quadrate bone with the palatal margin of the maxillary bone, then there would be nothing to distinguish that part of the Ornithocheiroid skull from the bird's skull. And hitherto no evidence has been found of the existence of either this bone or the malar in Cretaceous genera.

In another point of some importance there is a lack of evidence: no trace has been found of the existence in Cambridge fossils of the middle hole of the skull between the orbit and narine; and as the perforation does not exist in the Ornithosaurs *Pterodactylus longicollum* and *P. Kochi*, I have not outlined it in the diagram.

So that, to state the case of these Ornithosaurs separately, on the evidence at present known, it is found that the only points in which the skull differs from that of birds, are in the vertically expanded quadrato-jugal bone and the apparent expansion of the ethmoid to close in the front of the brain. Yet these characters, though minor in kind, are a wide divergence from birds, the latter one being seemingly unparalleled among Vertebrata, and the former implying an expanded squamose malar bone, and probably a developed postfrontal. Therefore there is reason to anticipate that in these bones Cambridge Pterodactyles will be found to approximate towards other Ornithosaurs, and, like them, to diverge from birds. It may then be appropriate to examine into their bearing on the animal's affinities.

In the first place, so far as can be judged from published figures, there is no absolutely conclusive evidence in any Pterodactyle whether the malar bone has a distinct existence; it might even be united to the maxillary, or, with less improbability, to the quadrato-jugal. Perhaps the strongest evidence for its separate existence is offered by the Cambridge specimens, where the quadrato-jugal appears to form part of the basal margin of the orbit, and clearly receives a bone in front which must also have entered into the orbit, while apparently nearly the whole of the maxillary is occupied in forming the back of the nostril, and there is no reason for suspecting that it extended back to the orbit; so that the existence of a separate malar bone is highly probable. And although no one can be more convinced of the fallacy of reasonings founded on imperfect knowledge of facts (the arsenal of erroneous ideas), I think that the existence of this malar bone may, on the evidence, be assumed.

It is evident, then, that by the existence of a quadrate and quadrato-jugal, these animals differ from mammals, where sometimes, as among ruminants, the malar unites with the (downward and forward process of the) frontal behind the eyes, and completes the orbit. The malar bone by itself, if distinct, might be compared to the mammalian malar.

In lizards malar, quadrato-jugal, and postfrontal bones exist, but their relations are different from what is seen in Ornithosaurs. The lizard quadrate is commonly vertical, and the quadrato-jugal is attached to its proximal end, while the orbit is completed after the mammalian plan by the (post-) frontal and malar, and the quadrato-jugal does not penetrate the suture between these bones, as it does in *Ornithocheirus*.

In Crocodiles there is still the same series of bones, with the malar and quadrato-jugal squamous: but they do not come near to Pterodactyles; for the quadrate is directed backward, while in all Ornithosaurs it is directed forward; and the quadrato-jugal, although attached throughout its length to the quadrate, does not enter into the orbit, but into the temporal fossa, and it cannot be said similarly to divide the postfrontal and malar bones.

In the Rhynchocephalia, typified by *Sphenodon*, there is but one bone between the maxillary and the vertical quadrate; and that bone Dr. Günther names the malar. But at the back of the orbit the postfrontal and malar bones are separated by a bone named by Dr. Günther the quadrato-jugal, which meets the squamosal behind, but is entirely separated from the quadrate bone; so that among none of the types which are correctly called reptiles is the resemblance to our Ornithosaurians very close.

In birds it is certainly more distant, owing to the rod-like form which these bones take; but if the bones had assumed a squamous character, and united with the upper boundary of the orbit, the skull in these matters would be essentially avian. Accordingly, with such wide divergences from all other animals, coupled with its own peculiar characters dependent upon the forward direction of the quadrate bone, and the uncertainty about the precise condition of the bones in Ornithocheiridæ, I find a difficulty in arriving at any more definite conclusion than that the general relation of these bones is more like what is seen in reptilian types than among birds and mammals. But in no reptile is there a similar condition, and perhaps the nearest reptile type is *Sphenodon*.

No Ornithosaurian hitherto figured displays the true structure of the palate. The most instructive specimens are those figured in the well-known memoirs of Goldfuss and Quenstedt. And as Prof. Quenstedt's description of the skull in his *Pterodactylus suevicus* makes known some points which do not appear in Von Meyer's general account, I translate what is said upon the subject in the special monograph 'Ueber *Pterodactylus suevicus*'* :—

"The head, 5 inches 10 lines (Paris) long, has suffered somewhat through pressure, and might therefore be considered inferior in some respects to that of [*P.*] *crassirostris.* Also all the teeth have fallen out; I have vainly endeavoured to trace their alveoli. It is noteworthy that the points of several of the teeth appear to be cut off. The fang and crown can be recognized; and the enamel is not in ridges, but only in wave-like folds.

"The lower jaw, 4 inches 5 lines long, displays the lower surface in a way hitherto unequalled. The symphysis alone measures 1 inch 8 lines, and is 6 lines wide behind. The symphysis proves how accurately Münster has expounded the lower jaw. Its surprising resemblance to the upper beak of a water-fowl was calculated, however, to lead any one to Wagner's different interpretation†. There is no trace whatever of a suture in the symphysis; and no nerve-pores, found so numerously in birds, can be seen at the foremost extremity. The indents further back appear to be chiefly due to pressure. A transverse section shows clearly that the whole symphysial region is parallel to the upper surface. The part which is arched over is made up of several elements, although it is difficult to obtain a true conception of their outlines. In continuation of the dentary bone (1) lies the superangular bone (4), with the angular bone (2) continuous with them on the inside. The thickened articular bone, at the proximal end, cannot be mistaken; its small hindmost continuation was somewhat larger in the living animal. Although one fancies one sees the hollow of the articulation, it is to be presumed that it did not lie on that side, but underneath, on the side which is averted from the eye.

"The upper jaw, again, has in front very much the form of a beak; but, unfortunately, the anterior end has suffered from a forcible twisting. The bone is therefore seen from above in front; and the further back it goes the more it is seen from the side. The nasal bones are well defined, and as the front end of the bone near them is perforated like the lower jaw, it seems as if the entrance to the nostril had been here, as is the rule with birds. In that case the aperture, which occurs fully 2 inches behind the extremity of the jaw, would have nothing to do with the anterior nares. In the forward part of this hole lie two bones, similar to each other (16), which become thinner further back: they are the vomers. On the hind part of the

* 4to (Tübingen), 1855, pp. 38–40.
† Akademie zu München, vi. p. 156.

nasal bone hangs down a triangular bone (2), which recalls to mind in a lively way the lachrymal bone in birds. But as there is a very strong process (19) of the jugal bone rising up towards it, the eye-hole may perhaps have been thus closed in front. The skull then would have had three holes, as was first so excellently demonstrated by Goldfuss:—the nostrils, supposed to be isolated in the anterior end; the middle, elongated, triangular hole; and the cavern of the eye. This latter is well defended on the hinder side by an elevated ridge of the frontal bone. I could not find the sclerotic circle of the eye in it; but several bones, which I have exposed as much as possible, are lying scattered in the eye-hole, as follows: the slender bone at the top (6), which is prolonged under the lachrymal bone, may be the sphenoid; the two triangular bones (25) are the pterygoids; in front of them lies a similar bone with three concavities (22), which from its position is to be regarded as the palatine bone. A sure foundation is found in the uncommonly strong quadrate bones (26); the left one is still in its natural position, but the right one lies in the hollow of the eye, with its articular surface facing the process of the jugal bone. The head measures only 4 inches from the articular surface of the left quadrate to the extremity of the beak; and one is therefore led to suppose that the lower jaw must have projected somewhat more than the upper jaw. The occiput, however, extends backward in a remarkable median crest, which has not previously been figured in any species: it might easily be overlooked, from its thinness; but its existence cannot be doubted. Including it, the whole length of the head amounts to 5 inches 10 lines. Above it lies a fractured bone, which can only be interpreted as the parietal bone. As the head has also suffered somewhat from the twist already mentioned, one is also able to see at the upper margin fractured pieces from the right side. At first I thought of exposing these also, but now think it more prudent to leave them alone for the present."

I have reproduced this passage because the specimen to which it relates shows the bones of the palate better than any other species, and not because Prof. Quenstedt's interpretation seems to me accurate. The numbers upon the bones in the figure are those used by Cuvier; but I would suggest the following modified interpretation, as in accord with the fuller knowledge gained since the monograph was written. If the small anterior depressions are correctly identified as nares, about which I entertain no doubt, then the bone marked 3 is evidently the nasal. This identification is probable, because the teeth are limited to the extremity of the snout, and entirely in front of the nares; from which circumstance the inference may be made that the premaxillary bone did not extend far backward, and formed the front of the nostril; so that, with the toothless maxillary forming the side border, the nasal bones might well close it behind. The bone marked 7, though named frontal in the text, would, from the number, seem to be intended for the parietal; it appears to me to correspond in function, by making the upper border of the orbit, with the frontal bone. The bone 8, evidently intended for the supraoccipital, seems to me, both from the figure and a cast of the original specimen, to be the entire side of the cerebral region pressed flat. I should interpret it as consisting of the parietal bone in the upper part, and of the squamosal in the lower part, which gives attachment to the quadrate and malar bones. The little bone (23) just above the proximal ends of the malar and quadrate, is probably intended for the squamosal; from the analogy of all other Ornithosaurs and lizards, I should rather name it the postfrontal. And with regard to the palatal bones, if they in any way resemble those seen among birds and lizards, they must certainly have a different naming from that detailed. I think the bone 22, regarded as the palatine, would be better identified as the lachrymal. The triangular bones (25) may well be the pterygoids, as Quenstedt names them. The angle of the triangle at one end of the long side would meet the quadrate; one of the short sides of the bone would unite mesially with the similar side of the other pterygoid bone; and both would have their other short sides looking backward, while the angle at the other end of the long side would meet the palatine bones in front. Considering the position of the latter bones in birds and reptiles, I have no hesitation in identifying the long slender bones marked 16 as the palatine bones. The small bone (6) named sphenoid I should rather identify as the right quadrato-jugal.

This interpretation enables me to offer a restoration of the Ornithosaurian palate (Pl. II. fig. 8), which can only be reconstructed on the basis of the bird's palate; for the form and relations of the pterygoid and palatine bones are very similar to what is seen in many natatorial birds.

It will be impossible, on comparing the figures, to discover any character, in which the Ornithosaur cannot be paralleled by birds, which would separate it as more than a different and not distantly allied genus, both the forms and arrangement of the bones being paralleled in many natatorial birds. Yet too much stress must not be laid upon these important characters in the way of affinity, because lizards also approximate towards birds in the plan of their pterygoid and palatine bones, though there is nothing so typically bird-like in their form, arrangement, and proportions as in the *Cycnorhamphus*.

Another point necessary to a knowledge of the skull is the composition of the lower jaw. And although only the dentary and articular ends are known in the specimens from the Cambridge Greensand, I propose to examine how much they really make known. First, there is the dentary bone, which never shows any indication of being composite: although numerous specimens have been examined, there is never the slightest trace of a median suture. The bone, in the only example which is at all perfect*, has the palatal surface much longer from back to front than the inferior surface, the dentary bone being comparatively small, not extending further back than do the teeth, and being underlapped throughout the greater part of its short length by other elements of the lower jaw. There is no direct evidence whether any of the Greensand species had the bone prolonged backward beyond the symphysis.

The largest fragment of the articular end at present known (Woodwardian Museum, J. C. 12. no. 1) has been figured by Prof. Owen in his Monograph on *Pt. simus*, published by the Palæontographical Society, 1860. It is broken in front, and shows on the upper part of the inner surface an area from which a bone has come away. This bone, which did not reach up to the superior border of the jaw, I think may have been a backward process of the dentary element. From front to back the exterior surface of this portion of the jaw is convex, and the interior surface concave (as much so as is usual among water-birds), suggestive of a median approximation. Another and small fragment (Woodwardian Museum, J. C. 12. no. 4) exhibits another sutural surface, which demonstrates that a straight suture, parallel to the inferior margin, and looking obliquely outward and upward, divided the lower *angular* bone from the upper *surangular* bone: the angular bone is the broadest from side to side; it is flattened underneath; and a concave channel runs along its inner surface from behind forward; the surangular bone is much the deeper from above downward, especially on the exterior surface, and some distance in front of the articulation it is compressed from side to side; so that while the limit of the bones is only marked by a slight groove externally, internally the strong projecting ridge of the angular bone gives the surangular an appearance of being deeply excavated. This bone

* Ornithosauria, pl. 12. fig. 1.

contributes the anterior boundary to the articular surface for the quadrate. The articular bone in its anterior part rests upon the angular bone, but behind the articulation the specimen is fractured. In passing backward the depth of the jaw becomes much less as it nears the articulation; here the bone widens and extends inward precisely as in birds: the heel behind the articulation is of varying length and form.

In every respect this structure is like that of a bird*, if we except the want of evidence of the existence of the opercular bone; but as it is possible that the interior surface which I have attributed to the dentary bone may be for the opercular bone, the correspondence may be more perfect than I have supposed it to be. If there were only four elements in the lower jaw, the whole arrangement would be very like that seen in turtles.

If, now, we endeavour to form a conception of the Ornithocheiroid head in its structural resemblances to other animals, we see that the entire skull, so far as known, is formed after the manner of birds in every region, except in the malar, quadrato-jugal, and postfrontal bones, which, though of the reptile type, are not similarly placed in any reptile, and must therefore be regarded as an Ornithosaurian modification of the bird's skull. The lower jaw may be Avian or Chelonian. The teeth must be regarded as Ornithosaurian, curiously combining Reptilian and Mammalian characters.

The points in which the Cambridge head certainly differs from other types are not important. They consist, if my identification is right, in the brain being closed by a bony mass in front, which extends forward partly between the orbits. This structure has not been figured in any of the true Pterodactylidæ, and does not appear to be constant in the Ramphorhynchidæ, and seemingly is equally inconstant in Cambridge genera. But in the one specimen in which such a mass occurs it is very wide from side to side, is anchylosed with what I interpret as the fore part of the sphenoid, and furnishes the authority for the convex mammal-like under part of the brain; and the bone also resembles the preorbital part of the ethmoid in the duck and in many birds. This resemblance is, indeed, so close that, but for the detailed correspondence of the base of this fossil specimen (Ornithosauria, pl. 11. fig. 7) to the base of the sphenoid in the back of an Ornitho-

* In 'The Ornithosauria' it is stated (p. 92) that the six elements of the lower jaw may be counted on each side. It would have been more accurate to have said five; for the separation of the coronoid from the articular is not well made out.

saurian skull, I should have adopted it. And still it is a point that requires additional evidence to pronounce upon decisively. Should the bird-like interpretation (to which, from the forward position of the orbits &c., I least incline) eventually prove tenable, it would take away the evidence for the anomalous cerebral characters which have already been dwelt upon, and bring both brain and brain-case into a more absolute conformity with birds than I have felt justified in assuming. Still no such bone has ever been found in Pterodactyles, and at present there is no proof that it existed.

The only other point in which Cambridge specimens appear to differ from those of Germany is the squamous character of the quadrato-jugal bone*.

I come to the last word about the skull, not because our knowledge is completed, but because there are no more bones. New specimens in time will fill in the lacunæ which have been indicated, and modify our doubtful determinations; but so much of the skull is now known that no specimens can unsettle or invalidate its avian affinities. And if a controversy nearly as old as modern zoology thus ends, it is because the more philosophical and severe science of our time has taught us to find an animal's place in nature by study of the common plan on which it is built, rather than in the old morphological way, which would predicate an entire organism from the form of a quadrate bone or a caudal vertebra. And the result gives strength to an old law of Cuvier's, which hitherto has never failed—that the pneumatic skeleton is always associated with avian organization. So that henceforth, just as we infer from the double-fanged tooth the lungs and heart, and brain and reproduction, of a mammal for the animal to which it belonged, so now we may infer for the animal which had limb-bones with pneumatic foramina the organization and systematic grade of a bird. Side by side with birds, the Ornithosauria are a monument of the faithfulness of Nature to her laws, and a new pledge to the student that she never will betray the heart that trusts her.

* A new genus appears to be constituted by some (three) portions of jaws from the Cambridge Greensand. Unfortunately, the extremity is not preserved. They have the ordinary dagger-shaped snout, but appear to be entirely destitute of teeth. I provisionally name the genus *Ornithostoma*.

Another unnamed generic type is typified by *Pterodactylus longicollum*, *P. rhamphastinus*, and the two species included under the name of *P. Kochi*. In this genus the middle hole of the skull is entirely wanting. For it I suggest the name *Diopecephalus*.

EXPLANATION OF PLATES II. & III.

Plate II.

Fig. 1. Upper surface of the anterior part of the frontal bone of an Ornithosaur.
Fig. 2. The same fragment, seen from the side.
Fig. 3. Interior aspect of the same specimen.
In these figures *o* marks the upper boundary of the orbit, and *ol* the region occupied in the fragment by the olfactory lobes.
Fig. 4. The corresponding interior aspect of the frontal bone of *Crocodilus Hastingiæ.*
Fig. 5. Interior view of the frontal bones of a chicken. The shaded part marks the cavity occupied by the fore part of the cerebrum—a part which is not preserved in the fossil, fig. 3.
Fig. 6. Restoration of the form of the cerebral cavity in the Ornithosaurians from the Cambridge Upper Greensand; outline, seen from above.
Fig. 7. Restored form of the cerebral cavity of an Ornithosaur, seen from the side.
In these figures *a* marks olfactory lobes; *b*, cerebrum; *c*, optic lobes; *d*, cerebellum. A dotted line is introduced between *c* and *a*, which would give the cerebrum a form more like that of a bird, and which possibly may prove to be its true shape.
Fig. 8. Restoration of the palate of the Ornithosaurian *Cycnorhamphus suevicus* (Quenst.): *Bo*, basioccipital; *s*, sphenoid; *Q*, quadrate bone; *qa*, quadrate articulation; *Pt*, pterygoid; *P*, palatine; *V*, vomer; *Pm*, premaxillary; *Mx*, maxillary; *m*, malar.

Plate III.

Portion of a bone supposed to be the maxillary bone of an Ornithosaur.

Fig. 1. External appearance.
Fig. 2. Interior appearance.
m is towards the maxillary border; *na*, a surface (perhaps articular) towards the nasal bone; *n*, part of the boundary of the nasal aperture. The inner surface of the bone is a good deal invested with phosphate of lime.
Fig. 3. Diagram side view of the Ornithocheiroid cranium, the shaded parts being at present unknown: *s*, squamosal; P, parietal; F, frontal; Q, quadrate bone; QJ, quadrato-jugal; M, maxillary; PM, premaxillary; D, dentary, A, articular end of lower jaw; N, nostril; O, orbit.
Fig. 4. Copy from Prof. Quenstedt's figure of the head of *Cycnorhamphus suevicus*: 3, nasal bones; 7, frontal; 8, parietal and squamosal bones; 23, postfrontal; 26, quadrate; 6, quadrato-jugal; 19, malar; 2, lachrymal bone; 22, lachrymal bone; 25, pterygoid; 16, palatine.
From this specimen is made the restoration Pl. II. fig. 8.

IV.—*Note on* Dorvillia agariciformis. By W. SAVILLE KENT, F.Z.S. &c., of the Geological Department, British Museum.

AT the November meeting of the Royal Microscopical Society, I described, under the above title, a new deep-sea sponge recently purchased for the British Museum by Dr. Gray, which description, with a plate (pl. 66) illustrative of its structure, has subsequently appeared in the December Number of the 'Monthly Microscopical Journal.'

At the time, I observed that some of the spicules figured greatly resembled those of *Pheronema*; and being derived from so great a depth, it was not unreasonable to suppose that spicules of that last-named form had become associated with it. Fuller examination has further strengthened me in this idea; and I now feel satisfied that none of the hexradiate forms, in addition to figs. 12 & 14, are referable to *Dorvillia*, having simply become entangled with it during contact with examples of other species.

Making these deductions, it will become evident that *Dorvillia* is a representative of the true Tethyidæ, its affinities with which have already been recognized in consequence of the highly developed triradiate character of the spicules and the remarkably firm consistence of its sarcode.

Since the publication of its description I have seen the yet unpublished plates of a form Prof. Wyville Thomson proposes to name *Tisiphonia agariciformis*, taken in one of the earlier expeditions of the 'Porcupine,' which plates have been sent by that gentleman to Dr. Gray only within the last few days. *Dorvillia* and this will probably prove to be identical; and had I been favoured with a sight of these plates in time, I should certainly have withheld its description. I would nevertheless remark that a brief but speedy notice of the most interesting forms collected, preparatory to the excellent and elaborate monographs in course of construction, would serve to efface the present feelings of fear and trembling with which one proceeds to describe any new accessions, while at the same time it would conduce greatly to satisfy the hopes long deferred with which zoologists on all sides are expectantly awaiting an account of the immense amount of material the late expeditions have afforded.

The plates of *Tisiphonia* here alluded to seem to include, as its young condition, Prof. Perceval Wright's *Wyville-Thomsonia Wallichii*, described in the 'Quarterly Journal of Microscopical Science' for Jan. 1870; and though *Dorvillia* is the first full account published, Prof. Wright's name, in the event of its proving identical, is perhaps entitled to precedence. Dr. Oscar Schmidt, on inspection of Prof. Wyville Thomson's plates, is inclined to refer it to his genus *Stelletta*, from the ordinary forms of which it differs only by its possession of long depending fascicles of anchoring-spicula, which he regards as merely special developments enabling it to adapt itself to the soft oozy condition of the bottom at the great depths at which it has been taken.

V.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, F.L.S.

[Continued from vol. vi. p. 482.]

Tecton*.

Broader in front than behind; clothed with a close pile. Head large, broad, and with a wide space between the antennæ, which is not hollowed; slightly prominent on the vertex, inflexed and cut straight, slightly raised from small antenniferous tubercles. Clypeus transverse. Labrum subquadrate. Eyes almost bifid, large. Antennæ starting from the division between the upper and under part of the eyes, nearly of the length of the body, not robust, and nearly of equal thickness, except the first article; with eleven elongate and subequal articles. Thorax widest in front, of the breadth of the head, constricted near the base, and without any lateral spine; but a trifling elevation may be distinguished behind the middle. Scutellum large. Elytra subcylindrical, scarcely broader than the thorax, slightly attenuated towards the base. Abdomen with five segments. Legs short; tibia subtriangular in the middle, moderately emarginate.

M. Chevrolat regards this genus as the representative in Africa of the American *Oncideres*. In respect that it is somewhat allied to *Prosopocera*, it may be so, for that genus is the true representative of *Oncideres*; but I feel much doubt as to the proper place of this genus. It by no means strikes me as so close to *Oncideres* as M. Chevrolat supposes.

Tecton quadrisignatum, Chevr. Rev. et Mag. d. Zool. Zool. 1855, p. 185. Pl. III. fig. 9†.

Pilo dense cervino cinereoque indutum; lineolis fusco-nigris duabus in thorace et in elytris basi extensis; capite longitudine antice carinato posticeque sulcato; thorace cum

* From *τέκτων, a carpenter.* † Of vol. vi. of the 'Annals.'

lineola nigra oblique posita in angulo postico, antice recto, postice leviter bisinuato versus latera, in dorso obsolete costata; scutello semirotundato; elytris mediocriter punctatis, cinereis, lineolis leucophæis sæpe obliquis versus apicem, lineolaque fusco-nigra intra humerum basi; pedibus brunneis, tarsis pallidis.

Long. 9½ lin., lat. 3½ lin.

Densely clothed with a uniform fawn- and ash-coloured pile, with a brownish-black linear patch at the external base of the thorax, continued on to the base of the elytra for a short space; head longitudinally carinate in front, and sulcate behind; thorax straight in front, slightly bisinuate behind towards the sides, obsoletely costate on the back; scutellum large and semi-rounded; elytra moderately punctate, with some paler oblique lines towards the apex; legs brown, tarsi pale.

Very rare. Only three specimens received.

Prosopocera.

This genus is another of the remarkable evidences of close affinity between the species of Old Calabar and Brazil. It is undoubtedly the representative of the Brazilian genus *Oncideres*, one of the new species now described (*P. Fryi*) having the appearance and yellow-flecked colouring of that genus in a more marked degree than any of the hitherto described species. It might be a question, indeed, whether it and *P. pictiventris*, which most resemble *Oncideres*, should not be made a distinct genus: but I think it would be an error, as indicating a greater departure from the other Prosopoceras than really exists. Not having seen the males of all the species, I cannot say whether they have a horn on the forehead or not; but I am inclined to think that in the majority of cases it will be found that they have not; for although the horn appears to be always present in the Senegal species, *P. cornifrons*, even there it is of variable dimensions; and in the Old-Calabar equivalent of *P. cornifrons* (*P. ocellata*), although sometimes present, it is absent in the great majority of male specimens; and in none of the other species have I seen any; and although I have supposed them to be all females, some of the specimens have certainly longer antennæ than the others, and may perhaps be males. With regard to this horn, it is a noteworthy point, corroborative of the affinity of the genus with *Oncideres*, that various species of the latter have likewise projecting horns on the forehead. In them the horns project, one on each side, from the inner side of the base of the antennæ; while in *Prosopocera* it is a single horn, projecting in the middle, lower down than the antennæ; but the horn, although single, is obviously composed of two horns soldered together; and it seems very plain to me, coupling it with the other points of resemblance, that it is the same tendency to produce horns on the forehead which we see in *Oncideres* that is also present in *Prosopocera*, but that the horns have taken a slightly different position and form.

1. *Prosopocera ocellata*, Chevr. Rev. et Mag. d. Zool. 1857, p. 76.

Grisea, lateribus thoracis infra pectoreque niveis; in elytris ante medium quatuor notulis ocellaribus nigro-velutinis albo cinctis, prima parva marginali, secunda dorsali obliqua ad maculam albicantem et obliquam margine juncta.

Mas. Capite cornu plus minusve protenso.

Long. 10–14 lin., lat. $3\frac{1}{2}$–4 lin.

Fœm. Capite, fronte transversim et semicirculariter impresso.

Long. 10–12 lin., lat. $3\frac{1}{2}$–4 lin.

Head grey, occasionally armed in the male with a projecting horn, which is very variable in form, in the largest specimens sinuate, toothed on the margins, grooved in the middle, and double-keeled longitudinally. This horn is more frequently absent than present.

I have a specimen which looks so much stouter and more obese than the others, that at first I thought it might be distinct; but I can see no other difference, except that the marginal black spot of the elytra is in it larger than that on the disk, which is not the case in any other specimen I have seen, the marginal spot being usually only half the size of the others.

One of the commoner species of Longicorns from Old. Calabar.

2. *Prosopocera myops*, Chevr. Rev. et Mag. d. Zool. 1855, p. 185. Pl. II. fig. 8*.

Fusca, mandibulis oculisque (fulvo limbatis) nigris; capite rotundato, anguste (inter antennas cruciatim) sulcato; thorace subtransverso, quater stricto, antice recto, fulvo, dense setoso, postice profunde sinuato, spina laterali brevi acuta; elytris, præsertim dorso, cinereo infuscatis, maculis duabus ocellaribus nigris ante medium; pectore cum vitta laterali albida.

Long. 16 lin., lat. 5 lin.

M. Migneaux's figure in Pl. II. renders further description unnecessary.

Rare.

* Of vol. vi. of the 'Annals.'

3. *Prosopocera dorsalis*, Chevr. Rev. et Mag. d. Zool. 1858, p. 306.

Simillima *P. myopi*, Chevr., sed differt præcipue colore obscuriore elytrorum, macula dorsali albida magis extensa, valde angulata, in medioque marginis ocellis quatuor atris. Cinerea; mandibulis oculisque (flavo limbatis) nigris; capite anguste sulcato, inter antennas arcuatim impresso nigroque signato; antennis corpore paulo longioribus, ♀ parce pilosis; thorace fusco, inæquali sulcis tribus transversis (primo valde sinuato), in basi infraque flavo, spina laterali brevi acuta; elytris brunneo-cinereo fuscoque disperse vel connexe variegatis, plaga magna dorsali media albida versus latera angulata, maculis ocellaribusque quatuor anticis nigris, prima albo cincta infra humerum, secunda pone medium elytri in limbo anteriore maculæ dorsalis.

Long. 16 lin., lat. 5 lin.

This species so much resembles *P. myops* that at first sight one would take it for a variety. It differs nevertheless in several points, which seem of specific value: its elytra are shorter and broader; the dorsal mark is larger and whiter, and more angular on the side; and, lastly, it has four ocellated black spots, while *P. myops* has only two; besides, the place which the dorsal mark occupies is more elongate, rounded, and of a more regular form than in *P. myops*. Head of a yellowish ash-colour, with some small distant punctures; the longitudinal line is in the form of a slender ridge from the base to the impression between the antennæ and a narrow groove beyond it. Eyes black, surrounded by a yellow circle, which is double behind them. Antennæ a little longer than the body, brown, slightly pubescent. Thorax transverse, straight in front, narrowly bordered with yellow, bisinuate and yellow behind, with three transverse grooves: the first is deeply sinuate and arched in the middle; the dorsal impression is in the form of a horseshoe; its colour above is obscure brown, and below yellowish white. Scutellum semirounded, brownish. Elytra sinuate at the base, convex, each rounded at the apex, adorned with four ocellated, silky, black marks, which are surrounded with a yellowish circle, and placed before the middle—the first on the edge of the margin below the shoulder, the second towards the middle of the elytron and a little towards the inner side, resting at its extremity on the anterior edge of the large white dorsal patch. Body below ash-coloured; breast having a yellow line on its lateral and posterior sides.

Unique. In my collection.

4. *Prosopocera Fryi.*

Magna, lata, supra subdepressa; pube cinereo-fusca induta; elytris flavido sparsis; capite lato, anguste (inter antennas transversim subarcuatim) sulcato, juxta oculos impresso; oculis maximis, antice depressis, superne fere bifidis, superne flavido limbatis; antennis corporis vix longitudine; thorace transverso, longitudine latiore, quater stricto, antice margine flavido, dense setoso, postice bisinuato, spina laterali brevi acuta; disco carinis convexis transversis lenticuliformibus tribus, quarum duabus anticis utrinque et tertia postice medio positis; elytris thorace latioribus, ad basin ante humerum arcuatim productis, suboblongis, subdepressis, lateribus declivis, humeris tuberculis asperatis, apice rotundatis, ad suturam rectangulatis et ibi denticulatis, flavido irregulariter transversim adspersis, guttis flavidis prope medium et circa humerum confluentibus: subtus flavido dense vestita, pectore lateribus cinereo et flavido sulcis transversis subalternatim indutis; mesosterno et metasterno omnino flavidis; abdomine medio cinereo, lateribus et segmentorum marginibus plus minusve cinereis, ceteris irregulariter flavidis; pedibus cinereis.

Long. 13–14 lin., lat. 5 lin.

A large, broad, wide-fronted, subdepressed species, clothed with a short pile of light cinereous brown, with a slight greenish tint; the head and thorax, elytra and underside more or less covered with yellowish fawn-coloured markings. Head broad, narrowly longitudinally sulcate down the middle, and with a somewhat arcuate, transverse, deeper groove between the antennæ; a depressed margin extends along the inner side of the eyes, which are very large, depressed in front, and almost cut in two near the top by the emargination on which the antenniferous tubercle stands; above they are margined with yellowish pile. The antennæ are scarcely the length of the body, and are stouter than in the other species of the genus; the first three articles are cinereous, like the ground-colour of the body, the remainder fawn-coloured, like the markings on it. Thorax transverse, broader than long, with four transverse grooves, which extend along to the breast; that in front is very bisinuate, and the two behind at the base are regular and even; the other in the middle spreads out and encloses three lenticular transverse ridges—two before (of which one is on each side of the middle line) and one behind in the middle; the anterior margin is densely fringed with yellowish pile; the lateral spine is short, but acute; the anterior margin is nearly straight, the base gently bisinuate. Scutellum moderate, slightly elongate, semirounded. Elytra suboblong, subdepressed, broader at the base than the thorax, with the shoulders projecting forward and roughened with tubercles, rounded at the apex to the suture; the sutural angle rectangular and toothed, the surface irregularly and pretty closely sprinkled with specks of ochraceous fawn-colour disposed somewhat transversely, which become slightly confluent around the shoulder, and form a slightly larger, irregular, not very marked patch in the middle; it is flecked with ochraceous fawn-colour, exactly as in *Oncideres*. Below, the breast has somewhat alternate, subtransverse, converging stripes of yellow and cinereous following the ridges and grooves, which are continued from the upperside of the thorax. The mesosternum and metasternum are entirely fawn-coloured. Sternum with a short, stout, triangular projection, the apical sides of which are slightly raised, and smooth and glabrous. The abdomen has the margins of the segments (except the first, which is entirely fawn-coloured) cinereous; in the centre a longitudinal broad space is cinereous, passing into fawn-coloured on each side; and beyond it the stigmata and more or less of the sides are cinereous, with a greenish tinge. The legs are moderate, and of the same cinereous colour.

Only two specimens received, apparently females.

This species is the transition link between *Oncideres* and the other forms of *Prosopocera*, on the one hand, and between the latter and *Sternotomis* on the other; the upperside reminds one very much of *Oncideres*, and the underside particularly of *Sternotomis*, the disposition of the colours and the pale-greenish cinereous being very much what was to be seen in some species of that genus. It is a fine species, worthy to be dedicated to my friend Mr. Alexander Fry, who first drew my attention to the remarkable affinity between *Oncideres* and *Prosopocera*.

5. *Prosopocera? pictiventris*, Chevr. Rev. et Mag. d. Zool. 1857, p. 78.

Latiuscula, brevis, griseo nigroque variegata; thorace (transverse et profunde bistricto sulcis duobus anticis rotundatis, foveola media impresso, obtuse spinoso), scutello elytrisque basi et in longitudine postice cervinis, pectore abdomineque nigris, albo-fimbriatis; antennis brunneis, breviter cinereo annulatis et vix corpore longioribus.

Long. 8–9 lin., lat. 2 lin.

Subcylindrical, short, stout, thick, dark grey. Head blackish, with a short grey pubescence and a close granular punctation; it is broad, cut vertically in front, and slightly convex, not deeply hollowed between the antennæ. Palpi ferruginous. Clypeus broad, straight. Eyes brown, distant, deeply emarginate on the upper two thirds. Antennæ scarcely longer than the body, brownish, ringed with ash-colour at the base of the articles. Thorax transverse, broad, straight in front and behind, but broadly and briefly advanced upon the scutellum, faintly grooved on each side, and very deeply double-grooved across towards the centre; on the edge of the first groove are two round spaces, and a deep spot is situated in the middle, near the second groove; the lateral spine is almost obtuse. Scutellum yellowish red, not very broad, semirounded. Elytra all along the base, a little beyond on the side, longitudinally from the middle to the apex of each of a yellowish red, transversely blackish behind the base, griseous on the middle, with the margin a little ash-coloured; they are broader than the thorax, obtusely rectangular beyond the shoulder, each narrowly rounded at the extremity, and with a rather fine and regular, although distant, punctation. Legs reddish brown, short; thighs tolerably thick, hollowed only at the extremity (to receive the knees), of the length of the tibiæ; intermediate tibiæ obliquely incised at the middle, on the outside; tarsi moderate, first article conic, second triangular, third narrowly lobed. Claws simple, rather strong. Breast white, with the posterior half and all the abdomen of a dull black margined with white on the sides of the body and on the posterior margin of the last segments. Sternum narrow, arched longitudinally, truncate and adherent in front, truncate but raised behind.

Only one specimen of this insect has been received, and it is of doubtful sex; for the abdomen is depressed as in the males, and the antennæ are short, as in the females. Its appearance was exceedingly like a squat *Oncideres* of small size. M. Chevrolat, to whom I gave it, referred it with doubt to the genus *Prosopocera.* Unfortunately, I have been unable to find it in his collection, now in the British Museum, so am unable to say more as to its generic identity.

Geloharpyia, J. Thoms., Lac.

Geloharpyia Murrayi. Pl. III. fig. 7*.

Sternotomis Murrayi, Chevr. Rev. et Mag. d. Zool. 1855, p. 184.

Valde affinis *St. amœnæ*, Westw. Parce punctata, nigro-holosericea, maculis duabus anticis lineaque superciliari in capite, lineis tribus longitudinalibus (linea dorsali medio

* Of vol. vi. of the 'Annals.'

attenuata, postice ampliata) in thorace, duabus maculis magnis subanguliformibus duabusque minutis suturalibus in elytris, pectore et abdomine lateribus virenti-albidis.

Long. 15 lin., lat. 5 lin.

The figure by M. Migneaux in Pl. III. renders any further description unnecessary.

It is a rare species, much prized for its beauty.

Sternotomis.

1. *Sternotomis imperialis.*

Lamia imperialis, Fab., Westw. Arc. Ent. ii. 149, pl. 86. f. 3.
Cerambyx luteo-obscurus, Voet, Col. ed. Pz. iii. 20, 19, pl. 7. fig. .
—— *ornatus*, Oliv. Ent., Ceramb. pl. 4. fig. 24 c.
Lamia bifasciana, Fab. Ent. Syst. i. 281.

I have taken this synonymy from Westwood's 'Arcana.' It differs entirely from that given by M. Chevrolat; but, on looking into the citations, I am satisfied that the above corresponds best with the descriptions and plates. M. Chevrolat doubtless rests his opinion upon a different estimate of the value of the variations of the species, or upon a traditionary knowledge of the types.

Not very rare. When it arrives in spirits, the green parts of this insect are of a lovely iridescent rose-red, slightly changing to green.

2. *Sternotomis chrysopras.*

Cerambyx chrysopras, Voet, Col. ed. Panz. iii. 21, 22, pl. 9. fig. 22; Schönh. Syn. Ins. vol. iii. p. 373.
Sternotomis chrysopras, Westw. Arc. Ent. ii. 155, pl. 86. f. 1.

Rare.

3. *Sternotomis Targavei* (Reiche), Westwood, Arc. Ent. 1844, p. 154, pl. 86. fig. 2.

In Prof. Westwood's figure, the apical portion of the elytra is figured green; but in my specimen it is yellow almost to the point.

This beautiful species is exceedingly rare.

Quimalanca, J. Thoms., Lac.

Quimalanca regalis.

Sternotomis regalis, Fab. Sp. Ins. i. 217.

Common.

TRAGOCEPHALA, Cast. Hist. Nat. Col. ii. 472.

1. *Tragocephala Galathea*, Chevr. Rev. et Mag. d. Zool. 1855, p. 184. Pl. II. fig. 6*.

Nigra, holosericea; vittis tribus croceis (una antica duabus lateralibus ad verticem) in capite, duabus lateralibus in thorace; elytrisque (tertia parte nigra) croceis; abdomine (nigro trifariam maculato) pedibusque cinereis; femoribus partim nigris; capite rotundato, omnino anguste sulcato; thorace longiore quam latiore, bistricto, lateribus angulariter dentato.

Long. 8–9 lin., lat. 2–2½ lin.

Black, velvety, with three orange-coloured stripes on the head (one in front, two on the sides), and two lateral ones on the thorax; sides of thorax angularly toothed. Scutellum black. Elytra orange-coloured, with the apical third black. Abdomen checquered black and ash-coloured, middle and sides alternating in colour. Legs with the thighs black, which may be partly due to the pile being rubbed off, except the under ridge and a patch below at the apex and base, cinereous; tibiæ and tarsi reddish, with cinereous pile.

Unique. One specimen in my collection.

2. *Tragocephala senatoria*, Chevr. Rev. et Mag. d. Zool. 1858, p. 56.

Nigra, holosericea; capite vittis viridibus duabus decussatis usque ad basin thoracis in margine laterali productis; scutello flavo; elytris ochraceis, puncto humerali, vitta communi ante medium abbreviata (includente maculam viridem subquadratam, ultra scutellum postice fere cruciformi), dimidia parte apicali (notulis tribus viridibus signata, duabus transverse positis, tertia virguliformi infra fere ad maculam interruptam juncta) nigris; thorace infra et abdomine viridibus (vitta lata longitudinali, punctoque in utroque segmento nigris); pedibus partim viridibus; pectore ochraceo.

Long. 9–10 lin., lat. 3–3¼ lin.

This species much resembles in its coloration *T. Guerinii*, White (*T. scenica*, Dej.), but it differs in the design on the elytra. Head velvet-black, with two longitudinal green lines which start from the exterior angle, course along the eyes, are united between the antennæ, and are prolonged along the sides of the thorax to its base. Mandibles green on the side, black and smooth at the point. Antennæ of the length of the body, black. Thorax velvet-black, straight in front, shortly

* Of vol. vi. of the 'Annals.'

sinuate behind, with a deep emargination before the scutellum; two transverse grooves in a straight line start from the lateral angle, which is sharp and flattened. Scutellum rounded, greenish. Elytra of an ochre-colour with a greenish tinge and with a humeral black spot and a broad common band of the same colour, terminating before the middle; it commences square (and has at its centre, behind the scutellum, a small oblong green spot), withdraws a little further on, and gives out on each side before its termination a small direct branch; the posterior half is also velvet-black; its anterior margin advances angularly to the front near the suture; towards the middle and the centre of its extent are two square, green, little drops, which are placed on a transverse line, and of which the exterior is a little largest; another green mark, in the form of a thick comma, is situated behind, and is almost united to the internal droplet. Underside of thorax (except the breast, which is ochreous) and abdomen green; middle of the latter marked longitudinally with a broad shining black band, and on each of the segments a small transverse black stroke. Legs partly green, appearing black on the denuded parts.

Unique. In my collection.

3. *Tragocephala chloris*, Chevr. Rev. et Mag. d. Zool. 1858, p. 57.

Affinis certe *T. nobili*, Fab., sed distincta. Atra, holosericea; capite flavo vel viridi, macula occipitali trigona, fascia arcuata inter, et lineola lata post oculos nigris, punctulis nigris quinque aut sex ordinatis in margine, sulco angusto longitudinali; thorace viridi-flavo, lineis longitudinalibus tribus nigris; dorsali latissima, duabus infra ex adverso oculis; elytris fasciis transversalibus duabus integris viridibus, prima infra basin, versus marginem attenuata, anterius per punctum humerale nigrum, et retro per ramulum obliquum nigrum, secunda versus medium posita, angulata supra ad medium, dein oblique flexa secundum suturam; ultra notulis duabus, transverse dispositis, laterali viridi interna albida, macula ovali transversa viridi ante apicem, notulaque albicante in imo suturæ; corpore infra flavo; in pectore lineola laterali nigra, et in utroque segmento abdominis maculis tribus nigris, mediis quadratis ad limbum posticum, sed lateralibus ad limbum anticum adnexis; pedibus flavescentibus, femoribus versus medium nigro maculatis tibiisque extus nigro limbatis. Varietas, prima fascia elytrorum in sutura late interrupta.

Long. 9–10 lin., lat. 2–2$\frac{3}{4}$ lin.

This species is very near *T. nobilis.* Of a fine velvet-black, adorned with bands and spots, which were at first of a fine delicate green, but which day by day became yellower. Head yellow, with a large triangular black patch on the occiput, also an arched line between the antennæ, and a large band behind the eyes, all black; five or six black spots are disposed in a line towards the sides. Antennæ a little shorter than the body in the females. Thorax green or yellow, marked with three black longitudinal lines, the dorsal very broad, and the other two facing the band behind the eyes. Scutellum shining black, half-rounded. Elytra a little broader than the thorax, and rather more than twice and a half its length, each regularly rounded; they have two entire transverse bands of a fine green: the first is situated behind the base, and retreats on the side by a black humeral spot placed before it, and behind it by an oblique straight black branch, which proceeds towards the front, but which is separated from it; the second is situated about the middle of their length, its anterior margin proceeds angularly towards the middle, is emarginate on the posterior margin, and is recurved obliquely towards the suture; a little behind are two small drops placed on a transverse line; the outer one is green, the inner white; thereafter there is a regularly oval transverse green spot at an equal distance between the two small marks and the extremity; finally a small white line is placed on the apical border of the suture. Body below yellowish green. Breast with two small black lines, the one, transverse, behind the shoulder, the other, longitudinal, near the anterior margin. Abdomen with three black spots on each segment, those in the middle square, resting on the posterior margin of the segment, while those on the sides rest on its anterior margin. On the fifth segment these spots are united to each other by the base. Legs yellow; thighs spotted with black about the middle; tibiæ bordered with black on the exterior side.

The *T. nobilis*, F., differs from this species, first, by its head having two black lines situated one on the internal margin of each eye; secondly, by the absence of two black lines on the thorax; these are replaced by a black spot; thirdly, by the two yellow bands of the elytra, which are joined to each other on the side, as well as a small external line which also joins the second band; fourthly, by the middle black line of the abdomen, which is narrower and otherwise marked.

Very few specimens received.

Nov. genus vel subgenus (*Tragon*).

4. *Tragocephala* (*Tragon*) *signaticornis*, Chevr. Rev. et Mag. d. Zool. 1855, p. 521.

Alata, punctata, cinerea obscura nigro varia; ore, oculis antennisque (articulo septimo albo) nigris; thorace postice acutius spinoso; elytris singulatim quinque maculis transversalibus nigris, una basi, duabus ante duabusque post medium.

Long. 8 lin., lat. $3\frac{1}{2}$ lin.

This species is removed from most of its congeners by its cylindrical form, its antennæ of a regular thickness and sharp at the tip, and its thorax with a spine a little more pointed and placed further back. It is of an obscure ash-grey sprinkled with black, impunctate. Head broad, square, slightly inclined, convex above; longitudinal groove narrow. Palpi, mandibles, and eyes black. Antennæ black; first article ash-coloured below; apex of the sixth, base of the eighth, and the whole of the seventh white. Thorax a little longer than broad, straight in front and behind, and transversely four-grooved. Scutellum moderate, semirounded, black, marked with a grey line. Elytra impressed with small points, broader than the thorax, with projecting shoulders, which are black on the outside, convex, parallel, shortly rounded at the apex, with the sutural termination rectangular; they are dark grey sprinkled with black; each elytron has five transverse black patches,—one on the middle of the base, two before and two behind the middle, and the two interior are more advanced than the two exterior. Prosternum scarcely raised behind. Mesosternum regularly raised, rather broad. Abdomen composed of five segments, the last the largest, and grooved in a cruciform manner. Pygidium broadly emarginate. Legs rather close to each other, unarmed.

M. Chevrolat suggests that this species should probably constitute a new genus.

Unique. Given to M. Chevrolat. I have not, therefore, the materials for characterizing the genus further than indicated in the above details taken from M. Chevrolat's description.

5. *Tragocephala* (*Tragon*) *jaguarita*, Chevr. Rev. et Mag. de Zool. 1855, p. 552.

Alata, punctata, minuta, cinerea; mandibulis, oculis tarsisque apice nigris; thorace transversim quadristriato, maculis quinque vel septem obsoletis et nigris, in lateribus posticis

acute spinoso; elytris singulatim cum circiter triginta maculis nigris subrotundatis transversimque dispositis.
Long. 4 lin., lat. $1\frac{1}{2}$ lin.

Greyish ash-coloured. Head finely and irregularly punctate, square, slightly convex and slightly inclined, rounded on the front, narrowly grooved. Labrum very large, transverse, square, covered with ash-coloured hairs, but smooth and black at the base. Mandibles and eyes black. Antennæ ash-coloured, with the third article long, three quarters black (remainder wanting). Thorax as long as broad, straight at the extremities, with four transverse grooves; some punctures on the disk, with five to seven obsolete black patches; lateral spine behind the middle, rather broad at the base, bent at the apex. Scutellum semirounded. Elytra a little broader than the thorax, projecting and rounded on the inner side of the shoulder, parallel, rounded at the apex, ash-coloured, and bearing about thirty rounded black spots of different sizes and generally disposed in transverse bands; their punctation is tolerably strong, numerous, and regular. Legs simple; tarsi with the penultimate and last article black. Body below uniform grey. Abdomen of five segments; the fifth and the first the longest, the fourth the shortest. Prosternum ash-coloured. Mesosternum shield-shaped, widened at the base, gibbous in the middle.

Unique. This should probably belong to the same genus as the preceding.

ACRYDOCEPHALA, Chevr., Lac.

Acrydocephala bistriata, Chevr. Rev. et Mag. d. Zool. 1855, p. 287.

Pilis brevibus griseis dense vestita; palpis, oculis et dimidia parte apicali mandibularum nigris; capite trisulcato, nigro bilineato, supra anguste et profunde emarginato bicornuto; thorace vittis tribus latis nigricantibus, punctis raris; scutello nigro; elytris modice et sat crebre punctatis, oblique bistriatis usque ad dimidiam partem anteriorem nigris cinereo irroratis et apice recte truncatis, vitta lata media nigra et nitida in abdomine, triangulari in pectore.
Long. $7\frac{1}{2}$–8 lin., lat. $2\frac{1}{4}$ lin.

Densely clothed with short grey pile; head trisulcate, with two black lines narrowly and deeply emarginate, and with two horns. Thorax with three broad blackish stripes and a few punctures. Scutellum black. Elytra black and moderately punctate, obliquely bistriate on the anterior half, speckled with cinereous, and with the apex truncate. Below with a broad black shining stripe in the middle.

Only one specimen. In my collection.

ANCYLONOTUS, Cast., Lac.

Ancylonotus tribulus, Fab. Syst. El. ii. 281.

This well-known African species does not seem to be so common at Old Calabar as elsewhere on the west coast. It has only come once or twice.

[To be continued.]

VI.—*On* Saurocetes argentinus, *a new Type of* Zeuglodontidæ. By Dr. HERMANN BURMEISTER.

[Plate I.]

THE public museum of Buenos Ayres has lately received the under jaw of a very interesting fossil mammalian, which I beg leave to describe, under the above denomination, as an entirely new type belonging to the curious tribe of Zeuglodontidæ. This specimen was generously presented to the museum by Dr. D. Manuel Montes de Oca, Professor of Physiology in the Medical Faculty of Buenos Ayres. That patriotic gentleman having noticed the great interest taken by me in it when looking over his valuable collection, offered me the opportunity of examining the bones and describing them for the benefit of science, which I am glad to acknowledge here with well-merited thanks.

Respecting the locality where the fossil was found, M. Montes de Oca could say nothing; he received it from one of his patients, who brought him the bones, broken as they are, from the interior of the country, as a contribution to his collection. But the adherent remains of the formation in which the bone was discovered prove very clearly that the fossil was taken out of a sandy bed of the great Tertiary formation on the shores of the river Paraná, which D'Orbigny has named the "*Formation patagonienne.*" This formation, described by Darwin, D'Orbigny, Bravard, and myself*, is chiefly a marine deposit mixed with beds of freshwater deposition, wherein are found many bones of freshwater fishes (Siluridæ), of Crocodilidæ, and even of terrestrial Mammalia. We have in the museum of Buenos Ayres bones of all these animals,

* Reise durch die La Plata-Staaten, tom. i. p. 410 (Halle, 1861, 8vo); Anales del Museo Publico de Buenos Aires, tom. i. p. 114.

and also the occipital part of a skull, which has so much resemblance to that of *Anoplotherium grande* (Blainville, Ostéogr. pl. 8) that we may infer the existence of this Tertiary form in South America during the Later Tertiary epoch. Bravard, in his 'Monografia' of the formation (Paraná, 1858, p. 45), mentions the same genus, represented by a first molar tooth of the animal; and I must confirm his discovery as very probable by the part of the skull in my hands, which, unfortunately, has no teeth, but only the occipital, parietal, and the mastoid portion of the temporal bone complete.

Marine Mammalia are rare. Bravard describes some portions of a whale (*Balæna dubia*, p. 34) as the only marine mammiferous animal known to him. I had the good fortune to find, during my residence in Paraná, the tooth of an *Otaria* (Reise, i. 431) in a bed of sandy clay exactly like the adherent portions of the formation on the lower jaw now to be described; and therefore I may assert with good reason that my *Saurocetes* must be of the same epoch and from nearly the same locality.

The fragment of the lower jaw is the middle portion of the whole, containing the hinder part of the two united half-jaws and the beginning of the two articular branches, which are broken off, as is also the whole front of the jaw. The remaining portion, shown in Pl. I. fig. 1, of half the natural size, from the left side, is on this side 15 inches long and $2\frac{1}{2}$ inches high at the highest region of the jaw, before the separation of the two articular branches, but only $1\frac{3}{4}$ inch at the beginning, under the first tooth. On the right side the articular branch is broken off; but a somewhat longer portion is well preserved, so that the whole length is 3 inches more—say 18 inches. But as a piece of the jaw is wanting on this side, I could not figure the right branch in its true position, and have given a separate figure of it (fig. 4) from the outside, also of half the natural size. The closed anterior portion of the jaw is 11 inches long and $1\frac{1}{2}$ inch broad at the tip, but $2\frac{1}{6}$ inches at the hinder part. Its transverse figure is an equilateral triangle with outwardly curved sides and a rounded inferior edge; the interior is entirely of compact osseous substance, with only two small open channels at the lower part. These two open channels (*canales alveolares*) are separated by a very thin osseous septum (fig. 2), which, like the channels themselves, rises much higher behind, so that each channel expands into a large open cavity in the interior of the two articular branches of the jaw in the same manner as in the lower jaws of the Delphinidæ, to which this lower jaw seems to have been very similar in construction, and especially to that of *Pontoporia* as it is figured in my 'Annals of the Public Museum of Buenos Ayres,' tom. i. pl. 26. fig. 2.

The superior part of the anchylosed portion of the jaw contains the alveoles for the teeth, whereof there are on the left side twelve, and seven on the right, wanting the hinder portion of this side of the jaw before the separated articular branch. Each alveole reproduces completely the figure of the roots of the teeth; it is, like them, divided at the lower end into two branches, and united by a very small short passage with the alveolar channel in the interior of the jaw (fig. 2). As some of the alveoles are open in the broad portion of the right side of the jaw, I could see the whole figure of them very clearly, and distinguish well the small and very short passage leading into the open channel of the interior of the jaw. In this hinder region of the anchylosed portion of the jaw, where the alveolar channel is much larger, even the tips of the roots of each tooth pass into the channel, so that they are seen like protuberances on the superior, larger side of the channel.

The upper surface of the anchylosed portion of the jaw between the teeth is moderately convex, with a median impressed line as the remains of an anterior suture which has united the two half-jaws to each other. On the opposite or lower surface no trace of suture is visible in the anterior portion of the jaw; but it is sufficiently conspicuous at the hinder end, before the separation of the two articular branches. The outside of the jaw is peculiarly wrinkled, and furnished with a very well-marked furrow on each side along the lower region (see fig. 1), which is narrower and deeper at the anterior end. From this furrow the wrinkles begin in an oblique direction, ascending from behind forwards, and growing somewhat smaller and less strongly marked. The furrow does not continue further back than to the end of the anchylosed portion, vanishing here completely. But the two articular branches have also similar but more horizontal wrinkles on the outside, as shown in figs. 1 & 4. It is worth notice that some of the Delphinidæ, like *Pontoporia* (see my figure, *l. c.*), have the same furrow on the anchylosed portion of the under jaw.

With respect to the teeth, the generic character of the animal is founded on the circumstance that all the teeth are of the same form, and not different, like those of *Zeuglodon* or *Basilosaurus*. In a paper published at Halle in 1847*, I have shown by figures that *Zeuglodon* has at least three different forms of teeth:—one with single crown and root; a second with a great conoidal crown to which are attached one

* Bemerkungen über *Zeuglodon cetoides*, Owen, *Basilosaurus*, Harlan, *Hydrarchus*, Koch, &c. 4to, with figure. Halle: Schwetzke & Sohn.

or two smaller cones, and a subdivided root on the end; and a third class of large molars, with two great equal roots and a higher compressed crown of from six to nine conoidal knobs, of which the central one is the most prominent and highest. It seems probable that the first class of teeth with the single crown were the foremost, the second the following on each side (corresponding to the false molars), and the third class the true molars of the hinder end of the series. In our *Saurocetes* no such difference occurs; all the teeth are of the same form, corresponding in structure rather to the second class of the teeth of *Zeuglodon* than to the first and third. Every tooth has a single conoidal crown, somewhat curved backward and compressed on both sides, covered, like the teeth of *Zeuglodon*, with a distinct layer of enamel, irregularly wrinkled on the external surface, as may be seen in fig. 3, which shows one tooth of the natural size*. Below the crown is a small and narrow cingulum, corresponding to the part of the tooth enclosed in the gum and outside of the jaw; a similar cingulum is also seen in the second class of teeth of *Zeuglodon* (see my cited account, fig. 7). Below this cingulum begins the root, enclosed in the alveole of the jaw, like a turnip, at first somewhat thickened and soon after more compressed from the sides, descending in the interior of the jaw, with two branches separated only at the end, which diverge somewhat from each other. The first or anterior is always somewhat thicker, but shorter; the second longer, thinner, and more prominent, is generally accompanied by another small knob at the beginning. The whole tooth is 2 inches high, of which the crown measures 8 lines, the cingulum $1\frac{1}{2}$ line, and the root 15 lines. All the nine teeth present in the jaw (namely, six on the left side and three on the right side) are of the same figure, without any difference except in size, the posterior teeth being somewhat smaller, as is also the case in the teeth-series of the living Delphinidæ.

The portion of the articular branch of the right side figured in Pl. I. fig. 4 begins with the alveole of the last tooth, and is from that point 5 inches long. Under the alveolar groove the piece is $2\frac{1}{3}$ inches high, and $1\frac{1}{2}$ inch broad, enclosing an open channel $1\frac{1}{4}$ inch high and $\frac{3}{4}$ inch broad. From this point the jaw enlarges more and more behind, so that the fragment terminates with a height of $3\frac{1}{3}$ inches and a width of $1\frac{2}{3}$ inch, with an open cavity in the interior $2\frac{3}{4}$ inches high and $1\frac{1}{2}$ inch broad. The osseous substance forming the branch is much thicker at the anterior than at the hinder end, measuring there

* In the plate the figure of the tooth is erroneously stated to be half the natural size.

on the upperside more than half an inch, and on the hinder end less than a quarter of an inch. The interior is entirely open, with a smooth surface; the outside has the same impressed wrinkles as the anchylosed part of the jaw on the exterior surface, but much smaller wrinkles on the interior, where the two branches are united to each other. Here the structure of the surface is finer, and the bone more delicate. As a part of this surface is broken off, I cannot ascertain the extent of the opening of the alveolar channel, which was on this side of the articular branch. The only particular character which I see here is the presence of a sharp edge on the lower border of the branch, beginning a little behind the alveole of the last tooth, and increasing in elevation behind.

Finally, comparing the known part of the animal with the lower jaw of *Zeuglodon*, there is no doubt that *Saurocetes* was an animal of much smaller size. Supposing that the broken tip of the lower jaw was 7–8 inches long, and the wanting end of the articular branches 5–6 inches, we may presume that the whole lower jaw had an extent of 30–32 inches; and in this case the whole skull may have been 38–40 inches or $3\frac{1}{2}$ feet long, *præter propter*. If that is true, the whole animal (if it had the figure of a dolphin like *Pontoporia*) may have been 15–16 feet long, as we know from my description that the skull occupies one fifth part of the entire body; or if we judge from the elongated figure of the lumbar vertebræ of *Zeuglodon* that *Saurocetes* had an analogous configuration, its total length may have been no more than 20 feet.

VII.—*Observations on the Species of* Atax *parasitic upon our Freshwater Mussels.* By Emil Bessels*.

It is comparatively but a short time since the embryology of the Arthropoda received far less attention than this interesting branch of science really deserved; and yet, since the classical memoir of Weissmann upon the development of the Diptera, it may almost be said to have become a favourite study with zoologists. In the course of the last few years there have appeared a series of works upon this subject, such as Mecznikow's embryological studies on insects and Dohrn's on the embryonic development of *Asellus aquaticus*, whilst Kupffer subjected the folded lamina (*Faltenblatt*) discovered by Weissmann to a thorough examination. Claparède promises us, in a memoir hereafter to be mentioned, further contributions; and quite

* Translated by W. S. Dallas, F.L.S., from the 'Württembergische naturwissenschaftliche Jahreshefte,' 1869, pp. 146–152.

recently A. Brandt has studied the developmental history of the Libellulidæ and Hemiptera with special reference to the embryonal envelopes.

The Acaridæ, however, had not been taken up by any one in the manner required by the present state of science. For a considerable time I had taken pity upon these neglected creatures, and investigated the development of *Atax*, *Phytopus*, *Tetranychus telarius*, *Sarcoptes*, and some other forms. When I was on the point of publishing my results (I only waited for the beginning of May in order to fill up some deficiencies in the development of *Phytopus*), I was not a little surprised at finding in the last part of Siebold and Kölliker's 'Zeitschrift' a memoir by Claparède*, elaborated in his usual masterly manner, which rendered the publication of the developmental history of those species which I had investigated in common with Claparède almost superfluous, inasmuch as our results essentially agreed.

The development of *Atax ypsilophorus*, some points in which will be here indicated, was described in its broad features by P. J. van Beneden as early as the year 1848†. But precisely the most remarkable circumstances escaped that observer, otherwise so accurate; and this may be due to the fact that he probably made use of a different egg for the investigation of each stage of development. In a letter which I sent to Van Beneden at the beginning of September 1868, I mentioned, *en passant*, that the results which I had obtained with regard to the development of *Atax* could not be brought into accordance with his. In connexion with a memoir upon the spherical organ in the Amphipoda‡ (sent to press in November 1868), I mentioned the occurrence "of an embryonal envelope of extremely peculiar characters in the species of *Atax* from *Unio* and *Anodonta*," and also the amœboid cells found between this envelope and the embryo, which are called hæmamœbæ by Claparède.

As has already been stated, my results agree with Claparède's in all the principal points. In the observation of the formation of the blastoderm, however, I have been rather more fortunate than the above-named naturalist, who was unable to observe that process. How long after the deposition of the eggs the blastoderm makes its appearance, no one can

* Studien an Acariden, pp. 445–546.

† "Recherches sur l'Histoire naturelle et le Développement de l'*Atax ypsilophora*," Mémoires de l'Acad. Roy. de Belgique, tome xxiv.

‡ "Einige Worte über die Entwickelungsgeschichte und den morphologischen Werth der kügelförmigen Organe der Amphipoden," Jenaische Zeitschrift für Medicin und Naturwissenschaften, Bd. v. Hft. 1. p. 98.

say with certainty, inasmuch as the deposition itself cannot be observed. In eggs which were taken from the branchiæ of the *Unio* or *Anodonta*, and apparently had undergone no change after deposition, I usually detected the first traces of the blastoderm in from two to three days. It is formed insularly, as may be easily proved by opening an egg carefully in a solution of 1 per cent. of bichromate of potash. It is impossible to ascertain the process of formation by the direct observation of the uninjured egg, on account of the dark colour of the yelk.

After the blastoderm has grown round the whole of the yelk, the embryonal envelope which Claparède describes as the *deutovum* separates from it. This is produced in exactly the same manner as the larval membrane of the Crustacea, as observed by Van Beneden and myself in various species of *Gammarus**. Claparède was at first inclined to regard† this envelope as the homologue of the structure which in insects has received the unfortunate name of the "amnion;" but he soon gave up this comparison. I, on the other hand, regarded the membrane in question in the Mites as homologous with the larval membrane of the Crustacea, and the latter as homologous with the "insect-amnion," for which I have elsewhere proposed the better name of "protoderm."

Shortly after the formation of the embryonal envelope, we see, between it and the blastoderm, the first amœboid cells (*hæmamœbæ* of Claparède). In the memoir above cited I remarked that these cells "are blood-corpuscles of quite abnormal derivation." In using this expression I had the circumstance in my mind that they are formed from separated blastodermic cells, which, at the time of their production, are the sole cellular structures that we find in the egg. I did not then feel it necessary to say any thing more upon this point, as the publication of my original memoir was to be expected. I thought at first that the blood-corpuscles were all developed from separated blastodermic cells, and only afterwards, perhaps after the formation of the buccal orifice, passed through this into the embryo. As, however, I never saw any such migration of the cells, even after observing them for hours, I have given up this view, and now think that there is a further formative focus for them in the interior of the embryo.

My present opinion as to the hæmamœbæ is, that they really agree perfectly in form and behaviour with blood-corpuscles,

* E. van Beneden and E. Bessels, "Résumé d'un Mémoire sur le Mode de Formation du Blastoderme dans quelques groupes de Crustacés," Bull. Acad. Roy. Belg. 2e sér. xxv. p. 443.

† *Loc. cit.* p. 97.

but nevertheless cannot be regarded as blood-corpuscles. I see in them appurtenances of the embryonal envelope which Claparède denominates the *deutovum*. Whilst at the commencement of embryonal development of many insects a *cellular* envelope separates from the blastoderm, and in some crustacea a larval skin, which is usually *structureless*, in *Atax* a larviform structure first separates from the blastoderm, and shortly afterwards the contractile cells. This state of things, when regarded in this manner, furnishes an additional reason for regarding the embryonal envelope of *Atax* as the homologue of the protoderm of insects.

* * * * *

In the course of his memoir Claparède suggests the question whether Van Beneden has not perhaps fallen into an error in representing the parasites of *Anodonta* as derived from *Unio*, or whether the same animal is parasitic upon *Anodonta* in Belgium that lives in *Unio* at Geneva.

In an appendix to a letter sent by me to Van Beneden, which will be printed in the next number of the 'Bulletins de l'Académie de Belgique,' Van Beneden remarks that he actually took the *Atax* figured in his work above cited from the branchiæ of *Anodontæ*.

I will here briefly communicate a case of migration from one kind of mollusk to the other.

When I was making my investigations of the embryology of *Atax*, I wished not to have to procure fresh material constantly, and therefore placed some hundred specimens of *Anodonta cygnea*, obtained from Esslingen, in a large well-trough with water running through it. As I also desired to study the natural history of the parasites of *Unio*, in about three months afterwards I procured a number of *Uniones* from the Enz, near Pforzheim; and these I kept in a tub. But as my stock gradually increased, I placed them, in about a fortnight, in the same trough with the *Anodontæ*. About four weeks afterwards I perceived in an *Anodonta* the same species of *Atax* which I had previously detected only in *Uniones*; and from this time forward I frequently found *Anodontæ* which contained from three to four mites of the other species.

By the great number of individuals which passed through my hands, I was enabled to discover a beautiful but rare dimorphism. Whilst the mites which live chiefly in *Unio* possess five suckers on each side of the sexual orifice, those from *Anodonta* have from thirty to forty on each side. Moreover the two species are distinguished by their form and size, even on a superficial examination, so that any confusion between them is hardly to be suspected. But I found mites which, as far as form and size were concerned, agreed perfectly with the parasites of *Anodonta*, but instead of the great number, had only six suckers on each side. Are these to be regarded as a distinct species? I think not. At any rate, we shall do better to regard this peculiarity as a case of atavism, especially as the two species are not widely distant. In any case the mite with five suckers on each side will have made its appearance earlier in the natural genealogical tree than that with from thirty to forty. But the form with six suckers is a reversion towards the primary form.

VIII.—*The Tertiary Shells of the Amazons Valley.* By Henry Woodward, F.G.S., F.Z.S., of the British Museum.

Of the great river-systems with which explorers have made us acquainted, that of the Amazons is perhaps the most remarkable, as it is also one of the largest in the world. The courses of nearly all the large rivers of our earth lie in a north and south direction; the Amazons, on the contrary, runs nearly west and east. Situated almost beneath the equator, it traverses the southern continent of America from the eastern slopes of the Andes to the North-Atlantic Ocean (nearly fifty degrees)—a distance, computed by its course, of upwards of 4000 miles. Twenty great rivers, all of which are navigable, contribute their waters to its stream, which, under various names, drains considerably more than two millions of square miles of country. It is 40 miles wide where it enters the sea, whilst at 400 miles up stream, to which distance the tide ascends, it is still more than a mile in width*.

The stratified sandstones and clays observable in this great valley were attributed by Gardner to the Cretaceous series; Spix and Martius described them as belonging to the Quadersandstein formation† (Upper Cretaceous). By the earlier observers, according to Lyell‡, the stratified portions of this series were supposed to be of marine origin, and were successively referred to the Devonian, Triassic, and Tertiary epochs.

Our own countryman, Henry Walter Bates, who devoted eleven years to the exploration of the natural history of this region, has given us most graphic accounts, in 'the Naturalist on the Amazons,' of the scenery, physical features, &c., but does not dwell much upon its geology.

It was left to Prof. Agassiz, after his visit to Brazil (1865–

* Ansted's Physical Geography, 1867, p. 160.

† Hartt, 'Brazil,' p. 484.

‡ Principles, vol. i. p. 467.

1866), to give to the geological world a new reading of this great and wonderful region.

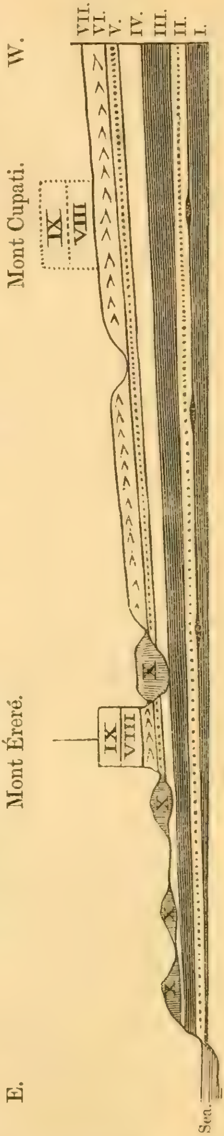
It would be impossible, in the length of an article such as the present, to enter fully into Prof. Agassiz's views; but it is essential to give a summary of them, in order to point out in what degree the writer differs from them.

In Prof. Hartt's recently published work* on Brazil, a *résumé* is given of a paper by Prof. Agassiz and Dr. Coutinho† from which we extract the following description and section:—

"Prof. Agassiz thinks that the whole valley of the Amazons was formed at the end of the Cretaceous period, which has left traces of deposits in the province of Ceará and on the Upper Purús. Here and there, whether by denudations or by anterior dislocations, one sees more ancient rocks. Thus Major Coutinho has found palæozoic Brachiopods in a rock which forms the first cascade of the Tapajos; Carboniferous fossils have been collected on the banks of the rivers Guaporé and Mamoré, in Matto Grosso; and, finally, at Manáos, Coutinho has recognized slates or *phyllades* in a very inclined position, and beneath the formations of red sandstone of the Amazonian valley.

"Prof. Agassiz supposed that during the Tertiary period the Amazonian region was above water, and that the sandstones and clays that now fill it are drift."

Annexed is a copy of the ideal section of these later deposits by Prof. Agassiz:—



Ideal Section of the Amazonian deposits.

* Scientific Results of a Journey in Brazil, by Louis Agassiz. Geology and Physical Geography of Brazil. By Ch. Fred. Hartt. London, 1870. Trübner.

† Bulletin de la Société Géologique de France, 2e série, t. xxv. p. 685.

Of this section the following explanation is given :—

"I. Coarse sands (*sable grossier*), forming the base of the drift throughout, seen wherever the level of the water has uncovered the lower beds of plastic clays.

"II. The mottled plastic clay (*argile plastique bigarrée*) shows itself on a large scale along the sea-coast at Pará, at the Island of Marajó, Maranhão, and here and there in the hollows along the course of the Amazons.

"III. Laminated clay in very thin beds, with frequent indications of cleavage. This deposit appears to be more considerable in the banks along the course of the Rio Solimões than in the lower part of the Amazons. It is in these beds at Tonantins, on the Rio Solimões, that M. Agassiz has found leaves of dicotyledonous plants which appear to be identical with species at present living in the valley of the Amazons*.

"IV. A crust of sandy clay, very hard, moulded in the inequalities of the laminated clay.

"V., VI., VII., VIII., & IX. *Sandstone formation,*—sometimes regularly stratified and compact, especially in the lower beds (V.), such as one sees on the borders of the *igarapés*† of Manáos; sometimes cavernous and intermixed with irregular masses of clay (VI.), especially well developed at Villa Bella and at Manáos; at others all the characters of a torrential stratification (VII., VIII., & IX.). The deposits of this last nature are only seen in the elevated hills of Almeirim, Éreré, and Cupati, and in the most elevated cliffs of the borders of the river, as at Tonantins, Tabatinga, São Paulo, and on the borders of the Rio Negro.

"X. The argilo-arenaceous unstratified drift, occupying all the inequalities of the soil resulting from the denudation of the sandstone with torrential stratification. It is in this drift that MM. Agassiz and Coutinho have found true erratic blocks of diorite, a metre in diameter, at Éreré. This formation is never met with on the cliffs elevated several hundreds of feet in height. There is not a trace of it on the summit of the hills of Éreré."

"The fact that the coarse sand No. I. appears throughout at the level of low water, that it follows the general slope of the valley, shows incontestably that the deposition of this

* "These leaves occur in a fine, soft, grey clay, resembling very closely the recent alluvial clays of Brazilian rivers; they are excellently preserved. The leaf is partly carbonized; but it curls up from the surface on drying, and may be detached, leaving a beautiful impression of the venation &c. (Ch. F. Hartt.)"

Sir Charles Lyell (Principles, vol. i. p. 466) speaks of these leaves as being found in bed II., in the delta of the Amazons on the island of Marajó, whereas they really occur in Bed III., and more than 2200 miles up the Amazons.

† The Indian name for small streams; literally, "canoe-path," from *igara*, a canoe, and *pés*, a path.

formation does not reach back to an epoch anterior to the excavation of the valley itself. The total thickness of the Amazonian drift does not exceed 300 metres (984 feet); it covers the whole basin of the Amazons, from the Andes of Peru and Bolivia to Cape São Roque; or, in other words, it is the most colossal drift formation known.

"Professor Agassiz believes that the Beds I., II., III. IV., or the coarse sands and clays, were deposited in a lake or sheet of fresh water occupying the valley of the Amazons, and sustaining on its surface a glacier descending eastward from the Andes, and furnished with a gigantic moraine in front stretching across the mouth of the valley and converting it into an inland freshwater lake. After the ice had broken up and become more or less disintegrated, and the waters of the lake had swollen, the sandstone formation V., VI., VII., VIII., IX. was laid down; then the barrier was burst; the waters of the lake, suddenly released, furrowed and wore down the sandstone beds, sweeping them entirely away over an immense area, leaving only isolated hills, like those of Éreré, Obydos, Cupatí, Almeyrim, &c., standing as remnants of the once universal sandstone sheet. After this period of turbulence and denudation came on an epoch of quiet, and in the bottom of the diminished lake the clays (No. X.) were deposited, while ice-rafts floating on its surface dropped here and there boulders to be buried in the accumulating material. Then the moraine was destroyed; the drainage of the waters furrowed deeply those clays, and even cut through them into the sandstone below, in which the various channels of the system of the Amazons are excavated. Professor Agassiz believes that the great barrier stretched across the Amazonian valley far eastward of its present extremity; and he has called attention to the similarity between the formations found spread over the coast of Maranhão and Piauhy and the Amazonian formations here described, showing conclusively that these deposits were once continuous. It is his belief that the Amazonian formation formerly extended a hundred leagues out to sea beyond the present mouth of the Amazons. There can be no doubt that there is a rapid waste of land now going on along the sea-shores of the mouth of the Amazons and of the coast eastward for a long distance, a waste amounting to even so much as two hundred yards in ten years in the Bay of Braganza—or a mile in twenty, as on the coast near Vigia, where an island a mile wide disappeared in that time. Since the Tertiary period," says Professor Hartt, "at least, and, I believe, for the greater part since the drift, the whole Eastern Brazilian coast has suffered denudation by the sea to an immense amount, and a very wide strip of Tertiary rocks has been removed. I believe that these deposits once extended beyond the Abrolhos, and that south of Cape Roque the sea has cut them away for a mean width of fifty miles or more."

Prof. Hartt adds:—"At first I was disposed to regard the Brazilian formation in question as Triassic; but I soon found that it was underlain unconformably by Cretaceous rocks in Bahia, and I came to the only conclusion possible—that it was older than the Drift, and newer than the Cretaceous. I can see no reason, therefore, for considering the coast beds any thing but Tertiary, though they may be, and probably are, very late Tertiary. It has seemed to me that the fact of the occurrence on an open sea-coast of clays and sandstones precisely similar to those occupying the lower plains of the Amazons, as at Pará, and in fact tying in with them, relieves one of the necessity of looking to a freshwater origin for the Amazonian beds."

These observations (coming as they do from one of Prof. Agassiz's own travelling companions and the geologist of the expedition, who has extended his knowledge of the geology of the district by a subsequent visit to Brazil) are of considerable importance. Whilst differing, however, from his chief as to the age and origin of these Amazonian beds, Prof. Hartt, like Agassiz, is a firm believer in the doctrine of "glaciers under the tropics down to the present level of the sea."

The only reason adduced by Prof. Agassiz for not regarding these formations as marine is the negative one, that he found no marine fossils in them. On the other hand, the only positive evidence which he seems to have found in proof of the freshwater origin of this vast deposit is the occurrence of dicotyledonous leaves in a single locality on the Rio Solimões, more than 2000 miles up the river.

The occurrence of erratic blocks of diorite "a metre in diameter" in the unstratified drift X. is adduced as indubitable proof of glacial agency; but the transporting-power of a river like the Amazons (several miles in breadth), swollen by rains and melted snows, may probably have sufficed. Or, as they occur elsewhere besides in the valley itself, they may quite as reasonably have been brought from the Antarctic by icebergs and dropped during the submergence of the eastern provinces.

On the 7th October, Prof. James Orton, of Vassor College, Poughkeepsie, New York, addressed a letter to the 'Geological Magazine' announcing that, in his late expedition across the continent, he had discovered a fossiliferous deposit at Pabos, and also that his correspondent Mr. Hauxwell, at his suggestion, had explored in other places on the Amazons, and found fossils in abundance near Cochaquinas, on the south side of the Marañon. "The shells," writes Prof. Orton, "are all found in the coloured plastic clays*, which stretch unbroken from the foot of the Andes to the Atlantic." .... He adds, "The forms are all very singular and unique; and from their extermination, especially of one genus (*Pachydon*) with all its representatives, we infer that the formation cannot be late Tertiary, and may be Miocene.

"The species indicate fresh- or brackish-water life; and the perfect preservation of the most delicate parts, some specimens retaining even the epidermis, shows a quiet lake or estuary. There certainly are no indications of a 'grinding glacier.'"

Under date of Oct. 10, 1870, Prof. Conrad publishes, "*in advance* of the 'American Journal of Conchology,' descriptions of new fossil shells of the Upper Amazon," some of which had been previously described and figured in the fourth volume of the same journal by Mr. Gabb. Having since had the opportunity of examining many hundreds of these shells sent home by Mr. Hauxwell to Mr. Janson (Museum Street), I venture to append a few notes thereon.

[To be continued.]

MISCELLANEOUS.

Notes on Arctic Zoology. By Dr. Robert Brown, M.A., F.R.G.S.

(In a letter to Dr. J. E. Gray.)

4 Gladstone Terrace, Hope Park, Edinburgh,
November 23, 1870.

My dear Sir,—I am at present working at the distribution of the Nort-west American faunas and floras, with a view to eventually producing a physical atlas of that region, and therefore venture to trouble you with this note to inquire if you have ever examined the skull of the *Phocæna* from Queen Charlotte's Islands, which the British Museum acquired from my collections; and if so, whether it is identical with any species of porpoise from the Atlantic. I remember that at the time (April 1868) you were inclined to believe that it was identical with *P. communis*. [I can see no difference in the skulls.—J. E. G.] If so, the fact would be rather interesting.

While I am at it, I may as well mention a few facts connected with arctic zoology, which you may find worthy of a notice in the 'Annals.' In a paper of mine on the arctic seals, in the 'Proceedings of the Zoological Society' for 1868, p. 425 (also translated in Petermann's 'Geographische Mittheilungen' for 1869), I discussed

* This is evidently Bed II. of Prof. Agassiz's section.

the species to which a seal called the "ground seal" (probably a corruption of "*grown* seal") belongs, and hazarded an opinion that it might only be *Phoca barbata*, O. Fab. Since that paper was published, through the kindness of Mr. Charles E. Smith, the surgeon of Mr. Lamont's yacht expedition to Spitzbergen in 1869, I have obtained skulls which leave no doubt of the soundness of that opinion. *Phoca barbata* must therefore be classed as an oceanic seal, and one of the species slaughtered by the sealers. *Halichœrus gryphus*, O. Fab., I find to be a very common seal in the Hebrides. It is born yellowish white, but begins to get dark on the snout and flippers a day or two after birth. So abundant is this species of seal in the Hebrides that a friend of mine, Capt. M'Donald, R.N., in one voyage of a few weeks in one of the fishery cutters, killed seventy. The same gentleman in April 1841 killed a walrus (*Trichechus rosmarus*, Linn.) on the East Heiskar, which adds one more to the recorded instances of this animal's occurrence on the British coasts.

You may remember also that, in a paper on the Greenland mammals, in the same work (Proc. Zool. Soc. 1868, p. 359), I expressed an opinion that the animal which the Greenlanders talk about under the name of "Amarok" was not, as Fabricius supposed, the *Gulo borealis*, Retz., but only the Greenland dog run wild and returned to its pristine condition of the wolf. At that time, however, no specimen of this much-talked-about animal had ever been killed; but the winter after we left the country (1868–69), a communication which I had recently from Greenland informs me that a real wolf (apparently *C. occidentalis* var. *griseo-albus*) had been killed at Godhavn in about 69° 14′ N. A whaling captain whom I met last autumn (1869) in Copenhagen had himself seen the skin, and says that it is identical with the wolf found on the opposite shore of Davis Strait. This wolf is quite abundant there, and so troublesome to the natives, that I was informed, when on that coast in 1861, that the natives had been compelled to remove their villages from some quarters where it was very abundant, on account of its destroying their dogs. The wolf killed at Disco Island (Godhavn) in the winter of 1868–69 had probably crossed Davis Strait on the ice; for the winter was a severe one, and the Eskimo about Pond's Bay (on the opposite shore) declared that wolves had that winter been very abundant thereabout. The same very intelligent whaling captain (a man whom I have known many years) reminded me of a fact (which he recalled to my recollection) that I omitted to mention in my papers on the arctic mammalian fauna (which, curiously enough, he had read in Godhavn, *in Greenland*), viz. that not unfrequently the arctic fox (*Vulpes lagopus*, Linn.), is seen, four or five hundred miles from the nearest land, feeding on the carcases of seals killed by the sealers on the great floes, between Jan Mayen Island and Spitzbergen, in the spring of the year—a habit which it shares with its much more maritime cousin the white bear (*Thalarctos maritimus*, Linn.). Though this plantigrade passes much of its time in the water, yet I need scarcely say that the author of an extraordinary paper, read to the British Association at Norwich, was vilely hoaxed when he gravely related, as part of his information derived from reliable individuals, that the polar bear will remain so long in the water as to allow of seaweeds growing on its back!

Finally, the recent discovery, by the German Polar Expedition (*vide* the 8th Report of the Bremen Committee recently issued), of the musk-ox (*Ovibos moschatus*, Gm.) in abundance on the east coast of Greenland, in about 75° north latitude, is a very interesting and rather suggestive fact. Hitherto it has only been very sparingly reported from the west coast, and then not south of Wolstenholme Sound, in 76° N. lat. It at one time appears to have been found more abundantly on the shores of Smith's Sound; but there is no evidence whatever to lead to the belief that it does at present live, or ever did live, south of the glaciers of Melville Bay. It thus appears that on both sides of the continent of Greenland the southern range of this huge arctic animal is limited by about 75° or 76° N. latitude.

Perhaps you may consider these notes worthy of preservation.

I have passed most of the autumn in Denmark, and everywhere heard congratulations that your health was again so good as to allow of your continuing your labours, so valuable to science. In this congratulation allow me to most heartily join, and to remain

Yours most faithfully and respectfully,

ROBERT BROWN.

Dr. Gray, F.R.S. &c.

On Recent and Fossil Corals.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I see in your November Number the following words by Mr. Kent:—"I may quote this form, again, as evidence bearing out the truth of my assumption, disputed by Mr. Lankester in a previous number of this Magazine, that the Corals of the Palæozoic epoch were equally complex and highly developed with those peopling the existing seas." There has been a little misunderstanding here. So far from having disputed this assumption, I was not aware that Mr. Kent had ever made it before. I will not now discuss it, but merely point out that this assumption, whether justified or not, is not identical with the assumption which I *did* dispute, viz. that the group of corals "had attained the very zenith of its development long before" the Silurian epoch "had commenced its decline." The development of a *group* is not measured by the degree of skeletal complexity attained by one of its subordinate groups.

I am, Gentlemen,

Yours truly,

Nov. 25, 1870. E. RAY LANKESTER.

Dredging in the Gulf of Suez.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—My friend Dr. Gray having pointed out to me that my observations in my paper on "Dredging in the Gulf of Suez" seem to imply that nothing had been done with the Echinoderms &c. which I presented to the British Museum, I beg to say that, so far from this being the case, Dr. Gray lost no time in naming the specimens, though the list with his notes upon them was unfortunately mislaid, with other papers, in consequence of his illness,—also that the spare duplicates were promptly forwarded to the public museums of Edinburgh and Liverpool, in conformity with my request.

I beg that you will insert this explanation in your forthcoming Number, as nothing could be further from my intention than to impute neglect to Dr. Gray, from whom I have invariably experienced the greatest kindness and willingness to render me assistance.

I am, Gentlemen,
Your obedient Servant,
ROBERT M'ANDREW.

Isleworth House, W.
Dec. 8, 1870.

On the Structure of the Crania of Reptilia and Batrachia. By Prof. COPE.

Prof. Cope communicated some results of his studies of the structure of the crania of the orders of Reptilia and Batrachia, recent and extinct. He explained the characters of the Ichthyopterygia as follows:—

The *quadrato-jugal* (squamosal of Owen, 'Anatomy of the Vertebrata') present; *postorbital* (of Owen) present. The *squamosal* (supratemporal of Owen) extending over the inner side of the parieto-squamosal arch so as to conceal the parietal portion of it, to the anterior part of the temporal fossa, and in contact with its fellow of the other side. It sends down a columella to the pterygoid. It extends also for a remarkable distance downwards behind the os quadratum. ? *Opisthotic* present. A distinct element exists behind the quadratum, which he thought might be the *suprastapedial*, otherwise called the incus, or hyomandibular, according to Huxley. The pterygoid prolonged backwards and expanded, in contact with the basioccipital, and extending from it to the quadratum. The posterior pair of elements of the superior face of the cranium being determined to be squamosals, the interpretation of the anterior elements becomes simple. The rhombic element with fontanelle is parietal (frontal of Owen 'Anatomy of Vertebrata'); and the preceding pair are the frontals (nasals, Owen). The true nasals were shown to lie at the proximal end of the nares.

The structure of the suspensorial region in the Anomodont, *Lystrosaurus*, was next pointed out. In this order there is no quadrato-jugal arch, and the zygomatic arch contains a very small postorbital.

The *squamosal* has an extraordinary development, and extends on the parieto-quadrate arch, and on the inner side of the temporal fossa on each side of the parietal. The *parietal* is not so far concealed as in *Ichthyosaurus*, but its posterior lateral process may be seen wedged in between the squamosal and the thin, plate-like opisthotic, which lies external to the supraoccipital on each side. The *opisthotic* is the parietal of Owen, and the parietal branch of the squamosal is the mastoid of the same author.

This branch in *Ichthyosaurus* and *Lystrosaurus* is continuous with the zygomatic portion of the bone, though another element might have been originally coossified with it. The posterior portion of the squamosal is prolonged remarkably; it is applied to the posterior face of the quadratum, and extends to its articular extremity. The *quadratum* is a small bone of a plate-like form, in contact with the squamosal above and the (?) prootic inwardly and anteriorly. *Suprastapedial* not distinguished. The parietal branch of the squamosal sends down a *columella* to the pterygoid. The *prootic* is a distinct though small bone, below and in front of the squamosal. The presphenoid is plate-like, and much as in the Crocodilia.

Prof. Cope thought that the Anomodontia, one of the earliest (Triassic) types of Reptilia, are one of the best examples of a generalized group among the Vertebrata. Thus the structure of the posterior part of the cranium is largely that of Ichthyopterygia, and partially that of Lacertilia; of the oral parts of the cranium, the prootic and mandible, of Testudinata. The vertebral characters are partly those of Ichthyopterygia, and the sacrum and rib-articulations those of Dinosauria. ·The peculiar presphenoid is characteristic of Crocodilia, and the osseous interorbital septum of Rhynchocephalia.

The position of the posterior plate of the squamosal in Ichthyopterygia and Anomodontia seemed conclusive as to the homology of that element with the bone covering the cartilaginous quadratum in Batrachia Anura, and the osseous quadratum in Urodela and Dipnoi, called tympanique by Cuvier, and temporo-mastoidean by Dugès. This bone had been already homologized with the præoperculum of Teleostei by Huxley; and it is thought that its present determination in the Reptilia established the serial homology of the præoperculum of the fish with the squamosal plate of the mammal.—*Proc. Amer. Phil. Soc.* vol. xi. No. 84.

On the Embryology of Limulus polyphemus. By A. S. Packard, Jun.

After a detailed description of the embryological history of the *Limulus*, the author concludes that before hatching it strikingly resembles *Trinucleus* and other Trilobites, a conclusion to which the whole account points. The Trilobites are therefore lower than the Xiphosura; the two groups should, on embryonic and structural grounds, be included perhaps in one order; and the former should therefore be removed from the neighbourhood of the Phyllopods and placed immediately next to Xiphosura. The organization and habits of *Limulus* throw much light on the probable anatomy and habits of Trilobites. The author infers that the eyes had a similar structure, that the circulation and the nervous system were alike, and that probably the genital organs were very similar in the two groups. He thence suggests that the eggs of the Trilobite were probably laid in the sand or mud and impregnated by the sperm-cells of the male floating freely in the water. The Trilobites probably lived by burrowing in the mud and sand, digging in the shallow palæozoic waters after worms and stationary soft-bodied Invertebrates.—*The American Chemist*, Nov. 1870.

On the Stipules of Magnolia *and* Liriodendron. By Thomas Meehan.

An examination of the stipules of *Magnolia* affords some highly interesting facts, most or perhaps all of which are known to leading botanists, but which do not appear to be as generally known as they deserve to be; and these facts may have a more intimate bearing on many of the questions connected with the laws of development than is suspected.

In most species of *Magnolia* a scar peculiar to the genus exists on the petiole. This scar is elevated somewhat above the surrounding tissue, as if the matter forming it had been laid on the surface after the rest of the petiole had been formed. The green is not of the same tint as in the rest of the petiole, but it is always of the same tint as that of the leaf-blade. In *Magnolia macrophylla* the petiole and under surface of the leaf are grey; the leaf-blade is pale green on the upper surface. The surface of the scar is pale green, corresponding to the surface of the leaf-blade. The whole appearance of the scar is such as if a portion of a leaf-blade had been grafted by its under surface on the petiole.

On the upper part of the scar next the leaf-blade are two small articulation points, where the membranaceous stipules finally parted from the leaf. Examining a leaf before these stipules have fallen, the main veins forming the skeleton of the stipules are found connecting with these articuli, and, spreading out, diverge downward toward the base of the leaf. In separating at maturity from the petiole, they part first from the base, and last from their place of articulation. Their weakest hold is the point furthest away from what thus appears to be their source at the apex of the scar.

Magnolia Frazeri elongates its petiole beyond the stipule several inches generally. The leaf-blade then exhibits the auricle so well known in this species. The structure of this auricle is similar to the stipules in *M. macrophylla* or *M. tripetala*. The veins start out in nearly as close a fascicle as in these stipules, and they diverge and curve downwards just as these stipules do. Above these strong veins of the auricle are very weak veins, necessitating a very narrow blade portion there, until another set of strong veins push out and make the main part of the lamina.

If we press these auricles back against the petiole, and imagine a union with it, then a separation from the main leaf-blade, and a union of the edges of the separated auricle, both above and below, we have a sheathed stipule exactly as we find them, and we see how easily *Magnolia Frazeri* might be a pinnate leaf of five leaflets on the supposition that the stipular portions really have taken the course we suppose these auricles might take.

I suppose no one of experience in living plants doubts the possibility of the adhesion of some parts and the separation of others, so as to make new parts or organs. If such is desired, I would refer to the *adhesion* of the carpellary leaves by their backs in the capsules of *Staphylea trifolia*, and, for *separation*, to the pinnate leaf often formed out of an entire blade in *Fraxinus excelsior*, *heterophylla*, and many other plants with entire leaves which often have pinnate ones amongst them.

It is scarcely possible, with these facts before us, to avoid the suspicion that the stipules of *Magnolia* are not formed like the stipules of most plants, which are perhaps leaf-portions which have never been well developed, but rather are the tolerably well-developed side pinnules of a trifoliate or deeply auricled leaf, which in an early stage had adnated with the petiole and by their edges, and thus formed the stipular sheath we see. The suppositional case I have drawn from the auricles of *M. Frazeri* is still better illustrated by leaves of some Ranunculaceous plants. For instance, *Anemone pennsylvanica*. Lay the lower lobes flat against the petiole, imagine the adnation by their backs, and cohesion of the edges, and we have the idea clearly.

It is difficult to conceive that these stipular sheaths could have been formed, in harmony with all the appearances we have detailed, in any other way; but ideas and possibilities are not as good as direct facts. These are furnished in good part in other ways.

In the East-Indian species *M. fuscata* the flowers are axillary, not terminal as in most other species. Three of the leaf-axils on the growth of last year produce flowers. The lowest flower is the weakest, the upper the strongest. The bracts which infold the flower-buds are of course transformed leaves; and here, in these weak flowers, where the tendency of the vital course is almost as near to foliar organs as to floral parts, we find these leafy-looking bracts are trifoliate. The central lobe is composed of a short petiole and a small oval leaf-blade. Sometimes this attempt of the lower axil to produce a flower proves abortive. The already formed petals die away. In such cases the two lateral leaflets die away also, and the little miniature central leaf goes on and developes into one as large as the average on any part of the plant. But in the stronger flowers we find, just in proportion to their strength, the two lateral leaflets enlarge, and the central one diminish until at length it disappears, petiole and all. The laterals then *adhere by their edges*, become fleshy, and end in being petals. These are clearly seen to be formed out of the adnated lateral leaflets, which form the stipular sheaths in other cases, with the central of the trifoliate type absorbed. This observation, in addition to the use I wish to make of it, confirms the views of some botanists, as I have learned from Professor Asa Gray, that it is by metamorphosis of the petiolar and stipular parts, rather than by modifications of the leaf-blade, that petals are formed.

From these facts we gather the certainty of a trilobate type of leaf and see the aduation of the edges; and only the dorsal adhesion to the petiole, which I have shown so probable as almost to amount to a certainty, is left to be established by actual fact.

This ternate division of the leaf is a marked character in Ranunculaceæ; and with this exposition of a ternate type in Magnoliaceæ, its claim to a place in the Ranal alliance, strong as it always has been acknowledged to be, is still more strengthened.

It is impossible to suppose that a genus so closely allied as *Liriodendron* should be founded on a different type from *Magnolia*. We shall see that only very slight causes, which we can well understand, have made some of the chief foliar distinctions; and the few which we cannot prove from actual facts can be made almost certainties from parallel observations. The identity of type will in this way be manifest.

First, as to the premorse or cut-off appearance of the end of the leaf-blade. This all results from the stipular portions being adnate with the stem-axis, instead of being wholly on the petiole as in *Magnolia*. In the latter the stipules are carried along as the petiole advances, the leaf-blade cannot grow beyond, and so in vernation has to lie flat up against them. In *Liriodendron*, the stipules being fast to the main stem, the petiole carries the leaf-blade beyond them, over which it is bent until its apex is brought down in contact with the straight line formed by the union of stipule and stem. Here it is pressed as into a mould by the elongating petiole, and the form of the leaf which we see is the necessary result. These processes in *Magnolia* and *Liriodendron* can readily be seen on an examination of the buds at any time during the growing-season; and to those who have no specimens the figure of the latter in Gray's 'Genera' will easily give the idea. It may be here noted that those who look only to Mr. Darwin's principle of natural selection to account for the laws of form, might be troubled by such cases as these. It is scarcely conceivable that a square-edged leaf-blade, as we find it in *Liriodendron*, is of any special benefit to the species; yet if this form is the consequence of some other act which is a benefit, the selection principle may still hold.

If the ternate type of leaf is probable in *Liriodendron*, as in *Magnolia*, the lower portion of the petiole, and lateral or stipular portions, must have adnated with the stem prior to the full development of the leaf. This view necessitates the idea that the leaf does not always originate at the node from which it seems to spring. I do not believe it does; but I am well aware that in this I have opposed to me the weight of our best botanical authorities, from whom I would not yet dare to differ until I shall have the weight of more facts. I would only say that in the case of *Liriodendron* the appearances are much in favour of the belief that in an early stage the petiole clasped the stem, and for a considerable length ultimately became an integral part of its cortical system. The vessels which are seen connected in direct lines with the petioles below and above the node, as they are in existence before the leaf-bud has opened and the leaf-blade has had any chance to elaborate sap from the light or air, just above supposed to be necessary before they could be formed, do not seem to originate at the node; while the fact that these vessels suddenly curve from the opposite side towards the supposed petiolar base is much more characteristic of an unfolding sheath than of a descending current of matter, which would most naturally go down in a straightish line. But that the petiole has really adnated with the stem in this way in *Liriodendron* seems most probable from the fact that on the opposite side from the leaf is often seen a ridge which could hardly be formed except by the meeting of two edges enclosing a stem, with a little to spare; and at other times there is a slight depression, as if the two opposite edges barely met. There seems to be every evidence short of an actual witnessing of the fact, that the petiole in *Liriodendron* became adnate with the stem, and in this way the two lateral sections (stipules) were brought into contact with the stem with which they united. This would bring them nearer the sources of nutrition, and enable them to assume a more leaf-like and permanent character than if on the petiole. They become rather primary than secondary leaf-organs; and this is just what we see them to be.

Thus we may assume that *Magnolia* has typically a ternate leaf-structure, that the stipules are the two lateral lobes, which, by a peculiar process of adnation, became stipular sheaths after having been partially organized as leaf-blade, and that *Liriodendron* differs from *Magnolia* only in possessing a greater power of adnation.—*Proc. Acad. Nat. Sci. Philad.* Oct. 1870.

A Remarkable Myriopod. By Dr. A. S. Packard, Jun.

While looking over a chip with Myriopods and Poduras on the underside, brought in from the museum grounds by Mr. C. A. Walker, I detected a lively little yellowish-white creature, which immediately suggested Sir John Lubbock's *Pauropus*. A closer examination showed that it was indeed a species of *Pauropus*, very closely allied to *P. pedunculatus*, Lubbock, and intermediate in some respects between that species and *P. Huxleyi*, Lubbock. It may be called *Pauropus Lubbockii*, in honour of the original discoverer of this remarkable type of Myriopods. No more interesting articulate has been discovered for many years; and the occurrence of a species in America is worthy of note. It has but nine pairs of legs (three pairs when hatched), and in some points in its organization seems to be a connecting link between the Myriopods and Poduridæ, the latter being true insects, probably degraded Neuroptera. Our species is yellowish white, and ·03 of an inch in length. Mr. Walker assures me, after seeing this specimen, that he saw a similar one last May under the bark of an apple-tree in Chelsea, Mass.—*American Naturalist,* vol. iv. Dec. 1870.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 38. FEBRUARY 1871.

IX.—*Description of a considerable portion of a Mandibular Ramus of* Anthracosaurus Russelli; *with Notes on* Loxomma *and* Archichthys. By ALBANY HANCOCK, F.L.S., and THOMAS ATTHEY.

[Plate VI.]

IN 1862 Professor Huxley made known the presence in the Lanarkshire coal-field of a large and powerful Labyrinthodont, to which he gave the name of *Anthracosaurus Russelli**. This species was founded on a nearly perfect cranium; and at the same time a vertebra and a rib supposed to belong to this Amphibian were also described. No further evidence of the existence of this formidable creature of the Carboniferous era was procured till Mr. Atthey obtained a large portion of another cranium belonging to it at Newsham. This interesting fragment was described, in the September Number of the 'Annals,' in 1869; and we gave in the same paper an account of the anterior extremity of a mandibular ramus and of a large sternal plate, which we believed likewise to belong to *Anthracosaurus.*

We are not aware that any further account has appeared of the occurrence of remains of this rare Amphibian. It is therefore with much pleasure that we are enabled, through the kindness of Mr. Ward of Longton, to describe a large fragment of a mandible belonging to this species. This specimen forms part of that gentleman's well-known collection, and is from the new ironstone shale of Fenton. It is a portion of the posterior extremity; but the articular process is wanting. The fragment is 7 inches long, and measures nearly 4 inches from the alveolar border (Pl. VI. *a*) to the inferior margin (*b*). There is just two inches of this margin perfect; and this is at the point where undoubtedly the ramus is deepest. The inner

* Quarterly Journal of the Geological Society, vol. xix. p. 56.

surface is exposed to view, and is concave longitudinally, the outer surface being a little convex, as is evident in the transverse section of the specimen in front. The bone, which is in a very perfect state of preservation, is composed of two parallel layers—an inner, the splenial plate (*c*), and an outer, the dentary piece (*d*)—and is stout, particularly at the alveolar border, where it is an inch thick; thence it becomes gradually thinner to the longitudinal middle line; here it is scarcely more than $\frac{1}{4}$ of an inch thick, and so continues to the inferior margin.

The upper surface of the alveolar border is slightly channelled, and is almost straight; but within $3\frac{1}{4}$ inches of the posterior extremity it is bent a little downwards (*e*), and then, rising up considerably above the level of the border, is continued backwards in a straight line (*f*) to the posterior extremity; this straight part is $1\frac{1}{2}$ inch long, and is bevelled off to a sharp edge. In front of the elevation the alveolar border has been torn, apparently by pressure, from the inner layer of bone, which at this part is pushed a little downwards.

The teeth are well preserved; in all there have been twelve, nine of which are almost perfect, and, with the exception of the three posterior ones, are all of the same size. They are nearly an inch long, and at the base are upwards of a quarter of an inch wide; they taper gradually to the apex, which is a little compressed in the direction of the long axis of the jaw, and in the same plane has the sides slightly carinated, and is also rather suddenly bent inwards and backwards; but the recurving is probably, in part at least, owing to pressure. The crown is not perfectly cylindrical or, rather, conical; it is a little flattened at the sides, and is therefore in cross section somewhat angulated; and at the base it is wider in the transverse than in the longitudinal direction of the jaw. The whole surface is covered with brilliant enamel, and is longitudinally grooved to within less than a third of the apex. The grooves are fine, rather distant, and the spaces between them are flattened, so that there is a tendency to a ridged appearance.

The teeth are clustered, and in this respect agree with those of the maxillæ. In the clusters the bases are in contact; and short spaces divide the clusters. The first tooth (*g*) is split longitudinally by the anterior fracture of the specimen, and very little of it remains: only a small piece of the base is perceptible; but a partial impression of the crown shows that it was as large as the others. The base of the second tooth is not far from that of the first, and is the first perfect one of the series. The third tooth has been removed for structural examination; it stood apart, about a quarter of an inch from the second, and as far from the fourth tooth. The fourth and fifth are in contact, and are separated from the sixth by about a quarter of an inch; the sixth, seventh, and eighth are close together, and form the largest cluster of the series. Then follows a space of upwards of a quarter of an inch, and the series is terminated by three teeth much smaller than the rest; these are clustered, the first two being almost perfect, and the third (*h*) having almost entirely disappeared. These three posterior teeth are placed just at the point where the alveolar border begins to rise, and are 2½ inches from the hinder extremity of the specimen.

The mandible of *Anthracosaurus* is distinguished from that of *Loxomma*, the only known jaw with which it is likely to be confounded, not only by its greater size, but also by the massiveness of the bone. It is an inch deeper or wider than the largest mandible we have seen of the latter; and the bone is very much thicker. The form of the teeth likewise distinguishes this species from *Loxomma*: they have the crown much less compressed, and the trenchant margins are not nearly so much developed; towards the base, too, they are more cylindrical, or, rather, conical, though they are somewhat irregularly flattened and angulated at the sides. They are also much more uniformly of a size; in this respect they vary greatly in *Loxomma*, while we have seen that in the fragment before us the teeth are about the same length, with the exception of the three terminal ones of the series. The internal structure of the tooth is also characteristic, and at once distinguishes this species from *Loxomma*.

Indeed the characters of the teeth of *Anthracosaurus* are very peculiar; their thickness and angularity at the base, the delicate conical taper upwards, the incurving of the apex, its slight compression and the small development of the trenchant margins are the distinguishing features of this form, and at once enable us to determine the generic and specific identity of Mr. Ward's interesting fragment. But had any doubt existed, the internal structure of the tooth would have removed it. In all these characters this specimen exactly agrees with *Anthracosaurus Russelli*; the Labyrinthodont structure in particular accords in every respect with the very clear description given of it by Professor Huxley in the original memoir.

It is true that the teeth are stated to be ridged, while we have described them as grooved. This character, however, we pointed out, in our former paper on *Anthracosaurus* already quoted, varies according to the state of preservation of the specimen. We have in our possession teeth of this species both ridged and grooved. They seem to vary in this respect even when perfectly fresh; but if a little eroded, the ridges are much exaggerated and become quite sharp, giving a very striking appearance to the tooth. In *Loxomma* the same variability obtains: the teeth of that form are usually grooved; some, however, are ridged, while in others the ridges are greatly increased by erosion.

There is in Mr. Atthey's collection a peculiar bone from the shale at Newsham, that has been a great puzzle to us for a long time. It was not till a nearly perfect mandibular ramus of *Loxomma* was obtained that its true nature was solved. It was then at once seen to be the articular piece, with a portion of the dentary bone attached, of some large Labyrinthodont. In form it closely resembles the same part in the ramus just alluded to; only it is very much larger, and must have belonged to a jaw equal in size to that from Fenton. In fact, from its dimensions and massive character, it would seem more than probable that this Newsham articular piece really belongs to *Anthracosaurus*.

The posterior margin of the fragment of the ramus in connexion with the articular piece is perfect, and sweeps downwards in an even curve, which, if continued a little further, as it appears to have been, would give to the posterior part of the jaw a depth of quite 4 inches—the measurement near the same point of Mr. Ward's specimen. The articular piece stands well up; the neck is short and stout; the process bearing the glenoid surface is massive, and is transversely elongated, measuring $2\frac{1}{4}$ inches long and an inch wide; the glenoid cavity is deep, and takes a slight sigmoid curve; behind at the outer margin there has been a stout projecting process; and in front towards the inner margin there has been a similar projection of the lip of the articular cavity. It would therefore seem evident that the attachment of the mandible to the tympanic trochlea must have been very firm, rendering the movements of the jaw secure and precise. Indeed the massive character of the whole articular piece indicates great power, and is well correlated with the huge vomerine tusks and formidable dentition of this species.

The presence of *Anthracosaurus* in the Newcastle coal-field does not rest merely on the occurrence of this articular piece. We have already alluded to a large portion of the cranium that was found at Newsham. This interesting specimen exhibits numerous maxillary teeth and the two great vomerine tusks so characteristic of this powerful Labyrinthodont. The anterior extremity of a mandibular ramus with five teeth attached was also described in the same paper with the last-named specimen. And now we have to record from the same locality a fragmentary specimen of the middle portions of a pair of mandibular rami displaying several teeth. These fragments lie one over the other, and are much confused and mixed up with some other bones that are adherent by pressure to the general mass. The surfaces of the teeth, however, are in a very good state: some exhibit grooves, others ridges. In one of the teeth the grooves are very delicate, and are precisely like those in Mr. Ward's specimen.

Besides the above evidence of the occurrence of *Anthracosaurus* in the Newcastle coal-field, detached teeth are likewise found at Newsham, agreeing in every particular, externally and internally, with the type specimens. They are rare, however, in comparison with those of *Loxomma*, which is undoubtedly the much commoner fossil of the two.

Loxomma Allmanni, Huxley.

Since our paper appeared in the 'Annals' (May 1870) on the occurrence at Newsham of an imperfect cranium of *Loxomma Allmanni*, Mr. Atthey has obtained from the same locality another and complete cranium of this fine Labyrinthodont. This second example was procured about the middle of last June, and is one of the finest and most perfect specimens that have yet been found. Indeed, so far as we know, there are but two others that can at all be compared with it; and these are the beautiful skulls alluded to in the above paper as being in the possession of Mr. James Thomson, of Glasgow.

Our second specimen is 14 inches long and nearly $7\frac{3}{4}$ inches wide across the occipital region, where the skull is widest. We estimated the length of the first obtained specimen, which wants the muzzle, as 12 inches; but, as it is 9 inches wide, this estimate is probably considerably less than it ought to be. Since we have seen that the one which is only $7\frac{3}{4}$ inches wide is 14 inches long, we should certainly expect that the specimen measuring 9 inches across would be proportionately longer. The latter could scarcely have been less, when perfect, than 15 or 16 inches in length.

The specimen recently obtained has been entirely removed from the matrix, so that both the upper and under surfaces of the skull are completely exposed to view. The bone is in a very good state of preservation, and exhibits in great perfection, covering the whole of the upper aspect, the peculiar honeycombed or reticulated structure common to these Labyrinthodonts. The roof of the mouth is also well displayed, particularly the sphenoid and the vomerine and palatal bones, likewise the posterior nares and the palato-temporal foramen. The basal portions of the teeth, too, are nearly all present; but the crowns, unfortunately, have disappeared.

In every respect the characters agree with those of the previously described specimen; and in addition, the parietal foramen is distinctly marked in the new example. This characteristic feature is not seen in either of Mr. Thomson's specimens; but in the original cranial fragment described by Professor Huxley it is well indicated on the inner surface*. In our specimen it is small and circular, measuring not much over an eighth of an inch in diameter. It is placed near the centre of the wide occipital portion of the median coronal bones. The mucus-grooves on the muzzle, too, are well developed: one passes straight across the premaxillaries in front; from either end of this, and forming with it an acute angle, another groove passes backwards for a considerable distance along the side of the muzzle.

The teeth are nearly all present in a more or less imperfect condition; mostly, however, the stumps only remain. There are three pairs of large tusks—one vomerine, two palatal. The vomerine tusks are situated about $1\frac{1}{4}$ inch behind the anterior margin of the præmaxillæ; the basal portions of these project considerably, and measure in diameter $\frac{3}{4}$ inch. The first pair of palatal tusks are placed 2 inches further back, and are scarcely so large as the vomerines; the second pair, which seem equally large, are $1\frac{1}{4}$ inch further in the rear, being somewhat in front of the transverse centre of the skull. Each præmaxilla bears four teeth, which are upwards of a $\frac{1}{4}$ inch wide at the base. There are five or six rather smaller teeth between the vomerine and the first palatal tusk, and the like number between the latter and the second palatal tusk; and behind this, again, there are four or five more, making in all in each side of the jaw about twenty teeth. All these teeth are placed a little apart, and have depressions behind them in the alveolar border; the tusks also are accompanied by similar depressions.

Not far from the spot where this fine skull was obtained, two mandibular rami (a right and a left) occurred two or three feet apart. They are of the same size, and most probably belonged to the skull in question. This would seem to be likely, not only on account of their close proximity, but also on account of their size, which agrees well with that of the cranium. The left ramus is imperfect, the posterior portion having been fractured and lost. A piece 9 inches long, however, of the anterior portion remains in a very good state, with

* Quarterly Journal of the Geological Society, 1862, vol. xviii. p. 291.

the stumps of the teeth attached. The right ramus is almost perfect; the alveolar border is quite so, and exhibits the teeth in a beautiful state of preservation; a great portion of the dentary bone is present, and is covered with the usual reticulated sculpture; the anterior extremity is quite perfect, as well as the articular bone—at the posterior end with the glenoid surface, which is transversely elongated, deep, and considerably elevated.

This large and perfect ramus is nearly $14\frac{1}{2}$ inches in length, and at the widest part, which is about 4 inches from the posterior extremity, is $2\frac{3}{4}$ inches broad. From this point it tapers gradually to the anterior end, where it is little more than an inch wide. The inferior margin is slightly convex; and the alveolar border is somewhat concave, with a slight eminence in front giving support to the first large tusk-like tooth.

There are upwards of twenty teeth, seventeen or eighteen of which are well preserved; a dozen are entire. They vary much in size, and in some places are arranged almost in contact; in other places they are considerably apart. Three are much larger than the rest, and seem to correspond to the vomerine and palatal tusks of the skull. These large teeth are $1\frac{1}{2}$ inch long, and are upwards of $\frac{1}{2}$ an inch wide at the base. The first of these is placed an inch from the anterior extremity, upon the eminence of the alveolar border already noticed; a single small tooth is situated in front of this. The second large tooth is 2 inches further back, and the third is $1\frac{1}{8}$ inch behind the second; the last is therefore $3\frac{3}{8}$ inches behind the first; but the space between the apices of the first and last large teeth is $4\frac{1}{4}$ inches—a distance corresponding very nearly to that between the depressions behind the vomerine and last palatal teeth. The smaller teeth vary from $\frac{3}{8}$ to about $\frac{3}{4}$ of an inch in length; they are all considerably compressed towards the apex, and have wide cutting-margins; the lower portion is rounded and grooved, the grooves extending for a considerable way up the crown.

Archichthys sulcidens, Hancock & Atthey.

Some additional remains of this large and powerful fish have recently occurred at Newsham, where the original specimens were obtained that were described some time ago in the 'Annals' (April 1870). The most important of these recent acquisitions is a considerable portion of a crushed head, which, though in a bad and much disturbed condition, shows in a very satisfactory manner the thick, massive character of the bones; moreover many of the parts are very well displayed. A large portion of a mandible, measuring upwards of 10 inches long, lies in the middle of the mass, with the inner surface exposed, and with the alveolar border turned over; so that several of the teeth are seen, measuring from $\frac{3}{8}$ to $\frac{4}{8}$ inch in length. This fragment (for, large as it is, it is but a fragment) has lost both extremities.

The anterior extremity of each mandibular ramus is likewise present on the slab, and has a large laniary tooth in front, and several of the small teeth behind. One of the large teeth is nearly perfect, and measures 2 inches in length, though the extreme apex is deficient, and is nearly an inch wide at the base. The other laniary tooth has been apparently equally large, but merely its stump remains. The largest of the small teeth are about half an inch long; they appear, however, to have been pretty regular in size, and are placed a little apart from each other. These two mandibular fragments are each upwards of 2 inches long; so that if one of them be joined to the large portion of the mandible already described, we have the dimensions raised to 12 inches; but as we have no means of determining how much of the proximal extremity is wanting, it is difficult to say what was the real length of this formidable jaw when perfect. Its massiveness, however, is sufficiently evident, as the bone of the anterior fragment is nearly an inch thick.

The left præmaxilla is also very well displayed, lying across the large mandibular fragment. It is $3\frac{1}{2}$ inches long, and is $1\frac{3}{4}$ inch wide. The anterior extremity is rounded; and close to the front margin there is, as in the mandible, a laniary tooth, which is small, however, in comparison with that of the latter; it is $\frac{7}{8}$ inch in length, and is proportionately narrow. This tooth is succeeded by about twenty minute teeth, $\frac{1}{8}$ inch long, or thereabouts, which are very regularly arranged at a little distance from each other.

Mixed up with the above are many other bones, belonging apparently to the skull; but they are too much broken up to admit of exact determination; the right præmaxilla, however, with its anterior laniary tooth, can be discovered amidst the commingled mass.

The surface of the more perfect bones exhibits the peculiar tubercular sculpture originally described; and the characters of the teeth show no variation from (indeed they are precisely similar to) those at first pointed out as distinguishing the species.

Two gigantic jugular plates were obtained at the same time, associated with the above remains, though not on the identical slab. We do not hesitate to assign them to *Archichthys*, not more on account of their association than from the character of the surface-structure, which agrees with that of the other bones of this fish, and that we know of no other species found in our coal-shales to which they can belong. The size alone would seem sufficient to determine the question. *Megalichthys* is certainly a large species; but the largest jugular plate we have seen of that fish is scarcely more than 7 inches long, not half the length of those in question. And, moreover, its form and enamelled surface are sufficient to distinguish it, though in general character it has considerable resemblance to the specimens under discussion. Except those that are altogether out of the question, the only other fishes of any considerable size that occur in our coal-shales are the three large species of *Ctenodus*: in this genus, however, the mandible is too short, and the space in front between the rami too contracted to admit of there being any large jugular plates; indeed *Ctenodus* is understood to have no jugular plates. Unfortunately, these two enormous plates are imperfect; but what remains of each is in an excellent state of preservation, and lies flattened out, the form being completely retained: and there is no difficulty in determining the entire contour; for whilst one has only the posterior extremity imperfect, this extremity in the other is entire.

The right plate has the under surface exposed; the anterior portion of this is quite perfect, a small part only of the posterior extremity, as just noticed, being wanting. In front it tapers gradually to a point, and there is a notch on the inner margin, about $1\frac{1}{4}$ inch from the apex; at this part the surface is depressed diagonally, the depression being bounded in front by a stoutish ridge. This plate, or, rather, as much of it as remains, is 12 inches long and $4\frac{1}{2}$ inches wide. Only the posterior extremity of the left plate is present; and this fragment is $3\frac{1}{2}$ inches in length, and lies with the upper surface exposed, with the inner margin in contact with the outer margin of the other plate. The posterior border is obtusely pointed; but as the slope is shorter on the outer than on the inner margin, the acumination is towards the outer edge.

By the aid of these two fragments, the form of the entire plate is easily determined. It is elliptical or widely fusiform, with the anterior extremity pretty regularly and gradually pointed, the posterior end being more abruptly and excentrically acuminated. When perfect, these huge jugular plates cannot have been less than 14 or 15 inches in length, as, judging from the specimens, it would seem evident that the fragment (which is 12 inches long) of the right plate has lost two or three inches of its posterior extremity.

A fragment of a bone lies on the outer margin of the right plate, which in all probability is the anterior central plate; but it is too imperfect to admit of any decided opinion.

The bones originally supposed to be jugular plates were folded and much crumpled and distorted, so that their form and dimensions could not be determined with certainty. We are now disposed to consider these to be certain cranial bones, of the exact nature of which we have not yet satisfied ourselves.

From the size of the jugular plates a very fair estimate may be made of the magnitude of the head. In *Megalichthys* the large jugular plates (and in that genus these plates closely resemble those of *Archichthys*) are about the length of the mandible, or rather a little shorter, allowing for the projection of the rami in front. If therefore we take this as a guide, and are correct in estimating the jugulars in *Archichthys* at 14 or 15 inches, the mandible cannot have been less than 15 or 16 inches long. Now, as the head extends considerably backwards beyond the articulation of the mandible, in some species for more than a third of the length of the mandible, it would appear that the head of *Archichthys* may be estimated as about 20 inches long, including, of course, in this calculation the gill-plates. That this is not an overestimate is evident from the fact that the operculum and præoperculum together are between 4 and 5 inches wide. The width of the head can also be very correctly estimated: it could not be less than ten or twelve inches. This is evident when we recollect that the joint width of the jugulars is 9 inches, that the mandibular rami are each an inch thick, and that it is not improbable that there were small external jugular plates lying between the rami and the outer margins of the large jugulars.

These are formidable proportions, indicating a very powerful creature; and when we take into account the magnitude of the oral weapons and the animal's superior activity, *Archichthys* must have been no mean rival to the large Amphibians of the Carboniferous waters: it must have been quite able to hold its own against *Loxomma*, or even against the more powerful *Anthracosaurus*.

Notwithstanding the recent discovery of this large and formidable fish, we are in possession of more information respecting it than has been attained in regard to many species that have been acknowledged for years. The characters of the dentition are perfectly determined: the mandible and præmaxilla have been obtained in a good state of preservation, with the teeth attached. The gill- and jugular plates, too, have occurred in most excellent condition, as well as several other bones, including some that apparently belong to the thoracic girdle. The body-scales have likewise been found associated with the bones.

We have also good reason to conclude that the genus *Archichthys* occurs not only in other coal-fields, but likewise considerably lower in the Carboniferous series.

EXPLANATION OF PLATE VI.

View of the inner surface of a portion of a mandibular ramus of *Anthracosaurus Russelli*, a little reduced in size: *a*, alveolar border; *b*, inferior margin; *c*, inner or splenial plate; *d*, outer plate or dentary bone; *e*, depression in alveolar border; *f*, elevated straight portion of ditto; *g*, impression of first tooth of the series; *h*, remains of the last ditto.

X.—*On Foraminifera from the Gulf and River St. Lawrence.* By G. M. Dawson*.

Several of the species of Foraminifera found in the Gulf of St. Lawrence have been noticed by Principal Dawson in vol. v. of the 'Canadian Naturalist,' p. 188 *et seq.* The following Table (pp. 88, 89), however, is the only approach to a complete view of the species and their distribution hitherto attempted.

Many of the deeper samples were small quantities of mud brought up in sounding, by Capt. Orlebar, R.N., of the Coast Survey, and by him kindly presented to Dr. Dawson.

The specimens from Labrador were obtained from material dredged by the officers of the Geological Survey; those from Prince-Edward Island were from a sample secured by C. Robb, Esq.; and those from the bank of Newfoundland were obtained from the late Sheriff Dickson, of Kingston.

The somewhat extensive series from Gaspé Bay was obtained during a dredging-expedition in the summer of 1869. The mud was sampled when brought up by the dredge, and reserved for examination, the depth being ascertained as carefully as possible. Several very rich and interesting samples are also from the dredgings of Mr. J. F. Whiteaves, F.G.S., in Gaspé and its vicinity.

The means were, unfortunately, not at hand for ascertaining the temperature of the bottom. But though there is reason to believe that the water at Gaspé Bay is somewhat warmer than the Gulf of St. Lawrence in general, the mud as it came over the boat's side felt icy cold to the hand, showing even here what a great effect the iceberg-laden arctic current has on the bottom temperature. The number of species tabulated must not in every instance be taken as a criterion of the rela-

* From the 'Canadian Naturalist,' June 1870; communicated by the Author.

tive richness of the localities, as much often depends on the amount of material at disposal. This is especially the case when comparing dredgings with soundings.

The general aspect of the Gulf-of-St.-Lawrence Foraminifera is northern, and in many places closely resembles the fauna of the Greenland coast and the Hunde Islands, as given in Parker and Jones's memoir (Phil. Trans. 1865). The gulf, at least so far as its Foraminifera are concerned, evidently belongs to the Arctic province, the limits of which skirt the Banks of Newfoundland, and pass thence southward to Cape Breton.

The refrigeration of its waters depends on the arctic current, which, entering the Straits of Belle Isle, floods the whole bottom of the gulf with water almost at the temperature of the Arctic seas. To these conditions the series of collections from Gaspé offers somewhat an exception, and is of a slightly more southern character, both as regards the species represented and the development which they attain. This difference depends on purely local causes, which, while slightly changing the character, give opportunities for a very abundant development of Foraminifera, more especially of the arenaceous forms. Gaspé Bay in no part exceeds 50 fathoms in depth, is about twenty miles in extreme length, well land-locked, and disturbed by no other current than that caused by the ebb and flow of the tide. The depth is not so great as to allow of the incursion of the cold and deep layer to any great extent; and the proximity of land and the shelter thus afforded tend still further to modify its temperature.

The bottom, in most of the deeper parts, is composed of fine sand and mud; and this it is which favours the very large development of arenaceous forms.

Past the mouth of Gaspé Bay sweeps the very strong tidal current of the St. Lawrence; and immediately we pass the shelter of Ship Head and come within its influence, the changes in the Foraminifera become strikingly apparent. The bottom consisting for the most part of clean gravel or coarse sand, most of the arenaceous forms disappear at once, and, instead of the abundance of Nonioninas and Miliolas previously found, a very large proportion consists of *Planorbulina lobatula*, which can hold its own, attached to seaweeds and polyzoans. *Polystomella arctica* also becomes somewhat prominent, while the Lagenidæ and Entosolenidæ appear in abundance.

What few sandy forms do occur are depauperated and composed of very coarse particles. The Foraminifera as a whole, however, are very abundant, and in some samples dredged by Mr. Whiteaves almost equal in quantity those in the deeper Atlantic soundings.

In the estuary of the St. Lawrence itself, *Bulimina pyrula* becomes a somewhat common form. Among forms which in the Gulf of St. Lawrence may be mentioned as specially characteristic of deep water are *Nodosaria* (*Glandulina*) *lævigata*, *Globigerina bulloides* (very small), *Bulimina*, principally *B. squamosa* (also small), *Uvigerina pygmæa*, *Cassidulina*.

From depths greater than 100 fathoms all the Foraminifera are very small and delicate; and Lagenidæ, Buliminidæ, *Globigerina bulloides*, together with a few depauperated *Nonioninæ*, constitute the greater part of the fauna. From these depths also come many Diatoms, mostly *Coscinodiscus*, and sponge-spicules. *Polystomella striatopunctata* is almost everywhere prevalent, though it nowhere attains to any very great size, and below about 30 fathoms becomes small and generally rare, and continues increasing in rarity till it almost disappears at 300 fathoms. In some localities, at about 30 fathoms, *P. arctica* is abundant, and greatly surpasses in size the ordinary *Polystomellæ* occurring along with it. The remaining *P. striatopunctatæ* also at this depth often show a remarkable proneness to run into modifications resembling one or other of the numerous species and varieties into which the genus is subdivided; but as the transition series are complete, it is very difficult to place the bulk of the specimens satisfactorily under them. It has been thought better, in the Table, to include as many as are easily seen to be modified *striatopunctatæ* under that name. *Nonionina labradorica*, though not so universally distributed as the above, is a very characteristic species in the gulf. It seems to be best developed and in largest numbers at about 30 fathoms. It thins off both in numbers and size as we go into shallower water, and decreases much in size, though not so perceptibly in numbers, as the water deepens to 100 fathoms and below. There is a remarkable absence of Miliolas in the estuarine parts of the gulf, which strongly contrasts with their abundance in Gaspé Bay and also on the Atlantic coast of Nova Scotia, and south.

One specimen of a curious sandy form of *Cornuspira foliacea* was obtained at a depth of 18 fathoms at Gaspé.

Biloculina ringens scarcely occurs above 30 fathoms.

At Murray Bay, which is only about sixty miles below the point where at least the surface of the St. Lawrence becomes permanently fresh, the Foraminifera become very scarce and poor. *Polystomella striatopunctata* is the most common, but it has become very small. *Nonionina labradorica*, *Lituola canariensis*, and *Trochammina inflata* also occur, but all much reduced in size, and, relatively to the amount of material examined, scarce. On passing from the gulf to the east of

Newfoundland, or to the south of Cape Breton, a change from the gulf fauna is immediately detected. *Polystomella striato-punctata*, there so common, becomes rare. *Nonionina labradorica* to a great extent ceases to appear, and *Uvigerina pygmæa* and Cassidulinidæ become more frequent.

The arenaceous *Lituola findens*, D. & P. (1)*, *Hippocrepina indivisa*, D. & P. (2), *Lituola cassis*, D. & P. (3), are most plentiful at depths less than 20 fathoms. *Lituola scorpiuris* (4) goes down to the greatest depths in Gaspé Bay, and is yet abundant at 10 fathoms, while the immense *Rhabdopleura*? (7) only appears at about 20 fathoms, and continues from that point increasing in numbers and size to the depth of 50 fathoms, which is the greatest depth in Gaspé Bay, where alone it has been found.

The distribution of these Foraminifera would tend, with other facts, to show that these organisms, together with most other marine animals of low organization, do not depend to any great extent on the depth or intensity of daylight, but almost entirely on the *temperature* of the water, as Dr. Carpenter maintains in his account of his recent deep-sea dredging; so that they would not give very satisfactory evidence of the conditions of deposit of Postpliocene or other beds, unless other facts were at disposal to show the depth, when the Foraminifera would give valuable assistance with regard to the climatic conditions at that depth. The quality of the bottom, however, has much to do with the general *facies* of the Foraminifera, as with other animals; for, as shown above, calm water, with a bottom composed of fine sand and sediment, is particularly favourable to the arenaceous forms, though, even under these conditions, they do not thrive in the very cold, deep water (such as that below 100 fathoms) in the open gulf. A strong current at once causes all sandy forms to disappear, mostly, no doubt, from the want of the fine materials necessary for their shells, and brings in a large preponderance of Planorbulinas, Lagenidæ, &c.

The arenaceous forms, with the exception of those which are tubular, constitute a series parallel to the calcareous forms, and the members of which graduate into one another. It seems not improbable that the individuals of the same species may assume either appearance. It does not appear, however, that the same individual can present both forms at successive periods. On the other hand, the sandy forms may really constitute a distinct group parallel to the others. Sketches of some interesting new forms are given. Dr. Parker has kindly assisted in naming some of the arenaceous forms. There are

* The figures refer to the numbers of the woodcuts.

also in the Gaspé collections some irregular arenaceous forms adherent to stones, along with *Truncatulina*; these have not been figured.

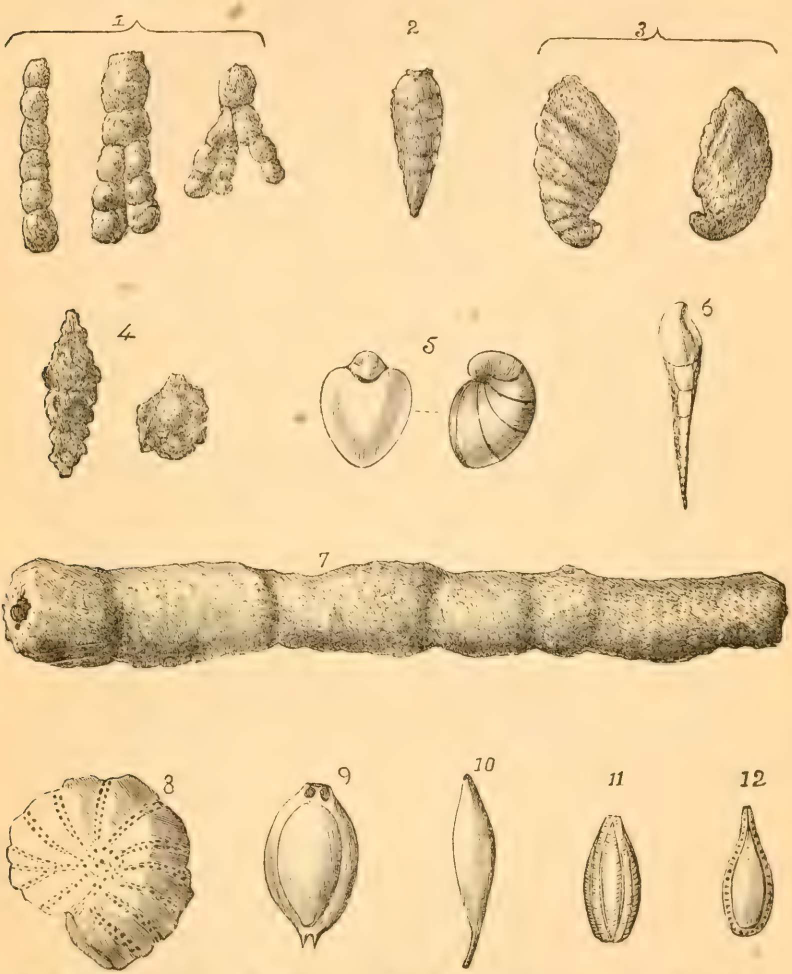


Fig. 1. *Lituola findens*, D. & P. Fig. 2. *Hippocrepina indivisa*, D. & P.
Fig. 3. *Lituola cassis*, D. & P. Fig. 4. *Lituola scorpiuris*, var.
Fig. 5. *Nonionina scapha*, var. *labradorica* (313 fms.).
Fig. 6. *Bulimina Presli*, var. *squamosa* (313 fms.).
Fig. 7. *Rhabdopleura*? Fig. 8. *Polystomella arctica*.
Fig. 9. *Biloculina ringens*. Fig. 10. *Lagena sulcata*, var.
Fig. 11. *Entosolenia striatopunctata*. Fig. 12. *Entosolenia marginata*.

Figs. 1, 2, 3, 4, & 7 are drawn to a scale half that of the other figures.

TABLE I.—*Showing the Distribution of Twenty-three Gatherings of Foraminifera from the Gulf and River St. Lawrence and neighbouring parts of the Atlantic.*

C, common. R, rare. S, small specimens. L, large specimens,

FORAMINIFERA.	313 fathoms, Gulf St. Law. Lat. 48° 25′, long. 60° 20′.	250 fathoms, between St. Pierre and Scatari.	200 fathoms, Cape Camille.	144 fathoms, north-east of Anticosti.	140 fathoms, Gulf St. Lawrence.	40 fathoms, Cape St. Nicholas.	Labrador.	Banks of Newfoundland.	Off West Cape, Prince-Edward Island.	Off South Coast, Cape Breton, 90 fathoms.	Gaspé, North-west arm, 7 fathoms.	Gaspé Bay, 10 fathoms (sand).	Gaspé Bay, 10 to 15 fathoms.	Gaspé Bay, 16 fathoms.	Gaspé Bay, 16 to 17 fathoms.	Gaspé Bay, 18 to 20 fathoms.	Gaspé, betw. Ship Head and Cape Bon Ami, 30 fathoms.	Gaspé Bay, off Grande Grève, 35 fathoms.	Gaspé, off Ship Head, 30 to 40 fathoms.	Gaspé Bay, off Grande Grève, 40 to 50 fathoms.	Gaspé Bay, Grande Grève, St. George's Cove.	Gaspé, River St. Lawrence, off Cape-Rosier village.	River St. Lawrence, Murray Bay, 15 to 20 fathoms.
Nodosaria (Glandulina) lævigata	*R			*R	*R												*	*S		*		*R	
Dentalina pauperata	*R																						
—— communis																	* RL			*		*L	
Lagena sulcata														*R		*R	*	*	*R	*L	*R		
—— ——, var. distoma	*	*R		*								*R						*					
—— ——, var. semistriata							*										*	*	*R	*L		*R	
—— ——, var. lævis		*R																					
—— ——, var. substriata										*													
Entosolenia globosa	*						*R								*R			*	*		*R		
—— costata							*R		*R			*R		*			*	*R S	*R		*		
—— melo, D'Orb.							*R	*R				*L					*R		*R	*R			
—— caudata, D'Orb.								*									*S		*R				
—— marginata, var. ornata							*R										*S						
—— marginata																	*R S						
—— squamosa																	*R S		*				
—— striato-punctata																	*R						
Polymorphina lactea	*R					*								*	*S		*					*R	
—— ——, var. compressa							*		*R L			*R L	*C L	*L			*L						
Uvigerina pygmæa								*R		*C S							*R S		*R S		*R S		
Globigerina bulloides	*C S	*C S		*			*R	*R									S		*R S		*R		

	Sounding.	Sounding.	Sounding.	Sounding.	Sounding.	Sounding.	Dredging.	Dead *Balanus* bro't up on cod-hooks.	Sand from an anchor.	Sounding.	Sounding.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.	Dredging.
Textularia agglutinans								*R							*R S								
—— ——, var. biformis							*R																
—— ——, var. Verneuilina polystropha							*					*		*		*R							
Bulimina Presli, type	*																						
—— ——, var. pyrula		*	*C	*C	*						*R									*R L			
—— ——, var. squamosa	C	*C		*			*R																
—— ——, var. Bolivina costata		*																					
—— ——, var. marginata		*		*																			
—— elegantissima																*C							
Cassidulina lævigata							*R	*					*			*R	*	*	*	*	*	*	
—— crassa																	*	*	*	*R	*	*	
Planorbulina lobatula							*C L	*C			*S	*R					C		*C		*L		
Rotalia Beccarii	*	*R																					
Pulvinulina repanda, subvar. Karsteni		*R					*			*C S							*	*	*R	* R	*R S		
Patellina corrugata																			*R S				
Polystomella crispa, var. striatopunctata	*R S	*R		*R S	*		*		*C		*C S	*S	*C	*C S	*	S	*C	*R S	*C S	*R S	*S		*C S
—— ——, var.									*R														
—— arctica																	*L		*L		*L		
Nonionina scapha								*C										*			*		
—— ——, var. labradorica	*	*	*	*C	*C		*	*R			*C		*		*	*	*L	*C	*	*C L	*R	*	*S
Lituola nautiloidea, var. canariensis			*				*				*R S		*	*	*C		*R S	*C L		*C	*C L	*C	*S
Trochammina inflata												*C S		*		*C S			*R S				*S
Cornuspira foliacea		*R S												*R S		*L					*R S		
Quinqueloculina seminulum	*R		*R	*			*		*			*C L	*C L	*C S		*R S	*R S	*L		*L	*L	*C L	
—— ——, var. subrotunda							*R																
—— ——, var. agglutinans							*						*S	*		*S		*	*R S	*R	*R S	*	
—— ——, var. Férussacii							*R											*L		*L		*L	
—— bicornis, var. elegans									*R														
Triloculina tricarinata																*R	*R S	*R S				*R	
Biloculina ringens	*						*R													*R	*R	*R	

TABLE II.—*Supplementary List of peculiar Arenaceous Forms.*

See figs. 1–4 and 7.

FORAMINIFERA.	Labrador.	Gaspé Bay, 10 fathoms (sand).	Gaspé Bay, 10 to 15 fathoms.	Gaspé Bay, 16 fathoms.	Gaspé Bay, 18 to 20 fathoms.	Gaspé Bay, 16 to 17 fathoms.	Gaspé Bay, off Grande Grève, 35 fathoms.	Gaspé Bay, off Grande Grève, 40 to 50 fathoms.	Gaspé Bay, St. George's Cove.	River St. Lawrence, off Cape Rosier (Whiteaves).
Lituola findens, *D. & P.* (fig. 1).				*C L	*	*			*R	
Hippocrepina indivisa, *D. & P.* (fig. 2).				*C L	*C					
Lituola cassis, *D. & P.* (fig. 3)		*	*C	*C L		*				
—— scorpiuris (fig. 4).	*		*C	*C L	*	*C	*C L	*C	*C	*C L
—— ——, var. (fig. 4).				*C L			*C L			
Rhabdopleura ? (fig. 7)						*	*C L	*	*C L	*C I

XI.—*Outline of some Observations on the Organization of Oligochætous Annelids.* By E. RAY LANKESTER, B.A. Oxon.

FOR some time past I have, as opportunity offered, examined the structure of the freshwater and terricolous Annelids. I have already published an account of the larval form of *Chætogaster* (Trans. Linn. Soc. 1868), and of its sexual form (Quart. Journ. Microscopical Science, 1869), to which I have now something to add; I have also briefly described the remarkable genital setæ which characterize *Nais* equally with *Chætogaster* (Ann. and Mag. Nat. Hist. 1869), and have shown that the Naididæ as a group present in their development two very distinct forms—the one larval, reproducing by fission, the other sexual, of a limited number of segments, provided with additional segments interposed between segments present in the larva, arising by new growth, bearing peculiar setæ and the generative organs—the setæ of the whole worm differing also to some extent in the adult and larval forms.

The mud-banks of the Thames about and below London swarm with countless masses of red worms belonging to the Sænuridæ; and these, besides others from ponds at Hampstead, have furnished me with abundant material. I propose to give a short statement of some new facts, which I hope to illustrate with detailed drawings hereafter. The immense profusion of the worms in the Thames mud, of which they are the almost solitary occupants of high organization, is surprising. They appear to exist under the most favourable conditions as regards food, attaining sexual completeness in winter as well as in summer, unchecked by any competition or by assailants.

1. *Families of the* Oligochæta.—The Oligochæta are best primarily divided as proposed by M. Claparède, into the *Terricolæ* and the *Limicolæ*. The former group has been but little studied, with the exception of the typical genus *Lumbricus*, and is not as yet broken up into families; it includes the genera *Lumbricus*, *Perichæta*, *Phreoryctes* and others, characterized by much greater histological and organological differentiation than is met with in Limicolæ. The Limicolæ have been divided into three families, Sænuridæ, Enchytræidæ, and Naididæ; but I should be inclined to place the Enchytræidæ as a subgroup with Sænuridæ, since only in this way can full weight be given to the very distinctive characters of the Naididæ. We thus have Lumbricidæ = Terricolæ, whilst Sænuridæ and Naididæ = Limicolæ. The Naididæ are further divisible into Naidinæ and Chætogastrinæ.

2. *New Species of* Sænuridæ.—The determination of species amongst these worms is very difficult, for two reasons:—first, that authors are not agreed as to what characters are important, and give descriptions of varying incompleteness; and secondly, that it is not possible as yet to say what are the limits of variability and the phases of development in one and the same species.

The most abundant worm in the Thames mud is the *Tubifex rivulorum*, described some years since with much care by M. Jules d'Udekem. Two other worms, however, are very abundant, living inextricably mixed with it in masses: these are a species of *Limnodrilus* and another, very interesting *Tubifex*. No observer has recorded *Limnodrilus* (of Claparède) in England; but I have found it abundantly in many localities, represented by three species. That in the Thames appears to be the first of M. Claparède's species, *L. Udekemianus* (Recherches sur les *Oligochètes*), being characterized by brown patches in the posterior segments, caused by stellate pigment-cells forming the endothelium of the perivisceral cavity (figured by me in Quart. Journ. Microsc. Science, July 1870). Another *Limnodrilus*, which I have obtained from an old pond at Hampstead, differs from either of Claparède's species in its great size (4 inches in length), as well as in the number of the setæ. In another series of specimens, which I think will prove specifically distinct, the chitinous tube in the copulatory organ is of enormous length as compared with those figured by the Swiss Professor. I have found that specimens of these and other worms may be mounted with great facility, and kept for reference, by means of glycerine jelly.

The second species of *Tubifex* in the Thames I first obtained with Mr. Kent in the Victoria Docks. I have since had specimens in abundance from near Barking. In this form, which differs in no respect from *T. rivulorum* when closely examined by the naked eye or low powers, the setæ of the dorsal row of the first ten segments present, when highly magnified, a form seen in no other Oligochætous Annelid, recalling by its specialization the setæ of some Polychæta. The bifid apex has its prongs directed forwards, and widely divergent, the interval being occupied by a finely ribbed membrane, which is somewhat depressed between the two prongs (fig. 1 *b*). With these

Fig. 1.

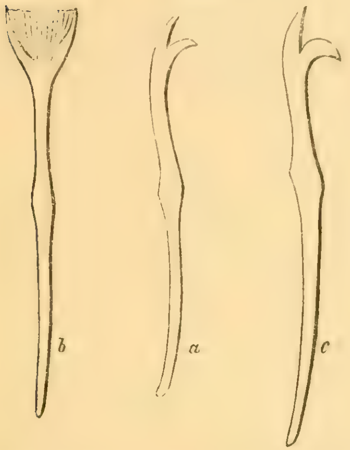


Fig. 2.

are associated from one to four capillary setæ in each bundle. The setæ of the first ten ventral (*i. e.* on the neural aspect) fascicles are small and of the usual crochet form (fig. 1 *a*); but after the tenth setigerous segment, the setæ, both in the dorsal and ventral fascicles, assume a very marked stout form (fig. 1 *c*), resembling those of *Lumbriculus*, and differing very clearly from those of *T. rivulorum*. The webbed or palmate dorsal setæ of the first ten segments appear to act in concert as so many oars, propelling the worm by the pressure of their flat surfaces on the water. This species of *Tubifex* differs further from *T. rivulorum* in the narrowness and elongation of that part of the male efferent duct which lies between the enlargement upon which the gland called "seminal vesicle" by Claparède is grafted and the proper penis. This portion, unlike what occurs in *T. rivulorum* or the two species figured by Claparède, is non-glandular, and resembles the corresponding part in *Limnodrilus*. This is a very important distinction. A further character is found in the spermatophores (bodies occurring in the spermatic reservoirs, which I have shown to be agglutinated masses of spermatozoa, and on which Claparède founded his genus of parasitic Opalinoid parasites, *Pachydermon*). In the new form these are elegant and tapering at each end, whilst in *T. rivulorum* they have a curious conical extremity, due to moulding in the mouth of the reservoir. On describing the setæ of this new form to Prof. Leuckart, last April at Leipzig, he told me that he had just seen a description of such setæ, and handed me a Russian work, 'The Memoirs of the first Meeting of Russian Naturalists at St. Petersburg, 1868, Supplement,' in which is a paper entitled "Materials for the knowledge of Onega Lake and Territory in their Zoological Aspect," by Karl Kessler. By the kindness of Dr. Alexander Brandt, who was fortunately present, I was made acquainted with the contents of this paper. Several Oligochætous Annelids are imperfectly described, and among them *Sænuris* or *Naidina umbellifera*, which is evidently the new Thames worm, though no anatomical details are given, except that the genital openings are in the ninth and tenth fasciculate segments. The palmate setæ are figured, but not well, and it is obvious the artist had not a very high-power microscope. Six specimens were obtained from mud by Lake Ladoga; and the specific name "*umbellifera*" is given, which I therefore accept for the Thames worm, which stands as *Tubifex umbellifer*. The genital openings in this species are placed as in the *T. rivulorum*, with which it is associated, viz. those of the spermatic reservoirs in the ninth fasciculate segment, those of the male ducts in the tenth fasciculate segment. The number of setæ and their form in a well-developed specimen were as follows:—(1) Ventral, 3 of *a* (fig. 1); Dorsal, 5 of *b* (fig. 1) and 2 capillary setæ. (2) V. 4 of *a*; D. 5 of *b*, 3 cap. (3) V. 4 of *a* (larger); D. 8 of *b* (larger), 3 cap. (4) V. 3 of *a*; D. 9 of *b*, 4 cap. (5) V. 3 of *a*; D. 8 of *b*, 3 cap. (6) V. 3 of *a*; D. 8 of *b*, 4 cap. (7) V. 2 of *a*; D. 5 of *b*, 3 cap. (8) V. 2 of *a*; D. 5 of *b*, 2 cap. (9) V. 3 of *a* (small); D. 4 of *b*, 1 cap. (10) V. 2 of *a* (small); D. 2 of *b*, 1 cap. (11) V. 2 of *c*; D. 3 of *c*, 1 cap. (12) V. 2 of *c*; D. 2 of *c*. (13–18) same as (12), then 2 of *c* in each ventral and 1 of *c* in each dorsal fascicle, with no capillary setæ for the rest of the worm. This specimen was not in a sexual state, though of large size ($1\frac{3}{4}$ inch).

It is a question whether *Tubifex umbellifer* has been introduced into the Thames by ships. It is very abundant in parts.

3. *Setæ of* Tubifex rivulorum.—A careful study of the setæ of

this species, consequent on the observation of the last species, has shown me that in *T. rivulorum* there is a rudimentary web to the dorsal setæ of the first ten fasciculate segments, and even traces of such a web as far as the fifteenth. This and the peculiar form of these setæ has not before been described. Though considerably smaller relatively, yet the setæ in this region approach those of *T. umbellifer* also in form, having the form seen in *b*, *b'*, fig. 2, with the prongs nearly straight, unlike those of the ventral region and of the other parts of the body (*a*, fig. 2). It requires a glass of very good power to see this web well—a $\frac{1}{16}$ or Hartnack's 10 *à immersion*. It is most developed in the setæ of the sixth and seventh fascicles, and is to be made out, though very slight, in the setæ of the fourteenth fascicle, where the prongs have assumed the uncinate form characteristic of most Oligochætous crochet-bristles. A remarkable fact is, that in young (*i. e.* small) specimens of *T. rivulorum* the webbing of the bifurcation of these bristles is more obvious than in the older and larger individuals. This suggests the supposition that *T. umbellifer* represents a more primitive form, and that the rudimentary webbing of the setæ of *T. rivulorum* is a case of retention, in a rudimentary state, of ancestral characters which were formerly highly developed. When it is remarked, further, that such a form of seta is unknown except in marine Annelids, and that, as far as it appears, *T. umbellifer* is a *brackish-water* form, the rudimentary webbing in *T. rivulorum* becomes more important.

I have seen no trace of such webbing in the setæ of *Limnodrilus* (which is consequently thus further separated from *Tubifex*), nor in any other Oligochætous Annelid examined with care for this purpose.

Four or five very fine hairs, of six times the length of the setæ, are often to be seen, in small specimens of *Tubifex*, surrounding each seta near its apex; they apparently result from the splitting-up of the horny substance of the seta; and they occur in *Nais* as well. Small dark particles are placed at intervals along these fine hairs. These appearances are probably pathological, but are so common as sometimes to lead one to suppose them characteristic and normal.

4. *Enchytræus* and *Pachydrilus*.—In a garden-heap I have obtained specimens of the typical *Enchytræus vermicularis*; whilst from a pond at Hampstead, from a running stream, and from the Victoria Docks I have obtained worms which should be referred to *Enchytræus*, but possess blood coloured red by hæmoglobin. That from the Hampstead pond is marked with light-yellow bands externally, and is otherwise colourless. There does not seem to be sufficient ground for

the genus *Pachydrilus*, to which these forms with red blood would be referable.

5. *Endothelium of the Perivisceral Cavity.*—The perivisceral cavity of the Oligochæta is lined with a more or less complete cellular membrane, which is *directly continuous* with the coarse-grained yellow cellular layer covering the large vessels and alimentary canal. The continuity of this layer has been hitherto overlooked. The whole endothelium, whether the visceral or the parietal portion, casts off its cells into the perivisceral liquid, where they float. The large bladder-like cells seen in *Limnodrilus* surrounding the coils of the segmental organ, and figured by Claparède, are simply continuations of the general endothelium, and are to be seen in *Tubifex* also. The parietal endothelium is more complete in *Limnodrilus* than in *Tubifex*, and the cells are large and clear, branching and anastomosing with one another on the surface of the internal muscular layer of the body-wall. In one species, as before mentioned, they are pigmented. In *Tubifex* there are very few cells indeed of the parietal endothelium on the muscular surface; but they are densely lodged in four grooves running longitudinally and placed between the longitudinal bands of muscular tissue. In *Tubifex* the cellular elements of the muscular tissue, as well as the cells of the parietal and visceral endothelium, are shed into the perivisceral liquid. This also takes place in other Sænuridæ. In *Chætogaster* there is no parietal endothelium, and the septal muscular fibres are branched cells with nuclei. In *Nais*, cells similar to those of the so-called hepatic tunic of the intestine are to be seen fixed to the body-wall, representing the parietal endothelium.

6. *Generative Organs of* Tubifex.—M. Claparède gave a very fair account of the genitalia of several Oligochæta in his 'Recherches,' adding much to what M. d'Udekem had done. At the same time I have been led to differ very much from Claparède on some important points.

It is not correct to say that *Tubifex* is simply hermaphrodite. What occurs here appears to occur also in other Limicolæ, viz. that though both sets of organs are present, one sex or the other predominates: thus it is usual to find an excess of spermatozoa or an excess of ova. Some very instructive specimens have come under my observation, in which the organs in the ninth fasciculate segment, viz. the testes and receptaculum seminis, were entirely undeveloped and not even represented, whilst those in the tenth (viz. the ovary and male efferent apparatus) were of full adult size; many large ova, ripe for deposition, were present, and the male efferent canal, penis, &c., with its expanded trumpet-like orifice opening in the ninth segment, totally devoid of spermatozoa, though working its cilia actively. The fact that a male and a female organ in the ninth segment were aborted, and a male and a female organ normally developed in the tenth, shows that there is no "solidarity" between the female organs as such, but that their development or abortion is due simply to the greater or less nutrition of their particular segment. These specimens were females in the essential, male in the accessory organs of generation.

Dr. Fritz Ratzel has recently given reasons for regarding *Tubifex* as exhibiting a dimorphism of the ovaries, the ova being usually detached as they develope from the terminal portion of the ovary which hangs in the tenth fasciculate segment in close contact with the glandular dilatation of the male efferent duct, whilst in other specimens floating masses of large ova are found freely in the body-cavity. I have observed the fact seen by Ratzel, but do not think it requires his interpretation. *Tubifex* occurs in the Thames in the sexual condition in winter and summer. In the autumn large specimens devoid of genital organs are to be found. In specimens taken in the summer I have sometimes seen a very curious condition of the ovary, masses of large ova being detached instead of one much larger ovum alone. I think, from the appearance of the substance of the ova and the condition of the copulatory organs, that this is an abortive development, ending in the degeneration of the ovaries, both they and the testicular elements becoming, after a certain season of activity, absorbed in the perivisceral fluid. I have also found curious corpuscles, evidently aborted sperm-cells, in the perivisceral cavity of *Tubifex* in the autumn.

The structure and position of the testis appear not to have been fully made out by M. Claparède or by other writers; and this is true not only of *Tubifex*, but of the other Oligochæta. Leydig's figure of the young testis in *Phreoryctes Menckianus* (Max Schultze's Archiv, vol. i.) is the only one which agrees with what I have seen. I have already figured the developing testis in *Chætogaster* (Quart. Journ. of Micr. Science, 1869); those of the other Oligochæta do not much differ from it. By examining very young specimens of *Tubifex* or *Limnodrilus*, the real nature and origin of the sacculate masses of zoosperms seen in adults may be ascertained. The young *Tubifex* of a quarter of an inch in length presents in the ninth fasciculate segment a pair of pyriform protoplasmic masses, very small, hanging one on either side of the nerve-cord; an exactly similar pair is seen in the tenth segment: the former are the testes, the latter the ovaries. There is only one pair of testes, not two or three as supposed by Claparède, who, I imagine, did not examine the youngest specimens. In the minutest details of structure the ovary and testis are at this period identical, consisting of nuclei scattered in a common protoplasm. The testicular masses segment, forming groups of nucleated protoplasm, each nucleus of which gradually developes around it a demarcated area. The cells thus formed have the exact structure of the young ova. At this point their development diverges; for whilst the ova increase in size individually without proliferation, the young sperm-cells exhibit most active multiplication by division of their nuclei into two, three, and four, thus forming floating spherical or compressed aggregates of young sperm-cells. The further development of these I have carefully traced in several genera of Oligochæta. Several phases appear subsequently in the development of each mass of sperm-cells, which have not hitherto been described, and require illustration. At one period in the development of the sperm-masses (the protoplasmic masses which give rise at their periphery to sperm-cells) of *Limnodrilus* the whole mass has a tendency to fibrillate into zoosperms; and some of these masses assume elongated forms far thicker than normal zoosperms, and exhibit both protoplasmic contractile movements and the flickering motion of a cilium. This fact has a special interest in demonstrating the identity of ciliary and amœboid movement, of which Häckel has lately written (Biologische Studien, 1870). The innumerable spermatospheres which are thus developed from the original pair of testes fill the segment in which they are formed, and also dilate certain folds of the peritoneal membrane in connexion with the septa which separate the ninth from the adjacent segments; and thus a sheath is formed for these rapidly multiplying floating corpuscles. One thing is quite certain, that this sheath is not part of the original testis, and that at first the spermatospheres float freely in the perivisceral cavity, as I have figured them in *Chætogaster limnæi*. The sheath is in all probability only a part of the dissepiment between the ninth and tenth fasciculate segments; and it is pushed down, as described by Claparède, through several succeeding segments as the spermatic elements increase in number. This occurs equally in *Nais*. It also frequently happens that a similar sheath extends forwards, distended with spermatospheres detached from the pair of testes. It will be observed that this description differs from that of Claparède chiefly as to the position and character of the original testes. The large sacculate bodies in the earthworm have the same origin as the sheaths containing spermatospheres in the Sænuridæ and Naididæ. Hering pointed out that these sacculi were not true testes, in opposition to D'Udekem, whose view I supported in a paper on the earthworm because I did not find the bodies described as testes by Hering. I do not now feel sure what the bodies called testes by him may be; but I have found the true testes in *Lumbricus* placed as in *Tubifex*. In *Lumbricus* there are at least two pairs. The true testes are clearly figured in an immature *Phreoryctes* (a Lumbricoid) by Leydig.

The view advanced by D'Udekem, that the penis in *Tubifex* is invaginated in the oviduct, is supported by Claparède. There is really no evidence to support this view; and, as stated by both these authors, it is purely hypothetical, favoured chiefly by the fact that no true oviduct has been found. The ripe ova descend through the septa of several segments in a *Tubifex* rich in ova, and they thus recede to a very considerable distance from the male genital opening. Hence it is difficult to comprehend how this can act as the orifice for the escape of the ova. The manner of the deposition of the ova can only be decided by observation, which is very difficult in this matter.

The glandular organ attached to the pyriform part of the male efferent duct has been called a seminal vesicle by Claparède, though he admits that he has never seen zoosperms in it. It is really, in all probability, a gland destined to secrete a cement to aid in forming the spermatophores, which very remarkable bodies occur in all the Limicolæ apparently, but were unknown to Claparède, since he mistook them, where he did find them, for parasitic Opalinoid Infusoria, giving to them the name *Pachydermon*. I have previously given reasons for regarding Claparède's various species of *Pachydermon* as spermatophores (Quarterly Journal of Microscopical Science, 1870); but I have now watched their formation, and more carefully ascertained their structure, so that the matter is beyond doubt. Claparède found species of *Pachydermon* in two species of *Clitellio* and in *Limnodrilus*, and mentions one seen by D'Udekem in *Tubifex*. I have obtained these bodies in great abundance in *Tubifex* and in *Limnodrilus*, and also in *Nais*. They occur in the spermatic receptacles, and are eminently characteristic of the different genera and species. They are formed by the moulding of the spermatozoa with a cementing substance in the long necks of the spermatic reservoirs. A curious conical head is thus given to the spermatophore of *Tubifex rivulorum*, corresponding to the shape of the orifice of the reservoir. The spermatophore of *T. umbellifer* has not this head, but is pointed, tapering at either end.

The spermatophore of *Limnodrilus*, again, is of a different shape, broad and rounded at one extremity, tapering at the other; that of *Nais* is very long and thin, the spermatozoa being simply twisted into a rope. In those of the Sænuridæ there is an axial canal filled with granular matter, or sometimes with shrivelled epithelial cells; the spermatozoa are set spirally round this canal, imbedded in the firm and tough cement so that only their extremities project. These extremities in *Tubifex* I generally saw in active movement whilst still contained in the seminal pouch, so that they propelled the spermatophore in most elegant curves through the water when liberated into it when this contained two per cent. of sodium chloride. The spermatophores of *Tubifex rivulorum* were of all lengths; sometimes quite short, little longer than broad, at other times they appeared as long, snake-like bodies; sometimes they were incompletely cemented, and sometimes the cement alone appeared to have assumed the form without imbedding any spermatozoa. The spermatozoa themselves, when fully developed, are thread-like filaments, without any distinct head, or rather with an unusually long and thread-like head, distinguished from the much shorter and somewhat slenderer filament by no demarcation, but by its mobility: the short filament is continually moving, bending over on itself, so as to give the appearance of a knobbed extremity with any but the highest powers of the microscope, since it remains in this reflexed position when at rest. The cementing substance of the spermatophores is probably secreted, to a large extent, in both *Tubifex* and *Limnodrilus*, by the seminal vesicles of Claparède, and in *Clitellio*, where these are wanting, by the glandular portion of the vas deferens. But it is clear that the thick cellular wall of the spermatic reservoir itself also takes a part in forming the cement, from the manner in which ill-formed spermatophores are sometimes seen adhering to the sides of the sac. In *Nais*, moreover, the vas deferens is most minute, with no glandular appendage whatever; the simpler form of spermatophore found in this worm is cemented entirely by the secretion of the walls of the spermatic reservoir.

The great distention of the spermatic reservoirs when filled with these bodies has not been sufficiently dwelt on. Both in *Nais* and *Tubifex* they become greatly elongated, and extend through several segments of the worm; their development is greatest in *Nais*.

7. *Genital Organs of* Chætogaster *and* Nais.—I have had further opportunities of seeing the genitalia of *Chætogaster limnæi*. The consecutive manner in which the various organs of generation are developed in this worm is curious. Specimens

in which there are ova and spermatospheres exhibit no trace of the genital setæ; and, again, when these appear, no trace of spermatic reservoirs, which do appear later, is to be seen. I have to add to my former description, that the genital setæ are not "stumpy," as there stated, except when young; they ultimately assume the same proportions as those of *Nais* (Ann. & Mag. Nat. Hist. 1869, vol. iv.), but exhibit a very slight notching of the apex, a trace of bifurcation. The fascicles of common setæ near which they lie indicate a distinct segment, so that there are two superadded to the larval series between the cephalic and abdominal series. Some distance anteriorly to these setæ a pair of spermatic reservoirs or pouches are developed, which, as I surmised at the time of my description of the worm, had not had time to make their appearance in the specimens formerly examined. These spermatic pouches were *ciliated* internally. At the base of each fascicle of genital setæ a very delicate and short vas deferens opens, not longer than a seta itself, ciliated within, but without any expanded trumpet-like extremity. This I had not seen in specimens previously to this autumn, but, from analogy with *Nais*, supposed such a simple vas deferens to exist. The very gradual and bit-by-bit development of the genitalia in the Naididæ is remarkable, and likely to lead to misinterpretation; but when we find spermatic pouches containing spermatozoa, we may feel sure that copulation has taken place, and hence that development is complete. Consequently there is not the same doubt about *Nais* as about *Chætogaster*. In *Nais serpentina* a very large pair of spermatic pouches open at the fourth pair of fascicles; between these and the normal fifth pair are the genital setæ, with very short, simple ducts opening at their sides (the vasa deferentia). There is clearly no "entonnoir vibratile" to these ducts; they are not longer than one of the setæ, and are very finely ciliated; they are so delicate and transparent as to be imperceptible generally through the dense cellular layer of the clitellus. The ova in the Naididæ float freely in masses in the perivisceral cavity, with one ovum enormously larger than the rest. I have observed one ovum in *N. serpentina* occupying three whole segments of the perivisceral cavity.

The cuticle of the sexual *Chætogaster limnæi* is very finely striated vertically, as seen in optical section. It was not sufficiently figured in my paper on this form.

8. *Sources of discrepancy.*—It cannot be too strongly insisted on that observations made at different seasons on the same species of Oligochæta may lead to different results. The differences of some writers are thus explained. It is necessary to follow each of these worms *at all seasons of the year*, from its deposition as an ovum to its natural death after a full life-period.

9. *Homogeny of the Spermatic Pouches and Vasa Deferentia with Segmental Organs.*—In *Tubifex* I have observed that in the ninth segment no representative structure precedes the spermatic pouches. They commence as nearly spherical inversions of the integument after the testis has attained some size. The condition of the vasa deferentia in the Naididæ is important in connexion with relation to the segmental organ. Their extreme simplicity (in which they differ notably from the Sænuridæ) would never have suggested an homogeny with the segmental organ as it commonly occurs. The common form (in the ancestral unisegmental Chætopod) from which the excretory segmental organ, spermatic pouches, and vasa deferentia have equally been developed was probably very simple. This is indicated by the simple form of the segmental organs in Polychæta, and the simple form of the vasa deferentia in Naididæ, as also the simple form of the spermatic pouches in all. The excretory segmental organs and the vasa deferentia of Sænuridæ are more closely related; and probably the latter were differentiated from the former at a later period in the development of the group than that at which the spermatic pouches and the simple male ducts of *Nais* and *Chætogaster* were evolved. It is remarkable that, in the case where special genital segments are developed (the Naididæ), both the segmental organ and setæ of these segments are of a more primitive form than those of the common locomotive alimentary segments; whilst in Sænuridæ, where the genital segments are present from the earliest period, and perform the functions common to all the segments or somites, the setæ and the segmental organ of one of the genital segments have the usual character of locomotive and secretory organs.

XII.—*The Tertiary Shells of the Amazons Valley.* By Henry Woodward, F.G.S., F.Z.S., of the British Museum.

[Continued from p. 64.]

[Plate V.]

The following is a list of the specimens recorded by Mr. Conrad.

Gasteropoda.

1. *Isæa*, Conrad.
   I. Ortoni, Gabb, sp.
   I. lintea, Conrad.
2. *Liris*, Conrad.
   L. laqueata, Conrad.
3. *Ebora*, Conrad.
   E. crassilabra, Conrad.

3 *a.* (Subg.) *Nesis*, Conrad.
   N. bella, Conrad.

4. *Hemisinus*, Swainson.
   H. sulcatus, Conrad.
5. *Dyris*, Conrad.
   D. gracilis, Conrad.
6. *Neritina*, Lamarck.
   N. Ortoni, Conrad.
   N. pupa, Gabb.
7. *Bulimus*, Scopoli.
   B. linteus, Conrad.

Conchifera.

Fam. **Corbulidæ.**

1. *Pachydon*, Gabb.
   P. tenuis, Gabb.
   P. carinatus, Conrad.
   P. obliquus, Gabb.
   P. erectus, Conrad.
   P. cuneatus, Conrad.
   P. ovatus, Conrad.

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1. *Isæa*, Conrad, Amer. Journ. Conch. 1870, pl. 10. figs. 6, 10, 13.

In the series before us we have no representatives of this genus. The figures given in Mr. Conrad's plate are not worth reproducing, having evidently been drawn hurriedly and without sufficient care.

Mr. Conrad presumes this form to be a freshwater shell closely allied to *Tricula*, Benson, found in India.

2. *Liris*, Conrad, *op. cit.* pl. 10. fig. 3.

The figure indicates a shell about 2 lines in length. These two shells, Mr. Conrad considers, probably belong to the Melaniidæ.

3. *Ebora crassilabra*, Conrad, *op. cit.* pl. 10. fig. 14. Pl. V. figs. 1 *a*, *b*.

"Shell turbinate; columella much arched; peristome continuous, thickened; aperture notched at base." We venture to refer the specimen figured on our plate (figs. 1 *a*, *b*) to this species; but Mr. Conrad's figure is very obscure. We have three specimens, all of which are umbilicated and the mouth very much produced.

This little shell closely resembles *Lacuna*, a North-American genus inhabiting brackish water.

The one selected for our figure indicates the presence of another Gasteropod of the family Buccinidæ, or *Natica*, as evidenced by the perforation in its whorl. This is most important, as Mr. Conrad expresses his inability to decide whether *Ebora* be a marine or freshwater genus.

Length 4 lines, breadth 3 lines.

3 *a*. (Subgenus) *Nesis bella*, Conrad, *op. cit.* pl. 10. fig. 17. Pl. V. fig. 3.

"Last whorl ornamented with seven prominent revolving ribs, the intermediate spaces concave; spire consisting of four volutions, flat towards the apex, two ribs on each except the apical whorl and the next, which are smooth."

We do not possess a specimen of this shell; but its form, which is very characteristic, leaves little doubt that it is referable to the recent genus *Fossar*, near *Lacuna*, and to the family Littorinidæ.

4. *Hemisinus sulcatus*, Conrad, *op. cit.* pl. 10. fig. 2.

"An elegant species, closely allied to *H. tenellus*; but it has a longer last whorl and a narrower aperture." Mr. Conrad considers this shell "a decidedly freshwater genus, a genus living in South-American rivers."

5. *Dyris gracilis*, Conrad, *op. cit.* pl. 10. fig. 8.

Another extremely minute shell (about 3 lines in length). Mr. Conrad thinks the mouth similar to that of the genus *Melania*.

6. *Neritina Ortoni*, Conrad, *op. cit.* pl. 10. fig. 5.
Neritina pupa, Gabb, Amer. Journ. Conch. vol. iv. p. 197, pl. 16.
Pl. V. figs. 2 *a*, *b*.

I am inclined to regard these two species as probably synonymous. Having received more than 250 specimens, I think it possible to trace up all the variations between the young and aged specimens, so as to connect them together. The colour-markings are inconstant, and cannot be dealt with, save as indicating varieties; and the form of the shell varies with the age.

The *Neritinæ* occur both in fresh and brackish waters, two West-Indian species even inhabiting the sea.

7. *Bulimus linteus*, Conrad, *op. cit.* pl. 10. fig. 9.

An outline is given of this, the only land-shell in the collection. The author refers it to some subgenus of *Bulimus*, probably *Plectostylus*, Beck.

Odostomia? Pl. V. figs. 4 *a*, *b*.

I venture to think the little shell figured in our plate (fig. 4) is referable to this genus. *Odostomia* is sometimes found in brackish water. Fig. *a* is of the natural size; fig. *b* the same enlarged. I prefer, however, to await better specimens before describing it further.

CONCHIFERA.

Anodon, Cuvier.

Shell like *Unio*, but edentulous; oval, smooth, rather thin, compressed when young, becoming ventricose with age.

Anodon Batesii, sp. nov. Pl. V. fig. 10.

I beg permission to dedicate this very beautiful and unique Amazonian *Anodon* to my friend Henry Walter Bates, Secretary of the Royal Geographical Society, whose researches on the Amazons have added such vast stores, both of knowledge and specimens, to aid the natural-historian.

Shell highly nacreous, with a very thin external cellular layer, tumid; umbones minute, compressed, scarcely perceptible above the hinge-line; hinge-line straight, nearly two-thirds the entire length of the shell (hinge-line $1\frac{3}{4}$ inch long in the specimen figured); posterior border one third deeper than the anterior. Greatest length $2\frac{3}{4}$ inches, greatest depth $1\frac{3}{4}$ inch; depth of valve at narrowest side $1\frac{3}{4}$ inch, thickness 1 inch.

Mr. Conrad speaks of "fragments of a singular bivalve, probably allied to *Mülleria*, one of which is pearly as a *Unio*, and has a narrow elongated muscular impression, very different in size and outline from that of *Mülleria*." Possibly Mr. Conrad may have seen fragments of this *Anodon*.

We have compared *Anodon Batesii* with *A. politus* from Siam, and *A. Kellettii*, and with a new species from Bareilly, India. All these, however, are thicker in the umbones and much shorter along the hinge. The South-American Anodons are all very different in form from *A. Batesii*, so far as the means of comparison in the British Museum enable us to judge.

Fam. **Corbulidæ.**

Genus Pachydon, Gabb.

"The name *Pachydon*," writes Mr. Conrad, "is objectionable, in consequence of its derivation being the same as *Pachyodon*; and I have been requested to substitute another." He adds, "If naturalists object to Mr. Gabb's name, I would suggest *Anisothyris* (unequal valves) to take its place." The objection to *Pachydon* is too obvious to need any further delay in condemning it: we therefore beg leave to adopt for the genus the name *Anisothyris*, Conrad, in its place.

"The hinge of this genus is very similar to that of *Corbula*, much more so than to that of *Azara*; but the spiral beaks are in marked contrast to those of *Corbula*."

In comparing the shells of *Anisothyris* (*Pachydon*) with *Corbula*, *Azara*, *Neæra*, and *Cardilia*, &c., it is curious to observe that the recent species all have the umbones directed towards the posterior (siphonal) end; in the fossil species, on the contrary, the umbones look towards the anterior side. We find also that the cardinal tooth is in the left valve in the recent, and in the right valve in the fossil shell, and the socket *vice versâ*. It is difficult to suggest any recent shells suitable for comparison with the more extreme forms of the genus *Anisothyris* which occur fossil in this locality.

We can, however, compare the most prevalent type of the larger species (*P. tenuis*, Gabb) with *Azara labiata*, D'Orb., which it closely resembles in general form. It differs, however, as already stated, in the direction of the umbones, and in the recent shell being nearly equivalve, whereas the fossil form is very inequivalve; the cardinal tooth and socket are likewise reversed; furthermore the tooth in *Azara* is hollowed out to receive a ligament, and is less strong and less curved than in the fossil. The pallial border is entire, and the muscular impressions agree with those of *Azara*.

Anisothyris tenuis, Gabb, *op. cit.* pl. 10. fig. 1.

This is the most abundant form of the larger kinds of this genus. To call it *tenuis*, however, is as unnatural as to spell *odon* with one *o*: the shell is essentially thick, both in substance and in ventricosity. It goes through several well-marked varieties, however; and, as our series comprises more than one hundred specimens, I may perhaps be allowed to re-christen it. In doing so I desire to perform an act of justice towards Mr. Hauxwell, who, I am assured by Mr. Bates, is a most deserving and indefatigable naturalist and collector, and from whose labours much good has already resulted to science and more may be anticipated. I propose to rename this species

Anisothyris Hauxwelli, sp. nov.
Pl. V. figs. 7 *a*, *b*, *c*, *d*.

Syn. *Pachydon tenuis*, Gabb & Conrad, *op. cit.*

"Subtriangular, very oblique; shell-substance thick in adult specimens; right valve profoundly ventricose; umbonal slope slightly angular, nearly terminal; posterior extremity truncated; cardinal tooth broad and thick, erect, curved, with an angular margin; this tooth is overlapped in front by a carinated and sulcated projection; lunular depression profound, very large, and broad."

I propose to adopt the following varieties of *A. Hauxwelli*, represented by good series of well-marked forms, viz.

Var. *α. distorta*. Var. *β. crassa*.

In variety *α* I have placed a large series of highly distorted specimens which may owe their singular form to having suffered by the periodic changes from extreme fresh water to extreme salt water, due to their estuarine habitat.

In variety *β* I place all the forms in which the extreme thickening of the shell renders their contour very dissimilar to the normal type. Such varieties as these, if met with in older deposits, would without doubt be treated as of specific value.

Anisothyris (*Pachydon*) *ovata*, Conrad, *op. cit.* pl. 10. fig. 4.

I look upon this species as probably founded on the young state of *A. Hauxwelli*, with which it very well agrees, save that it is said to be *white*: this, however, may be the result of bleaching.

Anisothyris carinata, Conrad, *op. cit.* pl. 10. fig. 7. Pl. V. fig. 6.

"Shell triangular, very inequivalve; right valve profoundly ventricose, but flattened on the disk; posterior slope flattened, having an indistinct ridge in the middle, and forming nearly a right angle with the umbonal slope, which is slightly carinated; posterior extremity acutely angular; left valve prominently angular on the umbonal slope, concave anterior to it, and depressed on the posterior slope, with a fine raised line in the middle of the slope; posterior ventral margin nearly rectilinear. This shell is covered with a very thin, pale, shining epidermis, and varies greatly from the typical species."

I have nearly a hundred specimens of this species, which appears to be most characteristic. The only form at all approaching it is the *P. obliquus* of Gabb, which, in some of its extreme varieties, assumes the angular form of *carinata*.

Anisothyris (*Pachydon*) *obliqua*, Gabb, *op. cit.*; Conrad, *op. cit.* pl. 10. fig. 15. Pl. V. figs. 5 *a*, *b*.

We possess a remarkably fine series of this species, numbering 830 specimens.

Shell very inequivalve; the valves extremely oblique, the posterior angle being drawn out, and the anterior compressed; so that the longest axis of the valves is from the umbones to the ventral margin, instead of from the posterior to the anterior side. The umbones are highly spiral, some examples ending in a perfectly free convolution; on the other hand, we have been able, from this large series, to pick out examples in which the spiral umbones are altogether suppressed.

In form this species closely resembles the recent genus *Cardilia*; but this shell is costated, whereas the valves of the fossil form are smooth. *Cardilia*, moreover, has a broad plate inside on the dorsal margin of the left valve; and the umbones are reversed, as in all the other species of this remarkable fossil group.

The specimens are very uniform in size, being, when adult, about $\frac{3}{4}$ inch in longest measurement, and 5 lines from the dorsal margin to the anterior side.

Anisothyris erecta, Conrad, *op. cit.* pl. 10. fig. 16.
Pl. V. figs. 9 *a*, *b*.

Triangular; both valves ventricose, not oblique; anterior end oblique, truncated; posterior side produced, cuneiform, flexuous, extremity angular; ventral margin rounded; summits very prominent; cardinal tooth comparatively small.

Mr. Conrad had "only one specimen of this graceful species, the largest of the genus known." "The valves are much less unequal than in the preceding species, and the erect beaks give it a very different contour from the others. The character *oblique* should," he thinks, "be omitted from the generic diagnosis."

Mr. Conrad makes a note at the end of the separate copy of his paper (obligingly lent me by Mr. Bates), with an outline of what he evidently considers a new form and has named in MS. *P. altus*. We fail, however, to see the difference between it and *P. erectus*, save that *P. altus* is the aged or mature shell, and the other the young or stunted condition. The name *Anisothyris* (*Pachydon*) *erecta* must be retained and include both.

This is a somewhat rare form: there are eighteen specimens, two only of which attain a considerable size, measuring 2 inches broad and $1\frac{3}{4}$ inch deep, and having a thickness of $1\frac{3}{4}$ inch; the rest are about $1\frac{1}{2}$ inch broad, $1\frac{1}{4}$ inch deep, and 1 inch in thickness.

Anisothyris cuneata, Conrad, *op. cit.* pl. 10. fig. 12.
Pl. V. figs. 8 *a*, *b*.

Triangular, oblique, ventricose, solid, subequivalve; beaks terminal, summit very prominent and oblique; anterior end abrupt; posterior end subtruncated; disk somewhat flattened mesially; umbonal slope rounded, undefined, nearly marginal; ventral margin nearly straight posteriorly; cardinal tooth oblique.

This is a well-marked species and readily separated. We have about fifty specimens before us, and, save in the difference due to age, the characteristic trigonal form is maintained in all.

If we venture to assert any thing positively respecting the nature of the habitat of these shells in their living state, it seems certain that the genus, represented by half a dozen species and nearly a thousand specimens, must decide the point.

In its living analogue, the genus *Azara* or *Potamomya*, Sby., we have just the evidence we need to argue upon.

"*Azara labiata*," says Darwin, "lives buried in the mud of the Rio de la Plata, *but not above* Buenos Ayres, and consequently in water which is little influenced by the superficial ebb of the river. . . . The same species is found widely dispersed in banks (*fossil*) over the Pampas near S. Pedro and many other places in the Argentine Republic nearly one hundred English feet *above* the Rio Parana."*

Here, then, we have the most complete analogous conditions established between the Pampas formation and the Amazonian shell-clay. In both, the shells have died, *as they lived*, in banks by hundreds and thousands, *all with their valves united in pairs and closed.*

Can any one doubt for a moment that which Mr. Hauxwell's discovery clearly proves—namely, that the estuary of the Amazons was once in long. 72° west, lat. 3° south, or more than 2000 miles above its present position? Indeed, as Sir Charles Lyell has well observed, there is nothing new in these phenomena; they are but "the natural result of the oscillations in the level of the land, extending over large continental areas, by which the fall of rivers is lessened at certain periods, giving rise to accumulations of matter more or less lacustrine, while subsequently, when a movement in the opposite direction takes place, the rivers cut through their old deposits, re-excavating the valleys and often eroding them below their original depth"†.

I cannot close this notice without adding that my best thanks are due to Dr. Baird for assisting me in the determination of these curious and interesting shells.

P.S. Since the foregoing was written, I have received from Mr. Robert Damon, of Weymouth, a second series of Amazonian Tertiary shells, forwarded to him by Prof. Orton; they, however, contain no new forms in addition to the series sent home to Mr. Janson by Mr. Hauxwell himself, save two species of the genus *Isæa*, namely *Isæa* (*Mesalia*) *Ortoni*, Gabb, and *Isæa tricarinata*, Conrad. Prof. Orton thinks that *Isæa tricarinata* is possibly the young of *Isæa Ortoni*; we do not, however, see any evidence of carinæ on the whorls of the latter. It is highly probable that there are two species placed together under *I. Ortoni*—one in which the spire is short and the

* Geological Observations on Coral Reefs, &c. vol. ii. chap. i. pp. 2 & 78.
† 'Principles,' chap. xix. p. 468.

whorls tumid, the other with a long and slender spire and with the whorls somewhat compressed.—H. W.

EXPLANATION OF PLATE V.

Figs. 1 *a, b.* *Ebora crassilabra*, Conrad, enlarged to twice and a half. In fig. 1 *a* is seen a circular hole made by a *Natica* or *Buccinum*.
Figs. 2 *a, b.* *Neritina Ortoni*, Conrad.
Fig. 3. *Nesis bella*, Conrad, enlarged.
Figs. 4 *a, b.* *Odostomia* ?, Fleming: fig. *a*, natural size; fig. *b*, enlarged.
Figs. 5 *a, b.* *Anisothyris obliqua*, Conrad: fig. *a*, anterior side; fig. *b*, left side. Natural size.
Fig. 6. *Anisothyris carinata*, Conrad, left side. Natural size.
Figs. 7 *a–d.* *Anisothyris Hauxwelli*, H. Woodw.: fig. *a*, left side, with valves united; fig. *b*, view of interior of left valve; fig. *c*, view of interior of right valve; fig. *d*, valves united, ventral margin, natural size.
Fig. 8 *a.* *Anisothyris cuneata*, Conrad, anterior side, valves united, natural size; fig. 8 *b*, right side.
Fig. 9 *a.* *Anisothyris erecta*, Conrad, anterior side, valves united; fig. 9 *b*, left side, natural size.
Fig. 10. *Anodon Batesii*, H. Woodw., left side, natural size.

XIII.—*On* Agulhasia Davidsonii, *a new Palliobranchiate Genus and Species.* By WILLIAM KING, Sc.D., Professor of Mineralogy and Geology in Queen's College, Galway.

[Plate XI. figs. 1–8.]

MY friend Mr. Thomas Davidson, F.R.S. &c., has kindly placed in my hands two specimens of an undescribed shell (see Pl. XI. figs. 1–7) possessing some unusual characters; and as he wishes me to describe it, I most willingly undertake what is to me a pleasing duty.

After some consideration I have come to the conclusion that the shell must be regarded not only as a new species, but as typical of a new genus; and as such I am, for the present, disposed to place it in the family Terebratulidæ*.

Genus AGULHASIA, mihi.

Diagnosis.—Areigerous. *Beak* pointed. *Deltidium* closed by a plate fixed to the inner surface of the area. *Foramen* at the cardinal termination of the deltidium. *Loop* short, slightly

* I have elsewhere (Proc. Dublin University Zool. & Bot. Assoc. 1859, vol. i. pp. 517, 518) restricted the family Terebratulidæ to genera with a small loop &c., as in *Terebratula vitrea*; and have included those with a long loop and some other differential characters in a distinct family, which I have named Waldheimiidæ, after the typical genus.

reflexed, and attached to the hinge by two crura. *Shell-substance* penetrated by branching tubuli.

This genus is singularly interesting in being the only one of the Terebratulidæ, and, with few exceptions, the only one among the Ancylobrachs*, that has the beak pointed, and its point non-foraminate. In these respects, however, it resembles the Helictobrachiate genera *Rhynchonella*, *Spirifer*, &c. With the latter it agrees in having a subapical foramen; but it is distinguished from them by the absence of an external plate (divided, or undivided) closing the deltidium. It is true this opening is closed by an internal plate: I consider the latter part, however, to be the homologue of the internal arch, attached to the inner surface of the area, common in Spiriferids, as pointed out in my "Monograph of *Syringothyris cuspidatus*"†. No Ancylobrach, as far as is known to me, possesses any such appendage. A further agreement between *Agulhasia* and many Spiriferids offers itself in the foramen being situated at the cardinal termination of the deltidium. In possessing an area the new genus resembles *Trigonosemus*, *Ismenia*, *Fissurostra*, and some other Ancylobrachs; but in these genera the foramen is situated at the apex of the beak, and the deltidium is usually closed by the ordinary *external* plate.

Histologically, *Agulhasia* departs from most of the Terebratulidæ in having the singular branching tubulation which, as I have elsewhere made known, characterizes *Terebratulina caput-serpentis*‡.

From the difficulty in examining the microscopic shell-structure of Mr. Davidson's specimens without breaking them, I am unable to say that the tubuli are so numerously and strikingly subdivided as those of the species in which they first occurred to me, though there is some appearance of a close approximation to it.

* I am unacquainted with any other Ancylobrach, except the genus *Stringocephalus*, that has not the beak truncated by a foramen.

† See Ann. & Mag. Nat. Hist. July 1868.

‡ See "Histology of the Test of the Class Palliobranchiata," in Transactions of the Royal Irish Academy, vol. xxiv. part xi. 1869. Fig. 8, Pl. XI., is a copy of a figure in this memoir, representing the branching tubuli of *Terebratulina caput-serpentis*. Their agreement in histological structure suggests a genetic relation between *Agulhasia* and *Terebratulina*; but the areal and apophysial features respectively characterizing these genera do not seem to lend much favour to this view. I have some grounds, however, for suspecting that, different as they are, there is a closer relation between them than would at first sight be admitted. My investigations with reference to this question are not yet completed; so at present I can do no more than merely give expression to a suspicion, which may or may not be hereafter confirmed.

Type species, *Agulhasia Davidsonii**, mihi.

Diagnosis.—Inequivalve: *large valve* incurved behind, flatly convex, with sharply turned-down sides, and an ill-defined broad shallow mesial depression; *small valve* slightly and evenly convex; *both valves* finely and numerously ribbed, with their margins strongly crenulated; *marginal outline* wedge-shaped, rather square anteally, and acutely pointed posteally; *beak* produced, solid, and well incurved at its point; *area* in the form of an acute isosceles triangle, somewhat convex and well defined; *deltidium* long and narrow—closed, except at the cardinal termination, by the internal plate; *foramen* incomplete and notch-like; *loop* attached by two crura originating close to the teeth, and projecting about one-third of the length of its supporting valve, strongly arched at the front or reflexed portion, and furnished with rather long crural spurs; *muscular impressions* large and strongly marked; *cardinal muscular fulcrum* large, with a central prominence rising out of a deepish cavity; *teeth* massive. *Colour* white.

Agulhasia Davidsonii, in its wedge-shaped outline and ribbing, strikingly resembles young specimens of *Rhynchonella* ——; but the latter shell is without an area. There are about twenty ribs on each valve, which become obsolete at the sides. Mr. Davidson's specimens are quite small (Pl. XI. fig. 1), the largest measuring $\frac{2}{8}$ of an inch in length, $\frac{1}{5}$ in width, and $\frac{1}{16}$ in depth: the thickness of their valves, especially in the umbonal region, and the excavated appearance of the muscular scars, are points strongly favouring the view that, small as they are, they represent a species in an advanced stage of growth. The umbonal cavity is nearly filled up with shell-substance.

The long narrow form of the deltidium (Pl. XI. fig. 7 *b*) causes the area (fig. 7 *a*) to appear as if divided longitudinally by a linear groove; which part is at once striking and unique. The foramen (fig. 7 *c*), which appears like a notch in the centre of the cardinal edge of the large valve, is made entire by the juxtaposition of the cardinal edge of the small valve (fig. 2). The area is well defined laterally by each of the sutures (fig. 7 *e*) which separate it from the inflexed sides (fig. 7 *d*) of the beak.

The loop (figs. 5 and 6) agrees very closely in form and relative size with that of *Terabratula vitrea*; perhaps its crural spurs are more produced.

The tubuli appear to run in rows, and to be most numerous

* I have much pleasure in dedicating this species to my esteemed colleague Mr. T. Davidson, with whom I have been in a measure more or less associated for a great number of years in elucidating a group of shells the favourite of us both.

in the ribs, from which they branch off laterally towards the furrows.

Mr. Davidson's specimens were taken in from 45 to 50 fathoms water, on the Agulhas Bank, south coast of Africa. The locality has suggested to me the generic name which has been given to the species.

EXPLANATION OF PLATE XI.

Fig. 1. Natural-sized outline of *Agulhasia Davidsonii.*
Fig. 2. Same species, dorsal view, showing position of the foramen.
Fig. 3. Same species, ventral view.
Fig. 4. Same species, lateral view.
Fig. 5. Same species, interior of dorsal valve, showing loop, teeth, and cardinal muscular fulcrum.
Fig. 6. Same species, profile view of the loop.
Fig. 7. Same species; view of the interior of ventral valve and of the upper aspect of the beak, the latter showing the area (*a*), deltidium (*b*), foramen (*c*), inflexed sides of the beak (*d*), and one of the sutures bounding the area (*e*).
Fig. 8. Represents tubuli characteristic of *Terebratulina caput-serpentis.*

I am very much indebted to Mr. Davidson for finishing off my rough sketches of the above figures.

XIV.—*On Fossil Sponge-spicules of the Greensand compared with those of existing Species.* By H. J. Carter, F.R.S. &c.

[Plates VII.-X.]

The material which furnished the fossil sponge-spicules from which all the figures, except three, in the accompanying four plates were taken, was found by my kind and intelligent friend Mr. W. Vicary, of Exeter, in the "Upper Greensand" of Haldon Hill, near Exeter, and of Black Down, near Cullompton, respectively,—the former portion in a stratum of greenish-brown, loose, fine sand, about 25 feet thick, and the latter in a rounded pebble of the same nature, more consolidated.

They were brought to my notice by Mr. Vicary and my friend Mr. Parfitt, also of Exeter, who read a valuable paper on them at the meeting of the "Devonshire Association for the advancement of Science, Literature, and Art," in July last, which was subsequently printed in their 'Transactions' for 1870.

The frequently loose state of the whole material, in which the spicules are sometimes almost as numerous as the grains of sand among which they are imbedded, together with their large size, render their extraction with a simple but powerful lens and a hair-pencil a work of time rather than one of difficulty.

Mr. Vicary and myself have thus taken out several hundred, from which I have selected seventy-six out of the seventy-nine illustrations in the plates. These, however, must not be viewed as rare specimens, but rather as the more perfect ones of myriads of the same kind in the deposit, which are all more or less fractured, worn away by attrition, or otherwise altered by petrifaction.

When we consider that they are imbedded in quartz-sand, and that therefore they must be the spicular remains of dead and disintegrated sponges which, for some time previously, had been drifting about at the bottom of the sea with the material in which they are now found, we cannot wonder that, under such circumstances, they should be chiefly the larger spicules of the sponges to which they respectively belonged, and that they should be more or less fragmental, and more or less altered in shape by the trituration to which they have been exposed—also that there should be almost an entire absence among them of the delicate and more minute spicular forms which in addition characterize most sponges.

Nor should we wonder that the solvent influences which have been affecting them for ages during and since their transformation into chalcedony (for such is their present state) have involved a certain amount of change in their form as well as in their composition. Thus we find that their canals are frequently distorted and enlarged, that they are more or less filled with glauconite or brown oxide of iron, &c., or that they are altogether obliterated, while their surfaces partake of the botryoidal character, in miniature, of the mineral (chalcedony) into which they have been transformed.

Still, uneven as their surface now is, and great as is the alteration in other respects which they have thus undergone, the greatest wonder of all is, how such delicate little objects could survive the changing hand of time so long as to be presented to us now, after an interval almost too oppressive in extent to be conceived, in forms so unmistakable and so easily obtained that they almost fall out of themselves from the sand in which they are imbedded as distinctly and as separately as if the deposit had been but of yesterday's formation.

No less remarkable is the fact that, while the grains of quartz-sand still retain their angles and smooth surfaces, the surfaces of the spicules and those of every other organic particle amongst them present the dimpled or tubercled form of chalcedony. Hence it becomes easy to determine at once what has not been organized, from the beginning, however small the particle may be. In short, the quartz-sand has yielded less to the chalcedonizing influence than the organic remains.

True enough as this is, still the characteristic form of the chalcedonic crystallization is so minute that it is often very difficult to determine whether that which we are looking at through the microscope is dimpled or mammillated, seeing that the circles or little monticules which represent this are seldom more than 1-3000th of an inch in diameter. Frequently the botryoidal surface is distinct; as frequently also the little mammilliform projections are surrounded by rings; and not unfrequently there appears to be a dimple in the centre. But such differences are of little moment if we remember that the surface of these spicules, originally as smooth as glass, is now rendered more or less uneven by the forms of crystallization presented by chalcedony, and that this character distinctly marks the difference between the organic and inorganic particles of which the deposit is composed. With this exception, the spicules are but "pseudomorphs," to use a mineralogical term, of what they were in the living animal, where they were produced.

Nor should we forget the effect of the "solvent influence" to which I have alluded, seeing that this also may have acted at one time in one and at another in another way during the transformation of the atomic constitution of the spicule, thus, under certain circumstances, eroding the surface which received an additional chalcedonic layer under others,—and hence, as regards erosion, the "reticulated" aspect noticed by Mr. Parfitt in his excellent paper (*l. c.*), which on the surface of some of the spicules is so marked as to indicate that in this way many may have altogether disappeared. This, too, may partly account for the apparently entire absence, above stated, of the minuter and more delicate spicules which existing species, almost identical with the fossil ones, as will be hereafter seen, show us must have been present in the sponges to which they originally and respectively belonged.

Be this as it may, the coarser features alone of the spicules remain; and so far altered is their original smooth surface by erosion or the presence of the botryoidal form of chalcedony, that not only is there an absence of the minuter and delicate spicules, but also of all the minute spines, tubercles, and other markings which, in many instances, more or less cover and characterize the large spicules of existing species, and thus may be inferred to have equally covered and characterized many of the fossil ones.

As above stated, out of the seventy-nine illustrations there are three only, viz. figs. 7, 8, and 9, which are not representative of the spicules in the greensand; and these have been copied from Schmidt and Du Bocage respectively, not less to illustrate the general plan on which I shall endeavour to show that many of the spicules have been developed, than to identify some of them with existing species.

All the figures have been drawn on the same scale, viz. 1-24th to 1-1800th of an inch, whereby their relative sizes respectively can be at once seen, their real sizes computed by compass and rule, and the introduction of measurements avoided.

Some of the figures appear very large; but when it is remembered that others would have been inconveniently small if the whole had been proportionally more reduced in size, this will be fully explained. At the same time it should be remembered that, as all are sufficiently large to be extracted with the aid of a simple but powerful lens, and therefore that there are hardly any spicules present so small as to require the microscope for detection, it is evident that nothing but coarse and large spicules exist in this deposit, that if there were originally minuter forms in it there is nothing now left to show that this was the case, and, therefore, that the great bulk of the sea-shore Spongiadæ, in which all the spicules are too small to be seen individually with a quarter-inch lens, have no representatives in this deposit.

Of the deep-sea sponges, such as *Hyalonema*, *Holtenia*, *Pheronema*, *Askonema*, *Corbitella*, Gray (?), &c., there is, of course, no representative; their delicate spicules slightly held together by equally delicate sarcode, and their habitat in the deep valleys of the ocean, almost entirely preclude the possibility of their spicules ever reaching such tidal currents as could drift together the gritty materials of the Haldon deposit.

Not so, however, with the Coralliospongiæ of Dr. Gray, and the Euplectellidæ, whose spicules are supported by a rigid structure of keratose fibre *silicified*. The habitat of the latter, at the Philippine Islands, in from ten to twenty-four fathoms (Bowerbank, Proc. Zool. Soc. London, 1869, p. 344), and that of most of those in the Gulf of Florida &c., forwarded by M. de Pourtales to Dr. Schmidt for examination, in minimum depths of from 90 to 152 fathoms (Grundzüge einer Spong. Faun. des atlantisch. Gebietes, 1870) show that these might have representatives in such deposits; and thus we find that, in the spiculiferous sand of Haldon Hill and Black Down, nearly half the organic remains consist of spicules and fragments of the silicified fibre of the Coralliospongiæ. The rest, chiefly belong to that group of sponges for which I have proposed the term "Pachytragiæ" (Annals, vol. vii. Jan. 1871), viz. the Geodidæ, *Stelletta*, *Dercitus*, &c., but not the Tethyadæ proper, of which *T. cranium* is the type, since the spicules of these sponges, with the exception, perhaps, of the large acerate one, whose form is too common to be of any value specifically, are far too delicate to survive the amount of trituration through which the coarser forms of the spicules of the other Pachytragiæ might pass, as we see in this deposit, for the most part, unaltered.

Nor have we met with any *stellates* (spicules), especially the larger ones of *Tethya lyncurium* and its like, better named by Dr. Gray "*Donatia*," to separate it from the true Tethyadæ, of which *T. cranium* is the type, although the little globular crystalloids (spicules), or little "siliceous balls," as they have been termed, which characterize the crust &c. of the Geodidæ, are extremely abundant.

If, then, there are none of these stellates present, which, in some species of *Donatia*, are equal in size to the larger globular crystalloids of the Geodidæ, we can hardly wonder at the entire absence of the minuter stellates of the Pachytragiæ generally, or of any other spicules so minute that a quarter-inch compound power is required to make them visible.

Whether *Donatia* (*Tethya lyncurium*) and its like existed at this period may be another question which the limited examination of the Haldon sand made by Messrs. Vicary, Parfitt, and myself is in no way sufficient to answer; for it may be assumed that, in a stratum 25 feet thick which is almost entirely composed of grains of sand and the spicular remains of various sponges, almost any amount of examination, most especially ours, must indeed be "limited."

Again, it is evident that there were sponges like the Esperiadæ (Gray) present, if bihamate spicules be allowed to determine this; for here, also, the other spicular element of these sponges, viz. the anchorates, are so much smaller, for the most part, than the bihamates in the existing species, that the anchorates, like the stellates of the Pachytragiæ, may have disappeared, either by the triturative effect of the sand at the time of deposit, or by the solvent effect of the fluids which have since percolated through it.

Lastly, it is possible that, in solid masses of flint, such minute spicules may be found to be most perfectly preserved, and in some parts representatives of the deep-sea sponges may be found entire; but neither appear, elementarily or entire, in the sandy grit of Haldon Hill or Black Down, so far as our observation has extended, nor, for the reasons above stated, is it likely that one ever so extended would be more successful.

Still there are a great number of forms in the Haldon sand which have living representatives, and probably a great many which have none. Let us, then, first see generally how far we are borne out in this conclusion by reference to those which I have delineated.

It will be observed, as before stated, that they are for the most part all large—that is, the largest spicules of the species to which they belonged; and therefore, if we compare them with living species, it must be with the larger spicules of these species.

There is no question, then, as to whether we shall take our characters from the large spicules of the latter for this purpose in preference to the small or minute ones—for, as before stated, most sponges contain two sizes (that is, the large and the minute—those which can be seen for the most part by the unaided eye or a low magnifying-power, and those which require the aid of a very high microscopic one)—since, as also before stated, the latter appear to be entirely unrepresented among these fossil spicules.

Our characters, then, among the fossil spicules (for it should be remembered that we have no *entire* sponges here) must, in common with their living allies, be taken from the largest spicules generally; and such we shall observe to be chiefly confined, in the latter, to the periphery, where their shafts are provided with heads which meet together externally, and thus form a shield-like surface to the sponge.

These heads, like the heads of so many nails, present forms which are peculiar to the species, and are developed inversely to the shafts; that is to say, the more expanded the head the shorter the shaft, and *vice versâ*. (The position of the shaft, branch, or arm where broken off is always indicated in the figures by a little circle, which is the axial canal, within a larger circle, which is the circumference of the spicule.) Hence, the shaft only differing in length or size, we must look to the head for the character; and here we shall at once see that, whether we take the simple trifid or ternate one in fig. 36 &c. Pl. IX. (existing species, *Geodia*), or the hexternate one fig. 30 (that is, the dichotomous division of the trifid or ternate head, ex. sp. *Stelletta*), or once more divided (dodecaternate, as in *Dactylocalyx Bowerbankii*, Brit. Spong. fig. 53), or still more divided (polyternate, as in fig. 1—ex. sp. *Dactylocalyx McAndrewii*, Bk., *McAndrewia azorica*, Gray, Proc. Zool. Soc. Lond. 1869, pl. v. fig. 3), or where the divisions are more or less united into a disk, figs. 3, 4, 5 (ex. sp. *Dactylocalyx polydiscus*, Bk., Proc. *cit.* 1869, pl. vi. figs. 10 &c.), we observe from Schmidt's and Du Bocage's figures of *D. polydiscus*, respectively copied into our Plate VII. figs. 7, 8, and 9, which are confirmed by Dr. Bowerbank's fig. 102 (Brit. Spong.), and my own actual observation of the spicula, that there are three canals in the centre diverging from a common one, which proves that, from the simplest trifid or ternate head to the most elaborately divided one, all begin with a trifid or ternate development—in short, that all are some multiple of three, and therefore that in it we have a distinct trifid or ternate system from the beginning for the grouping of the large spicules with which we are now concerned, which character is the most practicable, at least for our purpose.

In this view I have been alike anticipated by Dr. Bowerbank (1858) and Mr. Parfitt (*l. c.* 1870) independently, the former of whom, in 1869, writing on the "siliceo-fibrous" sponges, observes:—"The apices of the connecting spicules are exceedingly various in their form; but they are all modifications of a triradiate one, even the peltate forms" (Proc. *cit.* p. 73). I prefer much the term "ternate" or "trifid" to "triradiate," because the former apply to the branching of a stem (the axial canal), and the latter to a branching or radiation from a point, since this avoids a confusing of the tri- or quadriradiate spicules of the Calcispongiæ in particular with the trifid or ternate division of those of the Coralliospongiæ and Pachytragiæ; and as we are most familiar with the term "ternate," I shall henceforth use this with its necessary prefixes—a grammatical violation, it is true, but one, perhaps, which the desirableness of using short instead of long cumbrous terms may sanction.

From the ternate system of the peripheral spicules let us go to the silicified fibre of the interior; and here we have all the figures from 10 to 29 inclusively illustrating this structure, many of them, no doubt, somewhat worn by trituration at the time of their deposit, but otherwise the irregular knot-branching of the Dactylocalycidæ, and the more rectangular hexradiate one of the Euplectellidæ, together with the canalated fibre of *Farrea occa* (Bk. Proc. *cit.* 1869, pl. xxiv. fig. 1), all find their representatives respectively in these figures, many of which, also, are almost facsimiles of Schmidt's figures of *Lyidium torquila*, obtained by M. de Pourtales in 270 fathoms, off the island of Cuba (Atlantisch. Spong. Fauna, p. 84).

We now leave the Coralliospongiæ and go to the heads of the first and second divisions of the ternate system, for which group I have proposed the name of "Pachytragiæ" (*l. c.*); and here we revert to the condition of the deep-sea sponges, so far as the absence of silicified fibre is concerned; but instead of the, for the most part, soft, silky nature of their spicular structure, we have the short, rigid, ternately developed spicules of the Pachytragiæ, which grow and develope themselves, in many instances, on the shore-rocks, where they are exposed to the beating of the most tempestuous seas. Hence we shall not be surprised to find representatives of these in the Haldon deposit.

They will be found in Plates IX. and X. figs. 32–37 and 59–74 respectively.

Some of the hexternate heads, as figs. 30, 31, and 33, might either have belonged to Schmidt's Ancorinidæ, in which are included *Stelletta* &c. (Atlant. Spong. Faun.), or to the periphery of the Dactylocalycidæ (see Dr. Bowerbank's figures of *D. Masoni* and *D. Bowerbankii*, 2, 3, and 6 respectively, Proc. *cit.* 1869, pl. vi.); for they all have such hexternate heads for their periphery, although those of the Dactylocalycidæ appear to be the thickest and to have the stoutest shafts, which, in the fossil species are, for the most part, unfortunately broken off.

Where, however, the heads have not been so expanded, although still irregularly hexternate (as in Pl. X.), the shafts have consequently become more developed, and therefore have partly remained, thus giving us facsimiles of the spicules which characterize the Pachytragiæ generally,—that is to say, Schmidt's Ancorinidæ and Geodidinæ (Atlant. Spong. Faun.).

The figures 37–39 and 72–74 inclusively all appertain to a quadrifid or quaternate system, which, whether belonging to the Coralliospongiæ or to the Pachytragiæ, only find their parallel now, so far as I am aware, in *Hyalonema* (*Carteria*, Gray), where the minute feathered spicules have the like heads in miniature—some of the large ones with more extended arms also—and all the long large ones a crucial branching of the axial canal, with more or less inflation in the centre.

In *Askonema setubalense*, Kent, a similar condition exists; but here the minute spicules are hexradiate, and the large long ones present a hexradiate cross, with more or less central inflation. It is almost impossible to see all six arms of the cross at the same time in the long spicules; but the *quadrilobate* form of the inflation in many, if not most, is satisfactory evidence of this condition when the cross is not otherwise visible.

Returning to the Pachytragiæ, we find that the ternate spicules of the circumference, in the absence of silicified fibre for support, are accompanied by strong acerate, fusiform, smooth, and, generally, slightly curved spicules, which not only abound in the interior, crossing each other in all directions to form the skeleton, but frequently project somewhat beyond the surface in connexion with the peripheral spicules—also that this form is often accompanied by strong acuate spicules of the same kind, in which one half of the spicule seems to be more or less shortened in proportion to its thickness and the inflation of its rounded extremity.

Such spicules are represented in figs. 76 and 77 respectively; and as they greatly exceed in number all other large sorts in the existing Pachytragiæ (being *the* spicule of the mass), so they abound in a fossil state in this deposit, both entire and fragmentary, of various sizes, from 1-5th of an inch downwards, with proportional thickness.

As in no instances are such large stout spicules of this kind to be found in any species but the Pachytragiæ, so, for the most part, the whole of the fossil ones must be inferred to have come from sponges of this group. With one exception, however, viz. *Dercitus niger* (Ann. vol. vii. Jan. 1871), which differs from all others of the Pachytragiæ with which I am acquainted in having *no* acerate spicule, while its body, being crammed full of stout ternate ones in which the shaft but slightly exceeds in length the arms, finds its representative in fig. 71, which, with shorter shaft and of various sizes below this figure, is nearly as abundant as any other form of spicule in the Haldon deposit.

Lastly, we come to the smaller spicules; and here there are only four figures, 40, 41, and 42, 43, and 55, and 56 which can with any certainty be assigned to species like the existing sponges.

The first two evidently belong to the Dactylocalycidæ; but their smallness and differences respectively from those figured in Pl. VII., being strongly marked, may be easily appreciated by comparison.

In fig. 43 we immediately recognize a sharp-pointed bihamate spicule of large size, which may represent the Esperiadæ, its usual companions (viz. the anchorates) being assumed to have been too small to have survived the trituration of the deposit, or the solvent effect of the petrifactive process.

Figs. 55 and 56 are lateral and upper views respectively of the globular crystalloids, or siliceous balls, which characterize the crust of the Geodidæ, and which so abound, of many sizes below the figure, and of so many shapes between spheroidal and oval, that their presence in regard to numbers, not less than their variety in size and form, distinctly points out their origin from the disintegration of more than one kind of *Geodia*.

Of the rest, figs. 44, 45, 46, and 47 are figures of two spicules which are equally beautiful and abundant, but to whose origin nothing that I know of among existing sponges gives me any clue. They may have belonged to the Dactylocalycidæ, and future observation may throw some light upon their history; but at present I know of no moniliform spicules having curved, cylindrical, and quadiradiate forms respectively to which they can be likened.

Fig. 54 appears to have been one of the curved cylindrical spicules which has suffered from erosion, and thus shows the effect of the solvent power, which may thus be inferred, not only to have fretted out partially, but to have fretted away altogether many of the spicules that were originally in this deposit. Indeed we cannot have a more satisfactory example of this power than in fig. 70, which shows a very common occurrence in the Haldon deposit, viz. the bare extension of the axial canal in a consolidated state beyond the rest of the fossil shaft or spicule, which has thus evidently been removed by some solvent influence.

The remainder of the small spicules here represented are abundantly present in the deposit, but more remarkable for their multiplicity than for any peculiarities by which they could be identified with existing species; they represent the smallest spicules of the mass, and those forms which perhaps are most abundant, but by no means all the varieties which are present. In many instances the chalcedonizing influence has so firmly united them, as well as the little globular crystalloids of the Geodidæ, to the larger spicules, especially to the fragments of silicified fibre from the Coralliospongiæ (see figs. 19, 20, and 24), that they cannot be detached without fracture of the latter; but it does not follow from this that such small spicules have ever formed part of the sponges from which the large fragments or spicules to which they now adhere were derived. They were thrown together at the time of deposit, and became adherent afterwards. I have frequently destroyed a fine large spicule by endeavouring to detach the small ones from it.

Among the small spicules, however, are some pointed at one end and truncated at the other, as if fractured at this part, which appear to have originally belonged to the silicified fibre of the Coralliospongiæ; for such are occasionally seen to be not merely adherent to the fragments of this fibre, but actually with one end imbedded *in* it for some distance (figs. 25 and 28), just as with the *Aphrocallistes*, for a good example of which see Bowerbank's illustrations (Proceed. *cit.* 1869, pl. xxi. figs. 2, 3, and 4). The specimen of *Aphrocallistes Bocagei*, which was examined by Schmidt, was found by M. de Pourtales on a reef in the Gulf of Florida, 283 fathoms deep (Atlant. Spong. Faun.).

So long as we are content with the coarser features of the larger spicules of the Spongiadæ contained in the Haldon deposit, we shall find what we want; but if we allow our expectations to go beyond this, and seek for the minuter elements, either in the shape of spines or tubercles on the large spicules, or in that of the minute stellates or other spicules of this kind, which most probably accompanied them in the sponges from which they originally came, we shall be disappointed, at least so far as our investigations have extended. And although it would be too hazardous to state that such minute elements are *entirely* absent, still the effect of trituration at the time of deposit, and the subsequent solvent influence attending petrifaction, together with our want of success in this way, preclude all reasonable hope of their being present anywhere in such a sandy deposit. Where whole masses or entire sponges, as before stated, have become consolidated in the form of flint &c., they may be preserved, as flies in amber; but it seems hopeless to hunt for them in this sandy grit.

Nor is there much dependence, for the same reasons, to be placed on the forms of the smaller spicules, such as figs. 51 and 52; for what may have carried away the minute spicules and have affected the surfaces of the large ones, is not likely to have spared those of the smaller ones, in which the alteration in form would thus be proportionally more extensive and disfiguring.

Having now reviewed the illustrations in the accompanying plates *generally*, let us hastily go over the figures somewhat more *specially*, which, while it entails a little repetition of what has gone before, will serve to curtail much of the usual tabular explanation.

Of figs. 1 to 5 there can be no doubt that the latter belonged to a coral-sponge like *Discodermia polydiscus*, Bocage (Journ. des Sc. Mathémat. Phys. et Nat. Lisbonne, no. iv. 1869), from which are copied our two figures 8 and 9, being the upper and lateral views respectively of the disk. It was previously called *Dactylocalyx polydiscus* by Dr. Bowerbank, for whose illustrations, of a similar kind, see Proceed. Zool. Soc. Lond. 1869, pl. vi. figs. 10 &c.; since then it has been figured by Schmidt under the name of *Corallistes polydiscus* (Atlant. Spong. Faun. Taf. iii. fig. 8, 1870), of which our fig. 7 is a tracing. Bocage found his specimens implanted on a piece of *Halichondria*; but from what locality is not mentioned. That described by Schmidt was obtained at the minimum depth of 152 fathoms in the Gulf of Florida.

Neither Bowerbank nor Du Bocage gives his figures of the disk that amount of indentation which is found in Schmidt's; but if the latter be not another species, then it is probable that my figures 3, 4, and 5, which, with their like, abound in the

Haldon deposit, all come from a sponge or sponges closely allied to, if not identical with, *Dactylocalyx polydiscus*; in which case we appear to have the species still extant.

Not so, however, with figs. 1 and 2, which, with their like, are equally abundant. These disks, in addition to the difference of branching off almost close to the shaft, are much more lacinulated than any of the figs. 3, 4, and 5; besides which, the ends of the branches are not rounded. Indeed the characters are so distinct and so different from those of the disk of *Dactylocalyx polydiscus*, or any other species of *Dactylocalyx* with which I am acquainted, that I do not hesitate to designate them by the name of "*Dactylocalycites Vicaryi*," in honour of Mr. W. Vicary, of Exeter, to whom we are not only indebted for the discovery of these spiculiferous deposits, but for that of many other important geological facts in this neighbourhood. Fig. 6 is a lateral view of this disk.

It is possible that if the filagree terminations of the lacinulated disks of *McAndrewia azorica*, Gray (for good illustrations of which see Bowerbank, Proc. *cit.* 1869, pl. v. figs. 2 and 3), were broken off, we might produce figures something like 1 and 2; but in no instance have I observed the least remnant of a termination like these to the branches of *Dactyocalycites Vicaryi.*

Lastly, the heads, figs. 40 and 41, 42, Pl. IX., also appear to have belonged to the Coralliospongiæ, especially the latter, viz. figs. 41, 42, whose elliptical disk and sinuous margin so cause it to differ from all the rest, that for this I would propose the name of "*Dactylocalycites ellipticus*." Of fig. 40 I have only found two specimens; they are very small, but are so beautifully marked, that for these the most appropriate appellation that I can think of would be *Dactylocalycites callodiscus.* It should be remembered that we are here naming spicules only, and not entire sponges.

In figs. 10 to 18 inclusively we have specimens of "knots," so to call them, or branching centres of the silicified fibre of the Coralliospongiæ and Euplectellidæ, the rectangular branching of figs. 10 and 11, and the hexradiate appearance of figs. 10 and 15, being more particularly like that of the sponges last mentioned.

Fig. 12 is an instance of the canalled silicified fibre characterizing *Farrea occa*, Bk. (Proc. *cit.* 1869, pl. xxiv. fig. 1 and Brit. Spong. fig. 277).

And the rest may be siliceous knots from the Dactylocalycidæ generally.

In Pl. VIII. figs. 19 to 29 inclusively, we seem to have nothing but the coarsest parts of the silicified fibre of the

Coralliospongiæ. Such fragments are so abundant and so infinite in the variety of their forms in this deposit, that it has been a matter of difficulty to make any selection that could give even their general character.

Most of them have small spicules, fragmental or entire, adhering to them, as in figs. 19 and 24, which are drawn upon the same scale as the rest of the figures (indeed it should be remembered that not only all the figures except 7, 8, and 9, but every thing connected with them, are drawn upon the same scale in these representations). Such small spicules, as has been heretofore explained, need not have had any previous existence in the sponges from which the fragments to which they now adhere belonged.

Again, as there is also a great abundance of the globular crystalloids (little siliceous balls) of the Geodidæ in the deposit, many of these also, as represented in figs. 20 and 24, adhere firmly to the larger spicules of *all* kinds; these, in like manner, need not have had any connexion before the deposit took place with the spicules to which they are now attached. I particularly mention this, because the occurrence has often led me to the opposite conclusion, which subsequent reflection has thus corrected.

Figs. 25, 26, and 28 represent instances where the small spicules *did* appear to have been incorporated with the silicified fibre from the beginning, as seen especially in the *Aphrocallistes*. Indeed the imbedding of the spicules in the silicified fibre of the Coralliospongiæ, while it has its analogue in the entire enclosure of them in the living fibre of the Chalineæ, or in the insertion of their blunt ends only, as in that of the Oplitospongiæ, Bk., seems, in the Coralliospongiæ, to have been as present and necessary for the support of their delicate spicular structure in the more shallow tidal seas in which they live and have lived as it is absent and unnecessary in the flimsy spicular structure of the deep-sea sponges, which, like *Askonema setubalense*, Kent, attains "upwards of three feet in diameter" in the quiet valleys of the Atlantic Ocean (Monthly Microscop. Journ., Nov. 1870, p. 245, pl. lxiv.).

Fig. 29 represents a piece of silicified fibre with holes in it (*a*)—a very common occurrence, as may be supposed, in the Coralliospongiæ.

Following the numbers, we now come to the spicules of the Pachytragiæ, whose heads, where the shafts have been broken off entirely, and where fragments of them still remain, are represented in Plates IX. and X. respectively; and here we meet with the difficulty of determining, not only how many of those in Pl. IX., where the heads are without shafts, belonged to the Coralliospongiæ, but also which of these, and of those *with* shafts in Pl. X., belonged to the different divisions included under the head of Pachytragiæ.

We must here, for reasons above stated, omit from these altogether the Tethyadæ, of which *T. cranium* is the type, likewise *Donatia* (*T. lyncurium*) and its type, since, if neither the trifid spicules of the former nor the stellates of the latter can, from their extreme delicacy, be expected to be found in the deposit, these species have no other spicular element by which they can be recognized with certainty.

The thickness of the shaft at its base in the headed spicules rather indicates a short than a long shaft, as is well known to those who have studied the anchor- and vasiform trifid-headed spicules respectively of the Geodidæ &c., for which compare our fig. 63 with 59 in Pl. X.; but, as before stated, the expansion or elaboration of the head seems to take place at the expense of the shaft; and hence this so accords with what is found in the Coralliospongiæ, that where there is no part of the shaft left, and the thickness of the latter at its base is no indication of length, the development of the head is our only guide.

Thus, in the figures of Pl. IX., I *know* 32 to be the end view of the shafted spicule 66 in Pl. X., because I myself drew it from this spicule: and figs. 35 and 36 had also shafts; but they are omitted because there was no room left in the plates for lateral views of these spicules. Fig. 34 probably had a long shaft; and the head of 69, when viewed endwise, presented a hexternate form somewhat like 33; but whether figs. 30, 31, and 33 had short shafts or long ones there is nothing to determine, as they are broken off close to the heads in the fossils.

Thus, while there can be little doubt of the heads which have long shafts having originally come from some species of the Pachytragiæ, I have no means of deciding whether figs. 30, 31, and 33 belonged to the latter or to the Coralliospongiæ, since nearly facsimiles of 31 and 33 are given by Dr. Bowerbank in his illustrations of *Dactylocalyx Masoni* and *D. Bowerbankii* respectively (Proceed. *cit.*), and a facsimile of fig. 30 appears in Schmidt's illustrations of *Stelletta* (*S. discophora*, tab. iv. fig. 5 *a*, Adriat. Spong. 1862). The latter also, in its hexradiate form, is no less characteristic of Wright's *Wyville-Thomsonia Wallichii* (Quart. Journ. Microscop. Sc. Jan. 1870, pl. ii. fig. 3), also Schmidt's *Stelletta* (*Tisiphonia*) *agariciformis* (Atlant. Spong. Faun. Taf. vi. fig. 12), also *Dorvillia agariciformis*, Kent (Monthly Microscop. Journ., Dec. 1870, pl. lxvi. fig. 7), and, lastly, my own figures of the spicules in *Stelletta aspera* and *S. lactea* (Ann. Nat. Hist. vol. vii. Jan. 1871).

Thus the hexternate head seems to take us from the Pachytragiæ of the shore through the Coralliospongiæ of the comparatively shallow seas, down into the deep recesses of the ocean, where, at 1913 fathoms, Dr. Wallich found the diminutive but important little sponge to which Dr. Wright (*l. c.*) has given the name *Wyville-Thomsonia Wallichii*. Already it will have been seen that M. de Pourtales found this (for *Stelletta* (*Tisiphonia*) *agariciformis* of Schmidt appears, *mut. mutand.*, to be identical with it) in 178 fathoms; so that here we have a sponge, in form and habitat respectively, connecting the Pachytragiæ of the shore, through the Coralliospongiæ, with the Calycispongiæ (Kent) of the deepest seas.

Figs. 37, 38, and 39, Plate IX., and figs. 72, 73, and 74 Pl. X., are nail-like spicules, whose crucial or four-armed heads as plainly show that they do not belong to the ternate as that they do belong to a quaternate or quadrifid system, whose parallel, as before stated, is only found in the spicules of *Hyalonema* (*Carteria*, Gray).

On this, however, it may be observed that the minute spicules with feathered shafts and quadrifid heads are not confined to *Hyalonema*, but are found also in *Holtenia Carpenteri*, W. Thomson (Phil. Trans. 1869, pl. lxviii. figs. 9–11), and in *Pheronema Grayi*, Kent (Monthly Microscop. Journ., Nov. 1870, pl. lxiii. figs. 9 and 10). So are there minute hexradiate spicules in many of the Coralliospongiæ and Euplectellidæ; but Dr. W. Thomson states, respecting the former, that "opposite to the point of junction of the vertical with the four transverse rays there is frequently a more or less distinct rounded elevation or tubercle. This undoubtedly represents the sixth ray, the continuation of the primary axis of the spicule" (Phil. Trans. 1869, p. 704); so that *these* feathered shafts with quadrifid heads in *Holtenia* evidently belong to the hexradiate system. But where Dr. W. Thomson goes on to state that in some cases "the tubercle is developed into a branch, and the spicule becomes hexradiate, recalling the ordinary hexradiate spicule of the sponge-mass of *Hyalonema*," I must join issue, inasmuch as I have never been able to see such a tubercle in the minute spicules with feathered shafts and quadrifid heads, nor in the large quadrifid spicules of *Hyalonema*, although examined carefully for this purpose; nor have I ever seen in any illustrations, or in my own examination of my mounted specimens of the sponge of *Hyalonema*, any *hex*radiate spicules; while, as before stated, the simple cross in the centre of the longer spicules, which was first pointed out by Schultze (Ann. *l. c.*), has always appeared to me *quadri*radiate, as stated by him, and not *hex*radiate with quadrilobate inflation, as it is, for the most part, in *Askonema setubalense.*

Still it is not with the plan on which the minute spicules of sponges are developed that we have to deal in the Haldon deposit; for, as already mentioned, their entire absence there compels us to consider only the system of the larger spicules; and here we have one which is as distinctly quaternate in the division of its head as the quadriradiate cross, with and without shaft and extended arms respectively, in the large spicules of *Hyalonema.*

Fig. 39 is a lateral view of one of these spicules, and fig. 38 the end view of its head, in which the central lines represent the quadrifid branching of the axial canal. (The dotted lines, for the most part, in these figures represent restored parts.) Fig. 37, although on the same system as the last, much exceeds the rest in size; the central canals are enormously enlarged, apparently at the expense of the walls of the spicule, which are very thin; but whether this was originally the case, or subsequently produced during petrifaction, we will not consider now, as the subject (viz. the enlarged state of the canal in many of the fossil spicules) will by-and-by come before us separately. It will be observed that the ends of this quadrifid head have also disappeared; but a portion of the shaft, which cannot be made apparent in the drawing, still remains; nor is it improbable that the arms were carried out, as in the long-armed spicules of *Hyalonema*, to a much greater extent than the dotted lines conjecturally indicated.

Fig. 74, Pl. X., is a lateral view of another specimen of this spicule, showing the peculiar form of the arms; and fig. 73 represents the head end of fig. 72, which, being smaller and somewhat different from the rest, and furnished with a longer shaft, may have belonged to another species; while the short-shafted ones may perhaps, by the union of their heads (for in one instance I found two together), have formed the surface of some coral-sponge. Still, in the absence of all decisive evidence in this respect, I propose for these spicules (which are by no means uncommon, although not so plentiful as many of the rest, and bear a remarkable resemblance to nails) the generic name "*Gomphites.*" Those with the shorter shafts and more expanded heads I would call *Gomphites Parfittii*, in honour of Mr. Parfitt, who early recognized the value of these fossils generally, who partly brought them to my notice, and who subsequently wrote the valuable paper on them to which I have alluded, in which is figured the peculiar form under consideration. For the long-shafted one (fig. 72) with contracted head I would propose the name of *G. parviceps.*

Before returning to the ternate system again, I may here briefly allude to two other kinds of spicules, *not in this deposit*, called respectively by Dr. Bowerbank "biternate" and "trifurcated attenuato-hexradiate" spicules, the former belonging to *Dactylocalyx subglobosa*, Gray (Proceed. *cit.* 1869, pl. 22. fig. 11), and the latter to *Euplectella aspergillum* (Brit. Spong. pl. 8. fig. 189), since the straight lines in fig. 34 are introduced to show how these two forms might be produced. Viewing, then, those marked *a a a* as branches of the axial canal, producing the ternate system, we have the lines *b a b*, *b a b*, and *b a b* with the shaft in the centre, forming Dr. Bowerbank's "biternate" spicule; and by adding another branch with *b a b*, so as to produce the quadrifid head, together with one above and one below in the axis of the shaft, we get the "trifurcated attenuato-hexradiate" form. But as these forms are only to be found among the minute spicules of the existing species to which they respectively belong, they do not come into the category with which we are most concerned, although it seemed desirable to give them a passing notice. Again, it should be remembered, as enlarged figures often mislead, that if the spicules in question were drawn to the scale of our figure 34, under reference, their utmost size would not be more than the semidiameter of the circle representing the broken end of the shaft; hence their subordinate nature in respect of size.

It is very desirable, where we can, to take our characters rather from large than small objects; for it is much more useful to the many, who cannot afford to purchase microscopes for seeing the latter; and it becomes questionable how far species-splitting should be subject to microscopical examination, since there might be no end to this if there were no limit to microscopic power: hence the desirableness of restricting the latter in the formation of species, even as it is, to some practicable extent.

Returning to the ternate system of the large fossil spicules with long shafts, we have, in figs. 32, 35, & 36, Pl. IX., heads only, in which the shafts although not represented, are known to have been long; also figs. 59 to 71, inclusively, in Pl. X., where the heads and fragments of their long shafts still remaining together are thus represented.

And here, directing our attention first to the furcate division of the arms, or the hexternate forms in figs. 32, 34, and 35, Pl. IX., and figs. 58, 59, 60, 66, & 68, Pl. X., we observe that, although there is great irregularity in their dividing, they are all provided with long shafts. (Again I must beg the reader to remember that these figures are not selected from their rarity, but as the best representatives that I could find of their like, which exist in countless myriads scattered throughout the deposit.) The figures, then, to which I have just alluded are very similar in character, and, together with the vase-like trifid heads, figs. 61 & 67, and the bifid ones, figs. 65 and 64, may all be varieties of their proper types respectively, produced in one species of sponge, to which I would give the name collectively of *Geodites haldonensis*, taking fig. 58 as the best representative of this group.

If, then, we make this a *Geodia*, it involves the addition of an anchor-headed spicule with extremely long shaft (as those know who have studied the existing species); and this we appear to have in figs. 62 & 63, which, although slightly differing in form, may be but varieties of one type; also a large smooth acerate spicule, like that of fig. 76: and thus we have all the spicular forms characteristic of the circumferential zone of a *Geodia*, viz. :—(1) the thick ternate head, characteristically furcated and vasiform in this instance; (2) the vasiform, trifid, extended head; (3) the anchor-like or trifid recurved head; and (4) the large acerate spicule. Add, further, to these the globular crystalloid or little siliceous ball (Pl. IX. figs. 55 & 56) (found abundantly in this deposit) for the crust, together with the large acerate and acuate spicules (figs. 76 & 77, Pl. X.) for the interior, and we have, with the exception of the minute stellates &c. (also usually found in the existing species of the Geodidæ, but which, for reasons above given, we cannot expect to find in this deposit), all the spicular combination which belongs to a *Geodia*, except that, I think, there is no existing species known in which the arms of the ternate head are furcated and also spread forwards, instead of horizontally and more or less recurved.

Such a condition may be seen, so far as the furcation goes, in Schmidt's *Stellettæ* and *Ancorinæ* (Spong. Adriat. Meeres, Taf. 3 & 4, 1862); but here, again, the bifurcations are not prolonged, but *recurved*.

Fig. 69, which is hexternate, is, with its varieties, also a very common form in this deposit; and here the arms *are* spread out horizontally or laterally, and the furcations somewhat recurved, as in *Stelletta* &c. For this and its like, then, I would propose the name of *Stellettites haldonensis*; albeit it is not certain that this spicule, too, might not have been connected with a crust of siliceous balls and a spicular combination in other respects like that just mentioned, when it would become a *Geodites*, the absence of the siliceous balls being Schmidt's distinction. But, then, his *Stelletta discophora* has a crust of little siliceous disks, which are but a more depressed form of the siliceous balls; and so the future may furnish a species of *Geodia* with the hexternate or furcate spicule of *Stelletta* and the siliceous balls of a *Geodia*, in which case the genera of Schmidt's groups of Ancorinidæ and Geodidinæ would come together.

Lastly, we come to the simple ternate or trifid head of the long-shafted spicules, of which three kinds at least, with their varieties, abound in this deposit, viz. fig. 70, which is very stout, with long shaft and three arms expanded laterally, almost horizontally, and a little recurved. In the illustration, which is taken from the most perfect one that I could find, the arm on the left side is broken off square, and the other two, which were about equal in length, broken or rounded off by attrition. Fig. 36, Pl. IX., also belongs to the simple ternate division of the head with long shaft; but the arms are more or less straight, elongate, attenuated, and spread out at equal distances from each other, somewhat forwards. Fig. 71 is another of this kind, but frequently with very little difference between the length of its shaft and the expanded arms.

Of these the two former, viz. figs. 70 & 36, might, from the length of their shafts, have belonged to the circumferential spicular zones respectively of two different species of *Geodia*.

But the prevalence of fig. 71 and its varieties, chiefly in size, so nearly resemble the stout spicules with which an existing species, viz. *Dercitus niger* (Annals, Jan. 1871), is densely charged, that I do not think that a more appropriate appellation can be assigned to it than that of *Dercites haldonensis*.

The existing type grows on the rocks at Budleigh-Salterton, and is a black variety of *Hymeniacidon Bucklandi*, Bk., = *Pachastrella Bucklandi*, Sdt.

We now leave the spicules of the ternate system, and go to that large *acerate* form whose middle and ends are represented in Pl. X. fig. 76, *a a*, which, with the exception of *Dercitus niger* (which is peculiar in this respect), is the characteristic body-spicule of all the known Pachytragiæ; and hence its great abundance of different sizes in the Haldon deposit is easily understood. It is smooth, acerate, fusiform, and for the most part stout and slightly curved, as shown in the figure, which otherwise represents the average size of the largest specimens.

The same remarks apply to the *acuate* spicule, whose large and small ends are given in fig. 77 *a*, but with this exception, that the acuate form is somewhat smaller and less abundant in the existing species as it is in the Haldon deposit. It seems also to be but a modification of the body-spicule, in which one half is shortened and enlarged at the expense of the length of this half, the blunted extremity varying also in form from that of being simply rounded in fig. 78 to pin-head-like inflation as in fig. 77.

Here, then, we also come upon the characteristic form of the spicule in *Donatia*, Gray (*Tethya lyncurium*), and its like; but, as before stated, in the absence of the large stellates peculiar to the existing species, the acuate spicule alone is a useless indication.

Lastly, we arrive at the smaller spicules of the deposit, represented in Pl. IX.; and beginning with fig. 43, we at once recognize its bihamate pointed form, which association leads us to connect with the Esperiadæ. But where are the little anchorate spicules which in the existing species always accompany it in a still more minute form? These also are absent, and, from their minuteness and delicate forms, may have disappeared under the destructive and dissipating influences before mentioned. Still, for future reference, this spicule must also be named; and hence I would call it *Esperites haldonensis*.

It is six times as large as that of the great branching *Esperia* of the deep sea, from which I have been kindly provided with a small portion for reference by Dr. Carpenter; and this, again, possesses the largest bihamate of any existing species with which I am at present acquainted. Yet the fossil specimen is C-like, more or less contort, and in all other respects, as will be seen by the figure, exactly like the bihamate of the present day. It was first brought to my notice by Mr. Vicary, who found it in the Haldon deposit, after which I obtained several myself in specimens of this deposit. They are all about the same length, viz. 1-37th of an inch, while those of the deep-sea species only average 1-222nd of an inch; so that while the former can be well seen with a simple lens of low power, the latter can only be seen with the ¼-inch combination of a microscope.

Still larger is another but sigmoid contort form of this (?) spicule, viz. fig. 79, of which one specimen only has been found, and that, too, by Mr. Vicary, in the Haldon deposit. Its gigantic size, being 1-17th of an inch long, and of proportionate thickness, makes one almost doubt its identification with the bihamates. However, as it is, so it is represented in the figure, where its remarkable size and form show that it should also have a name for distinction's sake. Hence we will call this *Esperites giganteus*.

It is impossible to confound the bihamate spicule of a sponge with that of an echinoderm, since the latter, as in *Echinus sphæreus*, to which Dr. Bowerbank alludes (Brit. Spong. vol. i. p. 44), is not only vastly more minute than our smaller fossil specimens, but differs from the bihamates of sponges generally in being calcareous instead of siliceous, more or less crooked, and provided with a little point in the middle of its convex side, by which, as is wont with these spicules, it is attached to the flesh of the echinoderm. I need hardly add that the spicules of the Spongiadæ are free.

Next come figs. 46 and 47, which are as abundant in the Haldon deposit as they are remarkable for their beauty: these are moniliform, cylindrical, slightly diminishing towards the end, and slightly curved; they vary in thickness and in the number of their moniliform inflations, which seldom exceeds eight; but in fig. 46 there are nine, the end one of which on one side, having been apparently broken off, has been restored. Fig. 47 is another form of the same spicule, which is thicker, more obtuse at the ends, and has only six moniliform inflations: they vary somewhat in size also, and many are fragmental; but the more perfect form seems to be that of fig. 46. I know of no sponge possessing spicules like these; at the same time, being so abundant, and remarkable for their beauty and the peculiarity of their form, they demand specific distinction. Hence we will call this spicule *Monilites haldonensis*.

Fig. 54 appears to be an eroded state of the same spicule, unless it was one like that figured by Dr. Bowerbank (Brit. Spong. pl. 11. fig. 244).

Again, there is another moniliform spicule, much smaller than the foregoing, which is represented in figs. 44 and 45. This, however, is not linear like the last, but apparently quadriradiate. I say "apparently," because I am not quite certain that in some instances one ray would not be found to be longer than the rest, in which case it would belong to the ternate-shafted spicule represented in fig. 71. All its rays are moniliform, straight, and pointed, with such symmetry as to make it, although very small, a beautiful object. I also know of no existing sponge that possesses a spicule like this, for which I propose the name of *Monilites quadriradiatus*.

Fig. 47 is a very common form in this deposit, about the same size as *Monilites haldonensis*, but differing from it chiefly in being smooth instead of moniliform. It varies much in thickness and a little in length below that of the figure; but possessing no peculiarity referable to any existing sponge, no further notice of it is necessary, except that it is remarkable for its multiplicity, and originally may have formed the smaller spicule of one of the Coralliospongiæ, as a similar spicule, although a little less in size than the one figured, abounds in *Discodermia polydiscus* (Schmidt's mounted specimen of *Corallistes polydiscus* in the British Museum).

As this spicule is a simple or smooth analogue of *Monilites haldonensis*, so there is a simple one of *M. quadriradiatus*, which I have not figured, but which is equally plentiful with the latter in the Haldon deposit, and therefore equally deserving of notice.

Figs. 48, 49, and 57 are all abundant, but with no character to associate with any existing species in particular. Although small, they are much larger than most of the spicules of existing shore Sponges, excepting the Pachytragiæ.

Figs. 50, 51, and 52 are respectively peculiar in form, but, apart from the sponges to which they belonged, are of no specific value. Their figures are introduced here as representatives of a great variety of the same size which exist in the Haldon deposit. In fig. 52, which is the smallest spicule with definite form that I have found, we seem to have a capitate ray of one of the minute hexactinelled ("floricomo-hexradiate," Bk. B. S. pl. 8) spicules in the Coralliospongiæ; but this is all that can be said for it. In some instances it is as probable that the minute spines or projections of a spicule may have been obscured by chalcedonic union into one mass, as that the solvent influence may have carried them off altogether.

Last, although far from being the least important, are figs. 55, 56, which represent one of the globular crystalloids or siliceous balls of the crust of a *Geodia*. Perhaps, from its specific value and great abundance, it is one of the most interesting forms in the deposit. That represented in figs. 55, 56, which give its lateral and upper profiles respectively, is the average size of the largest, and shows that it is somewhat depressed or a little less in diameter vertically than it is laterally, also that it possesses the usual hilous depression below.

These little balls not only form the crust of the existing Geodidæ, but are scattered more or less throughout the whole structure of these sponges, where they present as many sizes as phases of development, which may thus be followed from the youngest to the most matured state (see their structure &c. 'Annals,' 1869, vol. iv. pls. 1 & 2). They are therefore exceedingly numerous; and, further, in the existing species, they somewhat differ in their globular forms and in the markings or pattern on the surface of the matured ones.

Hence it is not suprising that they should be very abundant and be present of different forms and sizes in the Haldon deposit; but the pattern on their surfaces is so obscured by the minute botryoidal crystallization of the chalcedony before mentioned, that I have only met with one instance in which the presence of a few tubercles bore indication of the original appearance; and these were too indistinct to be of any specific value.

The largest as to size and general shape, viz. that figured, bears a greater resemblance to those of *Geodia Thomsonii*, Sdt. (Atlan. Spong. Faun. Taf. 6. fig. 13), than to any other existing species with which I am acquainted.

There is hardly a large spicule in the deposit to which one or more of these little balls are not adherent; so that, as before stated, this must be regarded as accidental, and arising from their having been thrown together promiscuously at the time the deposit was formed.

It has, however, been necessary to add one of them to the combination of spicules before mentioned to complete the complement of *Geodites haldonensis*; and for this purpose we may take the largest size, or that figured in figs. 55 and 56. Of course the combination is conventional and provisional; but it is necessary, under the circumstances, for future reference.

Before concluding, we have to advert to a structural peculiarity in many of these fossil spicules, which finds its illustration in fig. 75, Pl. X., and to which I have before alluded as an unusual enlargement of the axial canal. Here it will be observed that the axial canal is extremely wide, and the wall of the spicule therefore very narrow, also that the former has in it the end of another spicule and several grains of sand: *a* is the wall, *b b* the dilated canal, *c c*, grains of sand, and *d* the point of a spicule.

This fragment, which represents part of the shaft of a ternate-headed spicule, is an illustration of what is frequently met with in the Haldon deposit, and, by the presence of the grains of sand, shows that this condition of the spicule was not produced during fossilization, but must have existed from the beginning.

It seems to derive explanation, however, from what I have particularly noticed in the deciduous spicules, both fragmental and entire, of the spiculo-arenaceous sponges and those in the head of *Squamulina scopula* (Annals, 1870, vol. v. pl. 4), viz. that most of them have unusually wide canals, insomuch that I have often thought that this arrest of development (for spicules appear to be formed endogenously rather than exogenously) in many instances had led to their being thrown off (like dead feathers) from the sponges in which they had thus become useless; and floating about, rather than sinking at once or becoming fractured and destroyed like the more solid ones, they had thus been more easily captured by those organisms which make use of such elements for building up their habitations. But be this as it may, the axial canals of the deciduous spicules, both entire and fragmentary, in the spiculo-arenaceous sponges and the head of *Squamulina scopula* are for the most part unusually large.

Concluding Remarks.

In accounting for the Haldon deposit geologically, with reference to the fossil spicules of the Spongiadæ which it contains, we have to consider whence the sand of which it is composed was derived, to what kinds of the Spongiadæ the fossil spicules in it belonged, in what kind of climate these sponges probably lived, what kinds of the Spongiadæ are not represented in the deposit, and, lastly, by what agency its elements were brought together.

These queries can be soon answered.

In the first place, the sand, coming from the disintegration of older rocks, was probably of shore origin. Then, the kinds of Spongiadæ to which the fossil spicules contained in it belonged (at least those which can be recognized) are the Pachytragiæ and the Coralliospongiæ, including the Euplectellidæ, the former of which now grow in the marginal zone of the sea, and the latter in the zone immediately following it,—that is to say, the Euplectellidæ at the Philippine Islands in 10 to 24 fathoms (Cuming, *apud* Bowerbank, *l. c.*) and the Coralliospongiæ in 98 (*Sympagella nux*, Sdt.) to 700 (*Aphrocallistes Bocagei*, Wright): none of those referred by M. de Pourtales to Dr. Schmidt were found below 450; and *Aphrocallistes Bocagei* was also found by Dr. W. Thomson in 700 fathoms. The Pachytragiæ appear to be world-wide in habitat, and the Coralliospongiæ confined to the warmer latitudes and the equatorial region of the sea. No spicules of the Calycispongiæ (Kent) or deep-sea sponges, such as *Hyalonema*, *Holtenia*, &c., have been found in this deposit, the materials of which must have been brought together by strong tidal currents.

It follows, then, that, the sand being of shore origin, the Pachytragiæ and Coralliospongiæ living in the marginal and following zones of the sea respectively in warm latitudes, while tidal currents requisite to drift into one and the same deposit such coarse materials are also chiefly confined to these regions, the deposit was formed rather nearer the shore than the deep sea, and in a climate much warmer than our present one.

Again, the sandy nature of the deposit, and the absence of all fossil spicules like those of the deep-sea sponges, contrast forcibly with the "oozy calcareous mud" of the region in which the latter live, which is also stated to be literally "crammed" with their deciduous remains.

Thus, geographically, geologically, and structurally, the deep-sea sponges so differ from the Coralliospongiæ that separating them for classification becomes absolutely necessary; and hence Mr. Kent, who is practically acquainted with both groups, has most advisedly instituted the appropriate name of Calycispongiæ for the former (Monthly Microscopical Journal, Nov. 1870).

The delicate though long spicules of the deep-sea sponges, held together only, as before noticed, by equally delicate sarcode, also contrast forcibly in structure with the rigid, silicified, keratose fibre of the Coralliospongiæ. But if rigidity alone be here considered, it may very properly be observed that in this respect the long, thick, twisted spicules of which the "glass rope" or stem of *Hyalonema* is composed has no parallel among any of the Spongiadæ.

Nor is it less true that this long stem, supporting a calyciform sponge upon its upper extremity, thus prominently differs from its companions *Holtenia* and *Pheronema*, whose sessile or stemless bodies are not only kept in contact with the mud, but partially imbedded in it by a beard of long spicules, far more delicate than those forming the stem of *Hyalonema*.

To this it might be added that a parasitic polype, first named by Schultze *Palythoa fatua* (Annals, 1867, vol. xix. p. 160), usually appears, according to Dr. W. Thomson's observation, on the stem of *Hyalonema* "before it is an inch long, and sometimes earlier." After which we know, by the specimens of the "glass rope" which are much above a foot in length, that the polype not only covers the greater part of them, but the *upper* end also, thus proving that in the "struggle for life" it has caused the calyciform head of the sponge to fall off, and has thus appropriated the stem.

Hence it becomes a matter for consideration how far the difference between the stem of *Hyalonema* and the beard of *Holtenia* arises from the presence of the polype upon the former.

The origin of parasites is involved in obscurity, as much as their modification of structure is often evident—for instance, the gall on oak-trees. And as this modification is to suit their own purposes, and the habit of a polype is for the most part to grow on a hard substance and live in clear water, may not the *Palythoa fatua* have compelled the sponge, in "the struggle for life," on either side, to elongate its stem, and thus reciprocally to produce the modifications which cause it so to differ from the beard of its companions *Holtenia* and *Pheronema*, which have no parasite? In short, might not the stem of *Hyalonema* have been the same as the beard of *Holtenia*, had not the former been accompanied by a parasite? If so, then Dr. Gray's separating the sponge at the top from it, and giving it another name (*Carteria*) is perfectly reconcilable; for the stem would then be a joint production of *Hyalonema Sieboldii*, Gray, and *Carteria*, Gray, with the latter name for the sponge alone,—thus retaining in *Hyalonema Sieboldi*, as Schultze has very properly observed, the name of the celebrated Japanese traveller who, so far as we know, sent the first specimens to Europe (Annals, *l. c.*).

There are other sponges which have a parasitic polype on them besides *Hyalonema*. Thus, Schmidt (Adriat. Spong. 1862, Taf. 6. figs. 2 & 3) gives figures of two Halichondroid, erect, branching species, viz. *Axinella damicornis* and *A. verrucosa*, each characterized by pin-like and acuate spicules, and on each of which there is a social parasitic polype imbedded in its proper cortical layer. But in the British Museum there are several specimens of a flat Halichondroid amorphous sponge (*Reniera*?), whose reticular fibre is charged with small acerate and slightly curved spicules, and on whose upper surface are plentifully scattered solitary polype-heads about 1-12th of an inch in diameter (in the dried state). These, which have been likened by Dr. Gray to the parasitic genus *Bergia* of Michelotti (P. Z. S. 1867, pp. 239 & 514), are imbedded alone, that is, without cortical layer, in the surface of the sponge. Their disks are charged with sand and deciduous spicules, entire and fragmentary, of different kinds; and so far, with their other polype-structure, they differ from the sponge in which they are imbedded; but beyond this they are directly continuous with the structure of the sponge, which thus evidently serves the purpose of a cortical layer or cœnosarc, and so stands in relation to them as the root-stock of a fruit-tree to its graft, there being as much difference between them and the sponge as between the insect which forces the oak to supply the "gall" and the oak-tree itself, so far as separate organization goes. What the modifications of the sponge-structure immediately around the polype-head may be, I am not prepared to state; but it is reasonable to infer that these are such as would not have been there, had the polype-head not been present: hence the *Palythoa fatua* with its social polypes and cortical layer may make use of the sponge-stem of *Hyalonema*, and thus, to meet the circumstances of the case, occasion the modifications in it above mentioned.

Returning to the habitat of the deep-sea sponges and the Coralliospongiæ respectively, we observe that they occasionally mingle; but while the former are chiefly confined to the most retired depths of the ocean, the habitat of the latter tends in the opposite direction.

Not only, however, do the deep-sea sponges and the Coralliospongiæ mingle, but there is one of the Pachytragiæ, viz. *Stelletta* (*Tisiphonia*) *agariciformis*, Sdt., = *Wyville-Thomsonia Wallichii*, Wright, which exists on a reef in the Gulf of Florida, in 178 fathoms, and was happily recognized by Dr. Wallich in "soundings" of the Atlantic Ocean brought up from a depth of 1913 fathoms.

All honour, then, be to one who, so far back as "October 1860," secured this little, wee young specimen, not more than 1-12th of an inch in diameter (Quart. Journal. Microscop. Sc. No. 37, Jan. 1870, pl. 2. fig. 1) for the future advancement of our department of science! It has even been suggested to me by Dr. Gray (to whose kind assistance much of this communication is due), and not without reason, that *Tethya muricata*, Bk. (Brit. Spong. vol. i. p. 25, and figs. 304 and 305), may probably be the same sponge.

Lastly, I would add that Schmidt (Atlant. Spong. Faun. 1870, p. 20, Taf. 2. figs. 16–20) reproduces several figures from fossil remains in the Cretaceous system, which, from their triaxial and "lattice-form" characters, he associates with the living species of "*Farrea*, *Aphrocallistes*, and *Dactylocalyx*." And, as far as the minute triaxial or hexradiate spicules go, he is right in considering them allied to these genera; but when instances of the silicified fibre are given as evidence of the "hexradiate" plan of their structures generally, it will be seen, as our figures show, that this is any thing but regular, and that the ternate division of the large spicules of the circumference, which alone we have had for our guidance, is the most constant plan, and the one least subject to complex modification.

The hexradiate form of the minute spicules answers very well for the character of Schmidt's general grouping under the term "Hexactinellidæ;" but when we come to divide the Sponges of the deep sea from the Coralliospongiæ, other definitions are required; hence the acceptableness of Mr. Kent's term of "Calycispongiæ" for most of the former. The remains of such sponges may be found in those deposits of the Cretaceous system which, from their subtleness, may be assumed to have been formed in deep seas, but not in such as bear the characters of the Haldon deposit.

Not so with the Coccoliths of the deep sea (to me calcareous, solitary, unicellular Algæ), which so abound in the

Laminarian zone at Budleigh-Salterton that it is impossible to examine microscopically a portion of Sponge, Echinoderm (visceral contents), or Compound Ascidian without seeing several of them. They, but for their delicate nature, would, it may therefore be assumed, have been as numerous in the Haldon deposit as they are in the deep sea and in the Chalk, which they might have contributed to form just as much as, if not more than, the other minute organisms found in it; for the coccolith is but a Melobesian cell (*Melobesia unicellularis*, mihi), which, like the arborescent *M. calcarea* on the south coast of Devon, may form beds of many miles in extent, entire as they die or fragmental as they pass out in a comminuted state from the alimentary cavities of the lower animals (e. g. *Ascidia arachnoïdea*, Forbes), which feed upon their protoplasmic contents most voraciously. Hence, too, perhaps their pelleted grouping in the form of coccospheres, if these are not their sporangia.

Besides sponge-spicules in this deposit, I have seen minute bivalve shells and a few minute Foraminifera, but no remains which I could in any way identify with the calcareous spicules of Echinodermata, Alcyonidæ, Gorgonidæ, or Ascidiæ.

EXPLANATION OF THE PLATES.

N.B. All the figures in these plates, excepting 7, 8, and 9, are taken from the fossilized remains of sponges in the Upper Greensand of Haldon Hill, near Exeter, and of Black Down, near Cullompton, respectively; and *all* are drawn on the scale of 1-24th to 1-1800th of an inch, in order that their relative sizes may be seen and their measurements respectively computed by compass and rule.

The fractured ends of the shafts or branches are represented by a point or little circle within a larger one, the former being intended for the central or axial canal, and the latter for the circumference of the spicule or branch respectively.

Dotted lines indicate restored parts, where they are not intended to represent the lines of one spicule behind another.

PLATE VII.

Figs. 1 & 2. Disks of *Dactylocalycites Vicaryi.*

Figs. 3–5. Disks of *Dactylocalycites polydiscus.*

Fig. 6. Disk of *Dactylocalycites Vicaryi*, lateral view, showing the shaft.

Fig. 7. Disk of *Dactylocalyx polydiscus*, Bk., after Schmidt, showing the ternate branching of the axial canal of the shaft (*a*).

Fig. 8. Disk of *Dactylocalyx polydiscus*, Bk. (*Discodermia polydiscus*, Bocage), after Bocage, showing the ternate division of the axial canal of the shaft (*a*).

Fig. 9. The same, lateral view, showing the shaft.

Figs. 10 & 11. Rectangular branching of silicified fibre like that of *Euplectella.*

Fig. 12. Canalled silicified fibre like that of *Farrea occa*, Bk.

Figs. 13–18. Knots or branching centres of silicified fibre, like that of *Dactylocalyx*.

Plate VIII.

Figs. 19–29. Fragments of silicified fibre. Figs. 19 & 24 show how small spicules are often adherent to them. Figs. 20 & 24 show how the little siliceous balls of Geodidæ are often adherent to them. Fig. 20 is an extremely common form, varying slightly in its detail, but so numerous as to be quite characteristic of some part of the silicified fibre of a *Dactylocalycites*; but whether to a particular species, or to what part of the fibre, I am equally ignorant. Figs. 25 & 26 show how small spicules are sometimes incorporated with them, as in *Aphrocallistes* &c. Fig. 20 shows a foramen (*a*) in the fibre, a very common occurrence, as may be inferred, in the silicified fibre of the Coralliospongiæ.

Plate IX.

Fig. 30. Hexternate head expanded regularly and horizontally.
Fig. 31. Hexternate head, of smaller dimensions.
Fig. 32. Hexternate head of long shaft (fig. 66), irregular.
Fig. 33. Hexternate head, stout, like the circumference-spicule of *Dactylocalyx Bowerbankii.*
Fig. 34. Hexternate head of long shaft, with blunt points, the straight lines *b a b*, *b a b*, and *b a b* showing that the branching of the axial canal, if thus carried on, would give the minute "biternate" form in *Aphrocallistes Beatrix*, Gray (Bowerbank, *l. c.*).
Fig. 35. Hexternate head of long shaft, irregular.
Fig. 36. Ternate head, with expanded, long, straight, attenuated arms, somewhat inclined forwards, and long shaft.
Fig. 37. Quaternate head, with fragment of shaft.
Fig. 38. Quaternate head of fig. 39, end view. *Gomphites Parfittii.*
Fig. 39. The same, with fragment of shaft, lateral view.
Fig. 40. Disk of *Dactylocalycites callodiscus.*
Figs. 41 & 42. Lateral and end views respectively of *D. ellipticus.*
Fig. 43. Bihamate spicule, *Esperites haldonensis.*
Figs. 44 & 45. Four-rayed moniliform spicule, *Monilites quadriradiatus*; two views.
Figs. 46 & 47. Curved moniliform spicule, *Monilites haldonensis*; two forms.
Fig. 48. Small acerate spicule.
Fig. 49. Small curved acuate spicule.
Figs. 50–52. Small spicules, more or less fragmentary or worn.
Fig. 53. Curved cylindrical smooth spicule, with obtuse ends; numerous, of many sizes.
Fig. 54. Eroded form, apparently, of fig. 46.
Figs. 55 & 56. Largest form of siliceous ball of *Geodia*; lateral and upper views respectively. *Geodites haldonensis.*
Fig. 57. Smallest form of curved acerate spicule; numerous, and of many sizes.

Plate X.

Figs. 58–68. Shafted spicules, *Geodites haldonensis.* Fig. 58. Typical form, hexternate head extended, vase-shaped. Fig. 59. Irregular form. Fig. 60. Regular form, smaller. Fig. 61. Trifid, extended cup-shaped. Fig. 62. Trifid, recurved, anchor-shaped. Fig. 63 The same, a little varied in form. Figs. 64 & 65. Bifid spicules (varieties?). Fig. 66. Hexternate, vase-shaped, closely allied to the type form, fig. 58 (for end view see fig. 32). Fig. 67. Trifid extended, cup-shaped head, with curved shaft. (This curved kind of shaft is so common and so remarkable that it also is very characteristic of *Geodites haldonensis*, if not deserving of a different specific denomination.) Fig. 68. The same as the last, with quadrifid head, furcated irregularly; variety.

Fig. 69. Hexternate head; stout spicule.

Fig. 70. Ternate expanded head; large spicule. *Stellettites haldonensis.* This spicule shows a very common occurrence in the deposit, viz. the bare extension of the axial canal (*a*), in solid petrifaction, without the walls of the spicule.

Fig. 71. Ternate head; arms straight, pointed, expanded laterally and forwards; shaft and arms very much alike in many varieties; numerous, of many sizes. *Dercites haldonensis.*

Fig. 72. Quaternate head, contracted, with long shaft; lateral view. *Gomphites parviceps.*

Fig. 73. The same, end view.

Fig. 74. Lateral view of *Gomphites Parfittii.*

Fig. 75. Portion of long shaft, to show the enlarged state of the axial canal, which is frequently present in these fossil spicules: *a*, wall of spicule, very thin; *b b*, axial canal, much enlarged; *c c*, grains of sand in it; *d*, end of spicule in it.

Fig. 76. Specimen of the large, fusiform, smooth, slightly curved, acerate spicule common in the deposit: *a a*, the pointed ends. This kind of spicule is very abundant, entire and fragmentary, of all sizes. The figure represents the average largest size, viz. about 1-5th of an inch long. The limits of the plate are not sufficient to allow of the spicule being represented in its entire length, and therefore the middle portion and two ends only have been delineated. The same remarks apply to the following spicule.

Fig. 77. Large fusiform acuate spicule, average large size, about 1-9th of an inch long.

Fig. 78. Smaller acuate spicule.

Fig. 79. Large contort bihamate spicule, *Esperites giganteus.*

XV.—*On a New Species of* Marginella *from South Africa.* By F. P. Marrat.

[Plate XI. fig. 13.]

Marginella Keenii, Marrat, n. sp.

Shell conically ovate; spire short; whorls four, rounded, blunt at the apex; colour orange-buff, somewhat translucent; columella with four sharply raised plaits; outer lip thickened, smooth within.

Hab. South Africa.

I have named this shell after my friend Mr. Keen, of Edge Lane, Liverpool, to whom the specimens (six in number) belong, and whose collection of *Marginellæ* is considered to be the finest in England.

100 Edge Lane, Liverpool.

XVI.—*Notes on the Structure of the* Crinoidea, Cystidea, *and* Blastoidea. By E. Billings, F.G.S., Palæontologist of the Geological Survey of Canada*.

[Continued from vol. v. p. 416.]

6. *On some points relating to the Structure of* Pentremites.

Professor Wyville Thomson has proposed a division of the skeleton of the existing Crinoid *Antedon rosaceus* into two systems of plates, which he terms respectively the "*radial*" and the "*perisomatic*" systems†. These he considers to be

Fig. 1. Fig. 2.

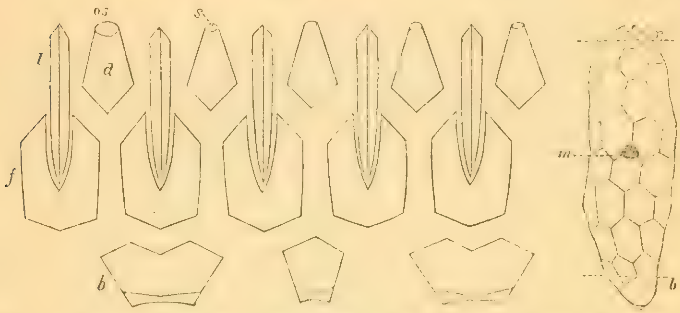

Fig. 1. Calycine plates of *Pentremites*: *b*, the basals; *f*, one of the five forked plates; *d*, deltoid plate; *l*, lancet-plate; *os*, oral spiracle; *s*, spiracle. Fig. 2. *Caryocystites testudinarius*, Hisinger: *b*, basal plates; *r*, radials; *m*, mouth.

thoroughly distinct from each other in their structure and mode of growth. The radial system consists of the joints of the stem, the centro-dorsal plate, the radial plates, the joints of the arms, and also those of the pinnules. In the perisomatic system he includes the basal and oral plates, the anal plate, the interradial plates, and any other plates or spicula which may be developed in the perisome of the cup or disk. This I think a good arrangement, except in so far as it regards the stem, which appears to me to be always an appendage of the perisomatic rather than of the radial system.

Throughout the whole range of the Crinoidea, the plates of the radial and perisomatic systems are easily distinguished from each other. In general the Cystidea have no radial plates in their calyces, except, perhaps, in a small area around

* From 'Silliman's American Journal of Science,' Sept. 1870.

† "On the Embryogeny of *Antedon rosaceus*, Linck (*Comatula rosacea* of Lamarck), by Professor Wyville Thomson, LL.D. &c." Philosophical Transactions of the Royal Society, vol. clv. part 2. p. 540.

the ambulacral orifice. This accords well with an important observation of Professor Thomson's on the structure of *Antedon* while in the earlier periods of its growth. "The entire body of the Pentacrinoid is," he says, "at first, while yet included within the pseudembryo and during its earliest fixed stage, surrounded and enclosed by plates of the perisomatic system alone; and it is quite conceivable that plates belonging to this system may expand and multiply so as to form a tessellated external skeleton to the mature animal, the radial system being entirely absent or represented only in the most rudimentary form" (*op. cit.* p. 541). Such is the structure of all the Cystidea. On referring to fig. 2, it will be seen that the whole of the body of *Caryocystites testudinarius* is covered with polygonal plates, without any trace whatever of a radiated arrangement. The plates are disposed in nine transverse ranges, girding the body like so many rings. This species is (and so are most of the elongated subcylindrical Cystideans) annulated rather than radiated, so far as regards the external integument. The lower range, below the line *b*, consists of the basals, whilst the upper, above the line *r*, may possibly be radiated. In all the globular or ovate Cystideans with numerous plates, such as *Sphæronites*, *Malocystites*, *Comarocystites*, *Amygdalocystites*, and others, the shell is neither annulated nor radiated, but composed of an indefinite number of plates, increasing with the age of the individual, and arranged without any well-defined or constant order. It seems clear, therefore, that the test of the Cystidea belongs mostly to the perisomatic system.

In *Pentremites* the three plates which are usually called the basals consist each of two pieces, one placed above the other, and in general closely anchylosed together. The lower pieces have each a re-entering angle in their upper edges, for the reception of the upper pieces which stand upon them. This structure was first pointed out by Mr. Lyon (Geol. Ky. vol. iii. p. 468), and is not generally admitted, although I believe it certainly does exist. It is said that the lower pieces consist of the upper joint of the column, divided into three by vertical sutures. To me they appear to be calycine plates. It is true that they do not form the bottom of the visceral cavity; but this may be due to the growth inward of the lower edges of those of the upper series. Something like this occurs in *Antedon*, where at first the bottom of the cup is formed by the basals, but afterwards principally by the first radials.

The forked plates are usually called "*radials*," but they certainly do not belong to the radial system. If they did, they would represent the first radials of the Crinoidea, and therefore they should support the bases of the ambulacra. A little consideration, however, will enable any one to perceive that in *Pentremites* the bases of the ambulacra are situated in the apex of the fossil, and do not come into contact with the forked plates. The apex of *Pentremites* is identical with the actinal centre of sea-urchins and starfishes, in which the mouth is situated. It is here that the ambulacra originate, and grow outward by the addition of new plates to their distal extremities. There can be little doubt that such was the mode of growth of the ambulacra of the *Pentremites*. The smaller extremity, therefore, of their ambulacra, which is received into the forked plate, is not the base, but corresponds with the apex of the ambulacrum of a sea-urchin or of a starfish. It also represents the tip of the arm of a Crinoid. If the forked plate is radial, then the arrangement of the ambulacrum must be the same as that which would be exhibited in a Crinoid with the upper end of the arm downward and resting on the first radial, whilst the lower end would be upward, the tip being formed of the second radial. From this it follows that the forked plates do not belong to the radial, but to the perisomatic system.

The five deltoid plates alternate with the forked plates, and are also perisomatic.

It is not certain that the lancet plates represent any of those plates which in the Crinoidea are usually called "radials." They are so arranged that if they were loosened from the walls of the cup, and their smaller extremities turned upward whilst their bases or larger ends retained their position, they would stand in a circle around the apex, as do the arms of an ordinary Crinoid. Their bases would alternate with the apices of the deltoid plates. They would form the outside of the arms, whilst the grooves and pinnulæ would be inside. Each would bear on its outer or dorsal aspect two elongated sacs, the two hydrospires that belong to the ambulacrum. I believe that the small groove in the ambulacrum of *Pentremites* was occupied by the ovarian tube only. If this be true, and if, also, the lancet plates represent the radial plates of the arms of the Crinoids, then the arm of *Pentremites* would have the respiratory portion of the ambulacral system on its dorsal, and the ovarian portion on its ventral aspect.

In the true Crinoids, both the respiratory and ovarian tubes are situated in the groove in the ventral side of the arm*. In

* Thomas Say, who was the first to recognize the Blastoidea as a group distinct from the Crinoidea, also supposed the function of the ambulacra to be respiratory. He says, "I think it highly probable that the branchial apparatus communicated with the surrounding fluid through the pores of the ambulacra by means of filamentous processes; these may

the Crinoids the pinnulæ are attached to the radial joints of the arm; in *Pentremites* they are not connected with the lancet plate, but with the pore-plates; in *P. pyriformis* they appear to me to stand in sockets excavated in the suture between the pore-plates proper and the supplementary pore-plates. Miller compared them to the series of azygos plates which underlie that portion of the ambulacrum of *Pentacrinus* that runs from the mouth to the base of the arm. These resemble the lancet plates in their being azygos and not connected with pinnulæ; but then, on the other hand, they differ from them in having a portion at least of the respiratory tubes on their ventral aspect. Mr. Rofe says that "in many species of *Pentremites*, if not in all, this lancet plate is in reality a compound plate, formed of two contiguous plates extending from the bottom of the sinus to the top, and then, turning right and left round the summit-openings, they pass down the adjoining sinus to form half its lancet plate, leaving at the apex of the body a pentagonal aperture supposed to be the mouth. In some weathered specimens the two parts of the lancet plate are separate; and in many they appear to meet only at the top and bottom of the cross section, leaving a lozenge-shaped opening between them" (Geol. Mag. vol. ii. p. 249). In a large specimen of *P. obesus* (Lyon and Cassiday), which was given to me by Mr. Lyon, a polished section shows that one of the lancet plates is thus divided; but in general no trace of a suture can be seen in these plates.

There are several points in the structure of the ambulacra of *Pentremites* that are well worthy of the study of those who have plenty of well-preserved specimens. Among these I would direct special attention to the markings in the ambulacrum of *P. pyriformis*. The median groove, which I suppose to have been exclusively occupied by the ovarian tubes, sends off branches, right and left alternately, toward the sides of the ambulacrum. These branches do not run directly to the ambulacral pores. Each of them terminates at a point between the inner extremities of two of the pores. There is at this point a small pit, which appears to be the socket of an appendage quite distinct from the pinnule. The groove does not reach the socket of the pinnule, which is situated further out,

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also have performed the office of tentacula in conveying food to the mouth, which was perhaps provided with an exsertile proboscis; or may we not rather suppose that the animal fed on the minute beings that abounded in the sea-water, and that it obtained them, in the manner of the Ascidia, by taking them in with the water? The residuum of digestion appears to have been rejected through the mouth." (Journ. Acad. N. S. Phil. 1825, vol. iv. p. 296.)

between two of the pores. On the other hand, a small groove runs from each pore inward, and terminates at another socket about halfway between the pore and the main median groove of the ambulacrum. It would thus appear that, besides the ordinary pinnules, there were two other rows of appendages on each side of the median groove.

The general conclusions at which I have arrived from the above are—that all the principal plates that compose the shell of *Pentremites* belong to the perisomatic system of Professor Wyville Thomson, that it is doubtful whether or not the lancet plates are homologous with the radial plates of the Crinoids, and that the ambulacra are more complicated in their structure than is generally supposed.

7. *On the Structure of the Genus* Nucleocrinus.

The body of this remarkable genus is ovate, elliptical, or oblong, and enclosed in a shell of strong perisomatic plates, which are in general so closely anchylosed that the sutures between

Fig. 3.

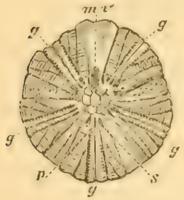


Fig. 4.

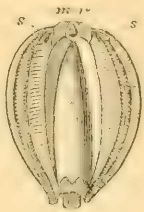


Fig. 5.

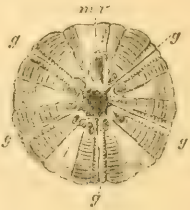


Fig. 6.

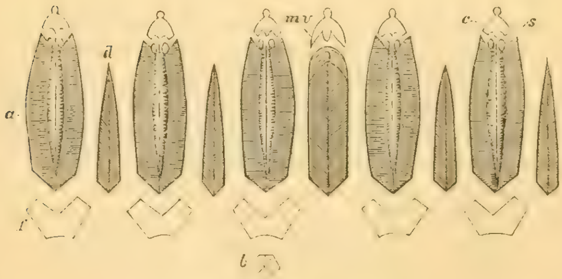


Fig. 3. Apex of *Nucleocrinus Verneuilii*, Troost: *g*, ambulacral groove; *p*, pore through which the groove enters into the interior; *s*, one of the ten spiracles; *mv*, oro-anal aperture. Fig. 4. Anterior side of a specimen: *o*, the anterior interradial. Fig. 5. Apex of a specimen which has lost the integument that covered the centre. Fig. 6. Diagrams of the plates of the test: *a*, ambulacral plate: *b*, the basals; *c*. plates of the apex; *d*, one of the interradials; *f*, forked plate.

them cannot be distinguished. According to Mr. Lyon, who, through his long-continued geological researches has collected and studied a vast number of specimens, there are three minute lozenge-shaped or quadrilateral basal plates, situated at the bottom of the columnal pit, always concealed when the column is present. These are surrounded by three other plates, the six together corresponding to the six pieces which constitute the compound basal plates of *Pentremites*. They are represented at fig. 6 *b*, as figured by Mr. Lyon (Geol. Ky. vol. iii. pl. 5. fig. 1 *b*).

In the next series there are five plates, which are undoubtedly the homologues of the five forked plates of *Pentremites*. They are very short, and confined to the base of the body. They form a shallow basin with ten re-entering angles in its margin (fig. 6 *f*).

Alternating above the forked plates are five pieces corresponding to the deltoid or interradial plates of *Pentremites*. Some of these are lanceolate in form (fig. 6 *d*), their broader extremities fitting into the angles between the forked plates. They taper to a point upward; and their sides are bevelled so as to pass under the ambulacral plates, to which they are in general so closely united that the line of junction is indicated only by the difference in the markings of the surface. Owing to this structure, these plates have not always been recognized by the authors who have described this genus. They were first pointed out by Mr. Lyon. The fifth deltoid or interradial plate is truncated at its apex for the reception of the oro-anal orifice (*mr*, figs. 4, 6). The sutures on each side of this plate are generally distinctly visible, especially in the upper part of the body.

The ambulacra are narrow—one line wide in a specimen fifteen lines in length, with a fine median groove about large enough to accommodate a tube of the size of a horse-hair. There are two rows of pores, those on one side of the groove alternating in position with those on the other side. These pores lead into the hydrospires. There appear to be only two rows of ambulacral ossicles. The pores are situated in the sutures between them. On each side of the ambulacrum there is a broad, transversely grooved marginal plate. From each pore a small rounded ridge runs across this plate. The grooves between the ridges originate at the outer extremities of the ambulacral ossicles. In well-preserved specimens the surface of these marginal plates exhibits no other structure than the transverse grooves and ridges; but in one weathered specimen that I have examined they seem to be composed of a number of narrow elongated pieces arranged transversely in such a manner that two of them abut against the outer extremity of each of the ambulacral ossicles, and extend outward towards the interradials. This seems to prove that the marginal plates belong to the ambulacra, as pointed out by Mr. Lyon, and not to the interradials, as represented by other authors. Although I have studied a large number of specimens, none of them were sufficiently perfect to enable me to make out the whole structure of this part of the test of *Nucleocrinus*. I have, however, seen enough to convince me that the ambulacra are much more complex than is usually supposed. The lancet plate, if it occur at all in this genus, must be very narrow. The ambulacral groove, as in *Pentremites*, sends off branches right and left. There is also evidence of the existence of minute marginal plates on each side of the groove.

The hydrospires are ten elongated sacs, each with two deep folds. They are perfectly homologous with those of *Pentremites*, only differing therefrom in not being united in pairs; consequently there are ten spiracles instead of five. The mouth, or oro-anal orifice, is larger in proportion to the size size of the body than it is in *Pentremites*. Mr. Meek informs me that the mouth in some of the Blastoidea is protected by a single valve that covered it like the lid of a jug. From the structure of the orifice, I am inclined to think that in *Nucleocrinus* it possessed a similar protection.

Fig. 7.

[Fig. 7. Transverse section through a specimen which has all the hydrospires preserved: *h*, the two anterior hydrospires; *p*, pore leading into the hydrospire; *g*, one of the grooves.

In the apex nearly all the space within the circle of apertures is covered by a thin integument of small plates (fig. 3). When this is not preserved, a large subpentagonal aperture is seen, as shown in fig. 5. This aperture occupies the position of the mouth in the existing Echinoderms. The integument, as will be shown further on, represents that which covers the mouth of an embryonic starfish. Mr. Conrad described this genus, in 1842, as having only one aperture in the summit:—"This genus differs from *Pentremites*, Say, in having only one perforation at top, which is central" (Journ. Acad. Nat. Sci. Phil. vol. viii. p. 280, pl. 15. fig. 17). His figure represents the fossil with the apex downward. Dr. Ferd. Roemer showed that, when perfect, there is no central opening; and he made this one of the grounds for separating the genus from *Pentremites*. He described the apex as being provided with six apertures, five of which were divided by a partition within each: these he considered to be the ovarian orifices. The sixth he supposes to be both mouth and vent, which accords with my view (Mon. der Blastoideen, p. 378). In 1868 I discovered the five small pores at the apical extremities of the ambulacral grooves (Silliman's Amer. Journ. ser. 2. No. 97, p. 353, and Ann. Nat. Hist. ser. 4. vol. iv. p. 76). In general it is difficult to see these pores; but if a silicified specimen, which has been fossilized in a calcareous matrix, be placed in an acid for two or three minutes, the acid cleans them out, and they then become distinctly visible. I believe these to be the pores through which the ovarian tubes passed outward along the grooves to the pinnulæ. There are thus sixteen apertures in the apex of *Nucleocrinus*—ten spiracles, five ovarian orifices, and one oro-anal aperture. There are no true radial plates. The whole of the test, with the exception, perhaps, of the ambulacra, belongs to the perisomatic system.

8. *On the occurrence of Embryonic Forms among the Palæozoic Echinoderms.*

Fig. 8.

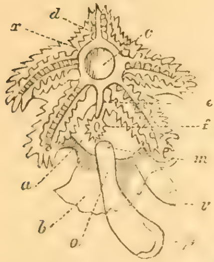


Fig. 9.

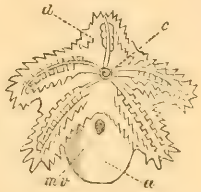


Fig. 10.

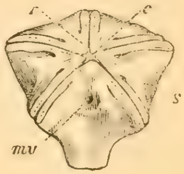


Fig. 11.

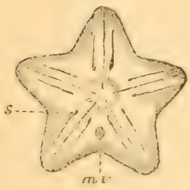


Fig. 8. *Bipinnaria asterigera,* Sars (copied from Müller): *a,* the stomach; *b,* part of the body of the larva; *c,* ambulacral centre, position of the permanent mouth, in this stage not open; *d,* one of the five ambulacral canals; *e,* sand-canal; *f,* madreporic plate; *m,* entrance into the stomach; *o,* œsophagus; *p,* larval mouth or pseudostome; *r,* œsophageal ring; *v,* vent. Fig. 9. Ideal figure described below. Fig. 10. *Codonites stelliformis,* oblique view, to show both body and summit. Fig. 11. Summit of fig. 10.

No proposition in natural history has been more clearly demonstrated than this—that in general the palæozoic animals resemble, both in external form and internal structure, the embryonic stages of those of the same class at present existing. Prof. Agassiz has long taught, in his lectures and various publications, that this is especially observable in the Echinodermata. Judging from the figures and descriptions of

Müller, Agassiz, Thomson, Carpenter, and others, I should say that in this class the most striking resemblance is that which occurs between the adult stages of the Cystidea, Blastoidea, and Crinoidea, on the one hand, and the embryonic starfishes on the other. The structural character that has the most important bearing on the subjects discussed in these notes is, that in all four of these groups the mouth is situated in one of the interradial areas, not in the ambulacral centre, as it is in the adult forms of the existing Echinodermata.

In *Bipinnaria asterigera*, Sars, according to Müller, the digestive cavity is a subglobular sac, without any extensions into the rays as there are in the adult starfishes. The œsophagus (fig. 8, *o*) is a fleshy, consistent tube, with a large mouth or pseudostome, *p*. It passes through the wall of the stomach by an opening somewhat smaller than the mouth, and situated in one of the interradial spaces at *m*. The madreporic plate (*f*) and the sand-canal (*e*), the latter holding the convoluted plate (when it occurs), are situated above the orifice (*m*), and between it and the ambulacral centre (*c*). The circular space at *c* is undoubtedly the homologue of the central space in the apex of *Nucleocrinus* (figs. 3 & 5) and of *Codonites* (figs. 10 & 11). It is also the position of the mouth in the adult starfish; but in the larval stage it is completely closed by the soft external skin and sarcode of the body. In the fossils it is also closed, but by an integument of thin calcareous plates. The *Bipinnaria* is nourished by minute particles of matter diffused through the water and drawn into the digestive sac through the mouth and œsophagus by the action of interradial cilia. I believe that all the fossil Crinoidea, Blastoidea, and Cystidea ingested their food in this way, and without any aid whatever from the arms or pinnulæ.

Perhaps there is no embryologist who will not admit that it is possible for an animal like *Bipinnaria* to develope organs of reproduction and propagate its species, none of its other parts making any further advance. Such an animal, with some slight modifications, would not be very widely different from a palæozoic Crinoid. If the sarcodic body-wall were to be consolidated into a thin calcareous integument, with the mouth even with the surface, the swimming-appendages aborted, and the vent closed up, it would resemble the cup of an *Actinocrinus* (fig. 9 *a*). The lateral orifice would then be both mouth and vent, as it is, at first (according to Prof. A. Agassiz, 'Seaside Studies,' p. 125), in the embryo of *Asteracanthion berylinus*. The ambulacral canals of *Bipinnaria* are the homologues, in a general way, of those which are found beneath the vault of *Actinocrinus*, and extend outward into the grooves of the arms. If the ventral perisome of the Crinoid were to be removed (the internal organs remaining undisturbed) the arrangement disclosed would be that represented in fig. 9—a convoluted plate in the centre with the canals radiating from it. The most striking difference is the absence of the œsophageal ring. According to the organization of *Actinocrinus* there could be no œsophagus at that point; and consequently there is no ring. The convoluted plate represents the madreporic apparatus. The sucking-feet of the starfish most probably represent the respiratory tentacles that border the grooves of the Crinoids, but modified into prehensile and locomotive organs. *Bipinnaria* and *Actinocrinus* agree in having the mouth in one of the interradial areas, and in the absence of an orifice through the peristome at the ambulacral centre. These two characters are embryonic and transitory in the starfish, but they were permanent in most palæozoic Crinoids.

In *Codonites stelliformis* (*Pentremites stelliformis*, Owen and Shumard), figs. 10, 11, the ambulacral centre, *c*, is completely closed. Five minute grooves radiate to the extremities of the five angles of the disk. These grooves are identical with those of *Pentremites* and *Nucleocrinus* and were occupied by the ovarian tubes. The ambulacral canals of the true Crinoids and of the starfishes are represented in a rudimentary condition, in this species, by the hydrospires, which open out to the surface through the ten fissure-like spiracles (*s*). The oro-anal orifice is interradial. *C. stelliformis* in external form, the interradial position of the mouth, and the closed ambulacral centre resembles *Bipinnaria* and *Actinocrinus*, but differs importantly in having its respiratory organs arranged in ten separate tracts, all totally disconnected from each other. It is a lower form than *Actinocrinus*, which, in its turn, is lower than *Bipinnaria*; and yet all three are constructed on the same general plan.

C. stelliformis, although much resembling a *Pentremites*, is a true Cystidean. Its affinity to *Codaster* was first pointed out by Dr. C. A. White, who also suggested that it should be assigned to a distinct group (Bost. Journ. N. H. vol. vii. pp. 486, 487). The main difference between the Cystidea and the Blastoidea is, that in the former the hydrospires do not communicate with the pinnulæ, whilst in the latter the cavities of the pinnulæ and hydrospires are directly connected by the ambulacral pores.

The development of the recent Crinoid *Antedon rosaceus*, as described by Prof. Wyville Thomson (Phil. Trans. 1866), pursues a course that could not possibly result in the production of such an animal as *Actinocrinus*. The pseudembryo, as it is called by Prof. Thomson, is a small ovate organism, with four transverse ciliated bands, a large keyhole-shaped mouth (pseudostome), and a small circular vent (pseudoproct). These orifices are connected by a rudimentary intestine (pseudocele). In this stage there is no trace of radiation, and the mouth, therefore, cannot be said to be interradial in its position.

The nascent Crinoid originates within the pseudembryo, but developes a mouth, vent, and stomach of its own, all quite distinct from those of its nurse. This new or permanent mouth is for a short time both oral and anal in its function; but although in this respect it resembles that of *Actinocrinus*, its position in the centre of the ambulacral system shows it to represent the mouth of the adult starfish, while that of *Actinocrinus* homologizes rather with the oral orifice of the *Bipinnaria*. At no time during its development does the ventral perisome exhibit the structure of that of the palæocrinoids, *i. e.* no orifice in the ambulacral centre, and at the same time one in an interradial space. In the central position of its mouth, and in the possession of an œsophageal ring, *Antedon* stands above *Actinocrinus* in rank, and between it and the adult starfish. In none of its stages does it resemble a *Bipinnaria* either in form or in structure.

9. *On some of the Objections that have been advanced against the Views advocated in the preceding Notes.*

In all the known species of the existing Echinodermata the mouth is situated in the centre of the ambulacral system; and it is contended that this fact proves that such must have been its position also in the palæozoic forms.

This reasoning is not strictly logical. It is true that in the known existing species the mouth is in the centre; but it does not certainly follow that it is so in all the Echinodermata, living and extinct. Whether it is so or not in any particular fossil species whose structure may be under investigation, *is a question of fact which can only be positively determined by direct observation of specimens.* On appealing to these we find that, in a large proportion of the fossil forms, there is no aperture in the perisome at the ambulacral centre. It also becomes evident by the comparison that in general the palæozoic species resemble the embryonic stages of some of the recent Echinoderms, and that in these (*Bipinnaria* for instance) the mouth is interradial. Rules such as that relied on in this case, afford a certain amount of presumptive evidence, which, however, cannot prevail against material and visible facts. When we can see clearly that there is no aperture in that point in the vault of a Crinoid beneath which we know the ambulacral centre is situated, it is perfectly useless to supply one by deduction*.

The second objection is, that many of the fossils have a *Platyceras* attached to them in such a position as to cover the aperture which I call the mouth, and under such circumstances as to induce the belief that it lived parasitically on the Crinoid. The only answer I can make to this is, that, admitting the facts, we must suppose that space was left for a stream of water to pass under the edge of the shell into the mouth of the Crinoid. In general, where one animal lives parasitically upon another, it does not destroy its host. Some of the Gasteropods of the Devonian and Carboniferous ages were carnivorous, as is proved by the bored shells and Crinoids that are occasionally found. I have seen a number of such specimens, and several years ago I read a paper on the subject (which was never published) before the Natural-History Society of Montreal. There were several good conchologists present; and the specimens exhibited were compared with bored shells of existing species: all pronounced the style of workmanship to be precisely the same. I have the proboscis of an *Actinocrinus* that is bored near the base; and among the fossils lent me by Mr. Wachsmuth is a *Codonites stelliformis* that has one of the ambulacra bored through. The view I took of the subject in my paper was, that the Gasteropod ascended the stalk of the Crinoid and thrust its proboscis into the mouth of the latter. The Crinoid then slowly drew its arms together, and held the shell fast until both died.

Fig. 12.

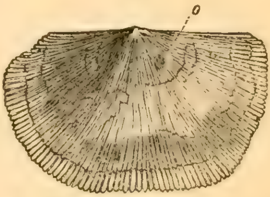


Fig. 12. *Streptorhynchus pandora.* A specimen bored at *o* by a carnivorous gasteropod. From the Corniferous Limestone, Devonian, Canada.

A third objection is the small size of the aperture in some of the species. In general, where there is no proboscis, the orifice is from one twentieth to one tenth of an inch in diameter, quite sufficient for an animal that subsists on micro-

* The position of the ambulacral centre may thus be found. When the mouth is eccentric, the ambulacral tubes usually converge to the centre of the vault; but when the mouth is central, we first find the azygos interradius, in general easily recognized by its possessing a greater number of plates than any one of the other four interradii. On the opposite side of the fossil is the azygos arm. The ambulacral centre is always situated between this arm and the mouth, never on the side of the mouth towards the azygos interradius.

scopic organisms. It is stated by Meek and Worthen that where there is a proboscis the aperture is sometimes scarcely "more than *one hundredth* of an inch in diameter." I believe that in many such instances the tube filled up by calcareous deposits on its inside, and that, when entirely obstructed, either a new aperture opened out in the side of the proboscis, or the animal died. In Mr. Wachsmuth's collection I saw a specimen with a second aperture in process of formation. A ticket was attached to it by him, giving this explanation. I am also informed that in some of the existing species of *Antedon* "the mouth is an exceedingly minute aperture."

A fourth objection is that the aperture is so situated that the arms could not have conveyed food to it. It is, however, proved by Dr. W. B. Carpenter that in the recent Crinoids the arms are not prehensile organs. The animal while feeding remains motionless, attached by its dorsal cirrhi to a stone, shell, or other object on the bottom. Its arms are either stretched out to their full length, or more or less coiled up, but quite immovable. As Dr. Carpenter's remarks have a very important bearing upon the subject, I shall take the liberty of quoting the following:—

"Whatever may be the purpose of the habitual expansion of the arms, I feel quite justified in asserting that it is *not* (as stated by several authors whom I have cited in my historical summary) the prehension of food. I have continually watched the results of the contact of small animals (as Annelids, or Entomostracan and other small Crustacea) with the arms, and have never yet seen the smallest attempt on the part of the animal to seize them as prey. Moreover the tubular tentacula with which the arms are so abundantly furnished have not in the slightest degree that adhesive power which is possessed by the 'feet' of the ECHINIDA and ASTERIADA; so that they are quite incapable of assisting in the act of prehension, which must be accomplished, if at all, either by the coiling-up of a single arm, or by the folding-together of all the arms. Now I have never seen such coiling-up of an arm as could bring an object that might be included in it into the near neighbourhood of the mouth; nor have I seen the contact of small animals with a single arm produce any movement of other arms towards the spot, such as takes place in the prehensile apparatus of other animals. Moreover any object that could be grasped either by the coiling of one arm, or by the consentaneous closure of all the arms together upon it, must be far too large to be received into the mouth, which is of small size, and is not distensible like that of the ASTERIADA"*.

* "Researches on the Structure, Physiology, and Development of *Antedon* (*Comatula*, Lamk.) *rosaceus*." Part I. By W. B. Carpenter, M.D., F.R.S. (Philosophical Transactions of the Royal Society, vol. clvi. part 2, 1866, p. 699.)

Further on Dr. Carpenter says:—

"It was affirmed by M. Dujardin (L'Institut, No. 119, p. 268) that the arms are used for the acquisition of food in a manner altogether dissimilar to ordinary prehension; for, recognizing the fact that the alimentary particles must be of small size, he supposed that any such, falling on the ambulacral (?) furrows of the arms or pinnæ, are transmitted downwards along those furrows to the mouth wherein they all terminate, by the mechanical action of the digitate papillæ which fringe their borders. This doctrine he appears to have abandoned, since, in his last account of this type (Hist. Nat. des Echinodermes, p. 194), he affirms that the transmission of alimentary particles along the ambulacral (?) furrows is the result of the action of cilia with which their surface is clothed. Although I have not myself succeeded in distinguishing cilia on the surface which forms the floor of these furrows, yet I have distinctly seen such a rapid passage of minute particles along their groove as I could not account for in any other mode, and am therefore disposed to believe in their existence. *Such a powerful indraught, moreover, must be produced about the region of the mouth, by the action of the large cilia which (as I shall hereafter describe) fringe various parts of the internal wall of the alimentary canal, as would materially aid in the transmission of minute particles along those portions of the ambulacral (?) furrows which immediately lead towards it*; and it is, I feel satisfied, by the conjoint agency of these two moving powers that the alimentation of *Antedon* is ordinarily effected. In the very numerous specimens from Arran the contents of whose digestive cavity I have examined, I have never found any other than microscopic organisms; and the abundance of the horny rays of *Peridinium tripos* (Ehr.) has made it evident that in this locality that Infusorium was one of the principal articles of its food. But in Antedons from other localities I have found a more miscellaneous assemblage of alimentary particles, the most common recognizable forms being the horny casings of ENTOMOSTRACA or of the larvæ of higher CRUSTACEA." (*Op. cit.* p. 700.)

The existence of large cilia within the intestinal canal, capable of producing a powerful indraught of water, renders any movement or concurrent action of the arms quite unnecessary in the ingestion of food. It does not matter, therefore, in what part of the body the mouth of a Crinoid may be situated, or how remote from the reach of the arms. Attached permanently to the bottom of the sea by their columns, the palæozoic Crinoidea, Cystidea, and Blastoidea remained, while feeding, most probably motionless, drawing in streams of water through their mouths by the action of their intestinal cilia. The long tubular proboscis with which many of the species are provided would thus be analogous in function to the siphon of the Acephalous Mollusca. The indigestible particles would be, from time to time, thrown out through the mouth, just as a starfish or a zoophyte frees itself of the refuse portions of its food, by casting it out of the same aperture through which it entered.

10. *On the Theory that the Ambulacral and Ovarian Orifices are the Oral Apertures.*

Assuming that the four objections above noticed are sufficient to prove that the aperture which I call the mouth is not that organ, it is contended that the Cystidea, Blastoidea, and Palæocrinoidea ingested their food through their ambulacral and ovarian orifices. This appears to me in the highest degree improbable. In the recent Crinoids the grooves of the arms are occupied by four sets of tubes, which Dr. Carpenter calls the cœliac, the subtentacular, the ovarian, and the tentacular canals. None of them communicate with the stomach. It is impossible that the most minute particle of food could gain access to the interior of the animal through any of them. The structure of the arms of the palæozoic Crinoids is such that we must presume that their grooves were occupied by similar tubes, which passed through the ambulacral orifices into the perivisceral space. In the Cystidea and Blastoidea the respiratory organs were not situated in the grooves of the arms, and the ambulacral orifices were therefore only ovarian in their function. The improbability of their being also oral apertures is best shown by an illustration.

In fig. 13 is represented (natural size) the apertures of the smallest specimen of *Caryocrinus ornatus* in our collection, selected for the present purpose because in the young of this species the valvular orifice is larger in proportion to the size of the disk than it is in the adult. It is in this specimen about one third of the whole width of the apical disk, while in a full-grown *Caryocrinus* it is only one ninth of the width. The same proportional size of the mouth according to age occurs in *Antedon rosaceus*. The valvular mouth at first is as wide as the disk; but as the age of the animal increases, the disk grows wider, but the mouth does not. The ovarian pores in *Caryocrinus*, however, are as large in the small ones (once they make their appearance) as they are in those full-grown. For recognizing these as ovarian pores we have the following reasons:—1, they are situated at the bases of the arms where the ovarian tubes must pass from the grooves into the perivisceral cavity; 2, when compared with the ovarian pores of a sea-urchin, they have the same size, form, and aspect. Fig. 14 represents the ovarian pores of the sea-urchin *Toxo-*

Fig. 13.

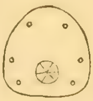
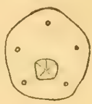


Fig. 14.



pneustes drobachiensis, Ag., natural size and arrangement. It may not appear at first view that this latter comparison has any probative effect. But it has, in this way. If these apertures in *Caryocrinus* were large openings a line wide, as are some of the ambulacral orifices of the Crinoids, I should say that they were unlike true ovarian apertures.

According to the new theory, this Echinoderm, *Caryocrinus ornatus*, was a polystome animal, and drew in its food through its six ovarian apertures, the large valvular orifice being the anus. To me this appears to be utterly incredible.

In fig. 14 I have represented the mouth of *Leskia mirabilis*, Gray. Both Dr. J. E. Gray and Prof. Lovén have pronounced this aperture to have the structure of the valvular orifice of the Cystidea. I have not the slightest doubt whatever that the mouth of the Cystideans foreshadows that of the sea-urchins. There is nothing whatever in its structure to show that it is not the mouth, but the contrary.

The new theory is not founded upon any peculiarities in the structure of the ambulacral orifices which would show that they are oral apertures, but only upon the four objections above noticed. The first of these is not logical, while at the same time it is purely theoretical, and avails nothing against material and visible facts. The fourth is completely disposed of by Dr. Carpenter's observations, which prove that in the Crinoidea the arms have no share whatever in the ingestion of food. The second and third objections are the same in substance; *i. e.* according to the second the supply of water to the mouth is diminished by the occurrence of a *Platyceras* over it, while, according to the third, the same effect is produced by the small size of the aperture itself in some instances. It does not require much consideration to convince one that, if these two objections are fatal to my views, they are equally so to the opposite theory. In *C. stelliformis*, for instance, the pores through which we must suppose the ovarian tubes issued from the interior are only large enough to admit of the passage of a fine hair; they are scarcely visible to the naked eye. The tube, under any circumstances, must have filled them almost entirely. If any space at all were left for the passage of a stream of water through the pore by the side of the tube, it must have been exceedingly minute.

When weighed as above, therefore, the evidence gives the following results:—The first and fourth objections avail nothing; the second and third militate against both theories; but when we take into account that in no instance, in the existing Echinodermata, where ovarian pores occur, are they at the same time oral orifices, the balance seems to be in favour of my view. This is all I desire to say upon the subject at present. Although I now firmly believe that the valvular orifice in the Cystidea, the larger lateral aperture of the Blastoidea, and the so-called proboscis of the palæozoic Crinoids are all oro-anal in function, yet I shall not maintain that view obstinately against good reasons shown to the contrary.

XVII.—*On a Species of Arenaceous Foraminifer* (?) *from the Carboniferous Limestone of Devonshire.* By Edward Parfitt, Esq.

[Plate XI. figs. 9–12.]

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

I beg to enclose you a rough sketch of what I had at first regarded as a species of *Cliona* new to science; but on a more extended acquaintance with the specimens, and comparing them with the beautiful figures of the arenaceous Foraminifera described by Dr. Carpenter in the Royal Society's 'Transactions,' vol. clix. part 2, plates 72–76, I am now more inclined to regard it as a sessile arenaceous Foraminifer. This species or form I met with on a block of carboniferous limestone brought from the quarry of Westleigh, near Tiverton, Devonshire. The specimen covered a space of eight or ten inches, and was so consolidated with the rock that, had it not been for the weathered surface, I should have passed it by.

The weathered surface has just the appearance of what we might expect to see in a free fossil *Cliona*; the resupinate stolons, variously branched and attached, quite resemble those of the recent forms of this genus (fig. 9). On having a small specimen cut and polished, I was much surprised to find that all the interstices between the stolons were filled with sand, charged more or less with a ferruginous tint; and on applying nitric acid to the surface for some time, this ate away the calcareous portions and left the interstices standing up prominently between the calcareous disks. The sand, as now exposed, appears to be quartz; and, generally speaking, the grains are as sharply angular as if it had just been broken up on purpose for this animal, and used by it directly. On comparing the part which had been submitted to the acid with the figures in the Royal Society's 'Transactions,' pl. 76, there is a very strong family likeness at once apparent. In my specimen the labyrinthiform spaces are filled with calcareous matter of the same colour as, and apparently very little different from, the limestone; at the same time each of the spaces of the labyrinthic structure shows a dark centre, more or less irregular in shape, as if the crystallization or infiltration had begun round the walls and had not quite filled up the centre of each space. The whole of the arenaceous walls or framework is rendered solid by the infiltration of the calcareous matter, so that even the quartz grains require nitric acid of its full strength to separate them. So far, I have not observed any shells of Foraminifera or any extraneous material worked into the walls of this species, more than the grains of quartz-sand; and if the calcareous matter were withdrawn, leaving only the arenaceous walls, the difference between a portion of this and Dr. Carpenter's figure (t. 76. fig. 2) would be very little indeed.

In some of the labyrinthiform spaces there may be observed, besides the one dark irregular mark, two or three small specks like imperfect cells: in one place I observed three elliptical disks, with perfectly formed double rings or walls; but although these disks have at first sight the appearance of sections of corals, the annulations are only paler-coloured lines, and not solid walls. The two loops in the left-hand figure and the septa in the lower figure are all of the same kind (see fig. 12); they do not appear ever to have been solid structures. When I first saw these cells, I thought it probable that the foraminiferous animal had grown up round some stems of corals for support; but on a more careful examination I am compelled to give up this opinion.

Now the question is, what is this animal, and what position can we assign to it in the scale of creation? It does not appear to be a *Cliona*; or if it is, its habits are quite different from those of other forms I am acquainted with; nor does it agree well with the arenaceous group of sponges, the "*Dysidea*," so far as I know them; but, viewing this in all its bearings, it appears to me to hold a place between the arenaceous Sponges and the arenaceous Foraminifera. The stoloniferous growth is common to both; in the Foraminifera there appears to be a much greater degree of regularity observed in building up their structures than is seen in the habits of the stoloniferous Sponges. The general growth of the Foraminifera is more or less concentric, starting from a primordial cell; in the fossil we have under consideration no such growth can be traced, although no doubt this also sprang from a primordial cell. But I would not insist upon this, as it may have been a gemma or bud, or even a group of cells; but whatever its beginning may have been, it has spread over several inches of the carboniferous limestone, and was also three or four inches thick. There is not the least sign of its ever having been circumscribed by a test of any kind, but it appears to have spread out over the rock in the same manner as we observe in the recent sponges.

I have said above that the interstices between the stolons or labyrinthiform structure are filled with sand, and from its appearance and hardness I thought it was quartz, as it is much harder than the limestone or calcareous matter which fills the stoloniferous structure, and resisted the action of the acid so thoroughly, while the interspaces were quite eaten away, that walls of crystals, as they now prove to be, were left standing up round the interspaces. My friend Mr. Vicary has kindly submitted a fragment of this fossil to the blowpipe, when it burns into a white lime, with minute scattered points of a metallic substance resembling iron, probably a carbonate or sulphate of iron. It is this, no doubt, which has given the crystals a ferruginous tint.

It has struck me as very curious, since it has been discovered that the crystals are calcareous, and, from their rhomboid form, they are believed to be carbonate of lime. If this be really the case, it would seem that this was an animal secretion. The crystals are very irregularly deposited, and adhere to each other at various angles; they are nearly all of the same size. I have met with similar crystals on the membranes or chitinous matter in the shells of *Carcinus mænas*; and they are also found in the shells of oysters, on the animal secretions; it is therefore not singular that they should be found here, and more particularly as both the Spongiadæ and the Foraminifera secrete calcareous or siliceous matter as the case may be. The crystals measure $\frac{1}{80}$ of an inch in diameter, varying but little in size. If these grains, or crystals as they now prove to be, had really been quartz, as I at first considered they were, I should then have thought that I had a new form of *Cliona* before me, and that it had the habit of constructing an arenaceous covering for itself. It may be thought by some, perhaps, that this was a burrowing *Cliona*, and that the infiltration of the calcareous matter into the stoloniferous structure may have quickly succeeded the death of the animal, and what are now crystalline rhomboidal prisms may have succeeded the decay of the rock or shell in which the *Cliona* lived and died. But I do not think this can have been the case. In the first place, the thickness is against it; and in the next, what should have precluded the infiltration into the decaying shell (an assumed shell) of the same material as that which fills the labyrinthiform or stoloniferous structure? I know of nothing; and I think, therefore, that we must fall back upon the supposition that this animal secreted the carbonate of lime. I scarcely know what provisional name to give this fossil, and shall therefore let it stand over to some future time.

I am, Gentlemen,
Yours obediently,
EDWARD PARFITT.

Devon and Exeter Institution, Exeter.

EXPLANATION OF PLATE XI. figs. 9–12.

Fig. 9. Portion of weathered surface with the crystals of carbonate of lime washed out or decayed: enlarged.
Fig. 10. Specimen cut horizontally, showing the interstices of the stolons filled with crystals: enlarged.
Fig. 11. End view of specimen, showing the stoloniferous masses standing out free. The cross lines are the natural size of the specimen.
Fig. 12. Three cells (?), showing indications of double walls and septa: magnified.

XVIII.—*Reply to* Dr. Gray *on* Testudo chilensis &c. By P. L. SCLATER, Ph.D., F.R.S.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,

Dr. Gray, following his habitual practice, has thought proper to reply to my scientific criticisms upon the species described by him as *Ateles Bartletti* and *Testudo chilensis* with a series of personal remarks which I do not care to notice. As, however, one of the charges made against me would, if true, affect the credit of this Society, I request you to publish, in answer thereto, the subjoined account of some observations on this subject made at the meeting of this Society last evening.

I may also as well state that it is not correct that (as assumed by Dr. Gray) my information as to the synonyms of the (so-called) *Testudo chilensis* was obtained from Dr. Gray's "short note."

I am, Gentlemen,
Your obedient Servant,
P. L. SCLATER.

Zoological Society of London,
11 Hanover Square, London, W.
January 17th, 1871.

"On concluding my series of reports upon the additions to the Society's menagerie for the past year, I beg leave to take this opportunity of calling the attention of the meeting to the register of accessions to the menagerie now lying on the table.

In it will be found the English and scientific name, sex, and locality, so far as these are ascertainable, of every vertebrate animal received alive by the Society, together with information as to how it was obtained, whether by presentation, purchase, or otherwise. A corresponding register is kept of all the deaths that occur in the Society's Gardens, and of the mode in which the bodies are disposed of. This lies also on the table. Both these registers, which are kept at the Superintendent's office in the Gardens, are, I need hardly say, at all times open to the inspection of the Fellows of the Society, or of any other person interested in them. Moreover, in order to give greater publicity to the list of arrivals, a copy of them is published every week in the 'Field' newspaper.

"From the earliest days of the Society's existence it has been the practice to keep a register of 'arrivals and departures' in the daily journal of 'occurrences,' as it is termed, prepared by the Superintendent. Ever since the day when I had the honour of becoming Secretary of the Society, the register of accessions has been carefully revised every month, and printed in the 'Proceedings.' This was at first done month by month*; but it was thought afterwards to be more convenient to give the list of additions for the year continuously, so that since 1862 it has been printed entire as an 'Appendix' to the yearly volume of 'Proceedings.' At the same time it has been my constant practice (as those here, who have so often had to listen to me, must be fully aware) to bring before the scientific meetings such notices as seemed to be requisite of all the more remarkable additions to the Society's collection, so as to call more immediate attention to every accession of special interest. I have likewise edited and published for the Society four editions of the list of Vertebrated Animals in the Society's Gardens, and am now engaged in preparing a fifth edition, which will contain a record of every accession received up to the close of last year, and will thus form a complete list of all the animals that have been living in the Society's Gardens during the past ten years. I have been induced to trouble the meeting with these few remarks, because, in the last number of the 'Annals of Natural History'†, a Fellow of the Society has assured the public that no proper record is kept of the living animals received in the Society's Gardens. How such a statement can have been conscientiously made in the face of the facts above stated, by

* See P. Z. S. 1859, p. 212, where the first of these lists (for May of that year) is given.

† Ann. Nat. Hist. ser. 4. vol. vii. p. 15.

one who was formerly a Vice-President of the Society and is in the constant habit of referring to the 'Proceedings,' I am not able to explain."

XIX.—*On* Ateles Bartletti. By Dr. J. E. Gray, F.R.S. &c.

In the minutes of the meeting of the Zoological Society, 17th January 1871, just published, it is stated that, on concluding his Report, "the Secretary called attention to the registers of accessions to and deaths in the Society's menagerie which lay on the table, and showed, in contradiction to statements recently published by Dr. Gray, that they were faithfully kept up, and that a revised abstract of the former was published every year as an appendix to the Society's 'Proceedings.'"

I did not deny the existence of the register, and I am very glad to hear that it is better kept than when I was able to attend the Society, when it did not furnish the information that I required; and the abstract being published in the 'Proceedings' is comparatively a recent custom. From the inquiries made of me, it is certain that the register must often have been many months in arrear; and if this register contained the habitats, the difficulty that I have experienced in obtaining them is the more incomprehensible.

Since my observations an alteration, which is a great improvement, has certainly been made. The dead animals are now marked with a ticket referring to the register giving the origin, habitat, &c. But this is not extended to all the specimens; for I received some young Crocodilians and a Lizard without any such ticket, and rejected them, as the habitat is most essential when determining the Crocodilians in their young state.

When Dr. Sclater made the extraordinary general statement* that the habitats of the specimens in the British Museum were not to be depended upon, of course he referred to the numerous specimens which we annually purchase from the Zoological Society; of the others he could have but a very limited knowledge; and the greater part are received from the

* It was to be expected that Mr. Sclater would before long himself refute the sweeping assertion that no argument whatever, as regards geographical distribution, could be based on the specimens in the British Museum. Only a week or two ago there appeared in 'Nature' a popular article of his on the Fauna of New Zealand. May we ask him whence he could have obtained more complete information regarding the reptiles of that country than from the Catalogue of the British Museum?

travellers who collect them, and are entered in the register with the habitats which they give them.

At the same meeting "Dr. Sclater exhibited a typical specimen of *Ateles variegatus*, Wagner, and pointed out its unquestionable identity with *A. Bartletti*, Gray."

I and other zoologists must be deeply indebted to the Bavarian Government, and to the Director and Conservator of the Museum at Munich, for having allowed one of their "typical specimens" to leave the country, to the Council of the Zoological Society for having incurred the expense of its transmission, and to Dr. Sclater for the energy he has shown in this important question, by which they have determined that the *Ateles variegatus* of Wagner is not the *Ateles melanochir*, as was formerly believed, but the same as *A. Bartletti*, which was published in the 'Proceedings' of the Society, under Dr. Sclater's editorship, several years ago; and I suppose its being Wagner's is a new discovery to him, as well as it is to myself; and therefore it was not a very great crime on my part not to know it. It did not require great scientific acumen to discover it when the specimen was observed in a Continental museum. However, I must say that, although I do not quite agree with it, there is great truth in the observation of Mr. Cotrel Watson (the author of 'Cybele Britannica'), "that wilfully to impose a new name to a plant already sufficiently named should be treated as an impertinence; on pretence of priority, to rake up and restore an old name which has fallen out of use, should be scouted as a mischief; the personal vanity which impels authors into this practice should be denounced as a nuisance." The late Dr. Walsh, the celebrated American entomologist, has been more severe. "To my mind," he says, "the naturalist who rakes up out of the dust of old libraries some long-forgotten name, and demands that it shall take the place of a name of universal acceptance, ought to be indicted before the High Court of Science as a public nuisance, and, on conviction, sent to a Scientific Penitentiary and fed there for the whole remaining term of his scientific life upon a diet of chinch-bugs and formic acid."

Unfortunately there is often as much personal animosity as vanity at the base of these proposed alterations and corrections, especially when they only refer to an isolated species of a genus, and do not arise from a general survey of the group, and when they are only directed against the writings of an individual author. In this case it will be necessary that the specimens in the Munich and the British Museums should each retain the name under which it had been described, or they will lose their typical identity, which is now considered of so great importance, when the name by which an animal is called and the author who gave the name are regarded as more important than the animal itself, its structure, affinities, or habits.

XX.—*Description of a new Species of Butterfly of the Genus* Paphia. By Osbert Salvin, M.A., F.L.S., &c.

In a collection of butterflies recently sent by Mr. E. M. Janson from Chontales, Nicaragua, is a single specimen of a very distinct species of the Nymphaline genus *Paphia*, which appears to be quite new, and which I propose to call

Paphia Jansoni.

♂. Exp. 3·6 in. Antennæ black; palpi brown, with their anterior surface lighter; prothorax, thorax, and abdomen blackish brown: anterior wings strongly falcated, above very dark brown; cilia of outer margin, a spot near the apex which runs out to the point of the hook, a second beyond the cell between the upper radial and third costal branch, a third (elongated one) between the radials, a fourth between the second and third median branches, and a fifth between the first and second median branches yellowish drab; region of the submedian nervure rufescent; posterior wings rufous, with the third median branch prolonged into a spatulate projection, anal angle strongly produced; outer margin, including the emarginations of the wing, very dark brown: under surface ochraceous brown irrorated with darker brown, and more pronounced transverse bands of the same colour; there is a series of pale spots near the apex of the anterior wing, and a pale spot about the middle of the subcostal nervure of the posterior wings, which also have other spots near the anal half of the outer margin edged outwardly with black.

Hab. Chontales, Nicaragua (*Janson*).

Obs. This species, so far as its form is concerned, belongs to the group containing *Paphia Electra* (Westw. & Hew. Gen. Diurn. Lep. p. 319; Hew. Ex. Butt. i. t. 46. f. 1, 2) and *P. Panariste* (Hew. Ex. Butt. i. t. 46. f. 3), being more nearly allied to the former than the latter. The colouring of the upper surface, however, is so entirely distinct that comparison is unnecessary.

BIBLIOGRAPHICAL NOTICES.

Natural-History Transactions of Northumberland and Durham. Vol. III. Part 2. 8vo, 1870.

Cardiff Naturalists' Society, Report and Transactions, 1868–69. 8vo, 1870.

The first of the above-mentioned works comprises papers read at the meetings of the Natural-History Society of Northumberland, Durham, and Newcastle-upon-Tyne, and of the Tyneside Naturalists' Field-Club, together with an Anniversary Address by the President, the Rev. R. F. Wheeler, Financial and other Reports, lists of officers and members, and index to the volume for 1868–70. The President's Address to the members of the Field-Club was read in the museum of the Natural-History Society, thus bringing pleasant reminiscences of summer excursions, and succinct notices of their useful results, to the indoor gathering of town and country members, amidst the trophies their science and energy have won from nature and stored in their famous museum. The address itself is not only an eloquent record of one year's happy work, but a typical compendium of the lines of research and modes of operation that our ardent but steady North-of-England brethren have pursued for a quarter of a century in their elaboration of complete catalogues and full descriptions of all things and circumstances which are presented to their notice as parts and belongings of the system of Nature—Newton's "elegantissima compages," of which man is not only to be an admiring spectator, but an intelligent interpreter.

Both the recent and the fossil life of Northumbria are worthily treated of in the fasciculus before us; and several of the communications, with their illustrations, have already graced the 'Annals of Natural History.' G. S. Brady catalogues many of the Freshwater Algæ, and also enumerates various bivalved Entomostraca, describing some little-known and new forms, with figures in plates 12, 13, & 14; indeed two new genera (*Potamocypris* and *Xiphichilus*) are established by this excellent entomostracist for some of them. T. J. Bold supplies some interesting and useful entomological notes for the year 1869; he assures us there is no ground for the fear of mosquitoes that English newspapers were affected with last summer: the *Cynipides* of the woody oak-gall appear to be all *females*: the short-tailed field-mouse of Cheviot has for its flea Curtis's *Ceratopsyllus talpæ*: there are eighteen species of the aquatic hemipterous genus *Corixa*, and at least seventeen other aquatic Hemiptera, in the district. J. Wright describes the enamel-tipped teeth of *Labrus maculatus* (pl. 15) for the purpose of setting some Londoners right who have ignored this structure in certain recent and fossil fish-teeth.

A. Hancock, T. Atthey, and R. Howse carefully describe and figure (plates 9, 10, 11) teeth of fishes known under the generic names of *Climaxodus* (M'Coy, 1848) and *Janassa* (Münster, 1832), and establish the priority of the latter. *J. bituminosa* (Schlotheim) has been discovered in the so-called "marl-slate" of the Permian formation at Midderidge, Durham. *Anthracosaurus Russelli* (Huxley) has turned up in Northumberland, and a new species (*reticulatus*) of *Urocordylus,* both Labyrinthodont Amphibians of the Coal-measures; and Messrs. Hancock and Atthey describe them in full. They also give a detailed account and careful figures (plates 7 & 8) of some remarkable little bodies, from the black shales of the coal-measures, which, after an exhaustive examination, they determine to be fossil Fungi—five species (or varieties?) of a genus they name *Archagaricon,* and which they demonstrate to be closely allied to the Indian *Sclerotium stipitatum* of Berkeley and Currey. These papers have already appeared in the 'Annals.'

Mr. Kirkby corrects, with the latest views and nomenclature, the description given by Messrs. Baker and Tate of the Permian formation of Durham. Sir W. C. Trevelyan observes that the well-preserved trunk of an oak, found in the Boulder-clay between the Lindenshaw and Cocker Burns, "is an indication, I think, that the *whole* of the country had not been covered with ice" in the Glacial Period, "but that there were parts free from it, on one of which this tree was growing." He also draws other interesting inferences therefrom. The Meteorological and Climatological Reports for 1869, by the Rev. R. F. Wheeler, month by month, for definite localities in the district, and with general notices also, occupy more than 100 pages, are most elaborate and praiseworthy, full of both scientific and popular information, and form necessarily a very valuable portion of the volume.

The second of the works under notice is worthy of high consideration as the result of the second year's existence and labours of a new Naturalists' Society, following (like many others, we are happy to say) the examples of the Berwickshire, Tyneside, and other Field-Clubs of long standing and good repute. The 120 pages of the Cardiff Naturalists' Transactions show that they have not been idle during 1868–69; and, though they have not added much that is new to science, they have been preparing themselves for accurate work by learning from Mr. Vivian what may be done with the microscope in mineralogy and metallurgy, and from Mr. G. C. Thompson and their president, Mr. W. Adams, what the real objects of their Society should be; whilst other members have collected information for them in papers and lectures on miscellaneous subjects. The outdoor meetings have taken the members to many interesting localities of botany, geology, and archæology, and have resulted in valuable notes on such objects of interest at the Cefn On tunnel and Caerphilly, at Southerndown, Ewenny, and Dunraven, and at Caerleon and Newport. At Southerndown, in a lecture on "the primeval rivers of Britain," Prof. T. Rupert Jones, of Sandhurst, descanted on the "fluviatile and lacustrine strata" met with among the British formations; and Mr. Franklen G. Evans, of Cardiff, described the occurrence of two peculiar siliceous stones found in a coal-seam, and other interesting facts. Mr. Evans has also supplied to this volume of Transactions a monthly Meteorological Report for 1869; and a large lithograph rain-gauge map, including Swansea, Merthyr Tydfil, Abergavenny, Newport, Cardiff, &c., and serving well to show the field of operations of this Naturalists' Society in South Wales, is appended.

Two memoirs (reprinted from the 'Geological Magazine'), and their plates, illustrative of fossil Reptiles and fossil Bivalved Entomostraca discovered in South Wales by Mr. J. E. Lee and Mr. W. Adams, and described by Prof. Owen and Prof. Rupert Jones respectively, form part of this highly praiseworthy volume of reports and transactions.

Geology. By Prof. John Morris, F.G.S., &c., and Prof. T. Rupert Jones, F.G.S., &c. First Series. 12mo. London: Van Voorst, 1870.

Professor Rupert Jones is probably of opinion that the clergy have too long had a monopoly of the convenience of possessing printed skeletons for their discourses. In order to extend a similar benefit to geological lecturers, he publishes, in the little volume now before us (which is to be followed by a Manual of Geology of the regulation pattern), the heads of lectures on Geology and Mineralogy delivered by him from 1866–1870, at the Cadet College, Sandhurst, together with the synopses of Lectures used at the Staff and Cadet Colleges, Sandhurst. As far as the mere furnishing of skeleton courses of lectures is concerned, this little book, coming from the hands of a highly accomplished geologist and experienced teacher, will prove of immense value to those who are entering upon a course of geological tuition, and especially to regular science-teachers and to schoolmasters, who, possessing already some knowledge of the subject, desire to give their pupils instruction in geology.

Professor Rupert Jones considers also that the book may be useful to the student, who "will find clear statements and explanations of the things, facts, and circumstances on which Geology is based;" and this, to a certain extent, is certainly the case; but it seems to us that the information given is too condensed and purely synoptical in its nature to enable any but very exceptional students to learn Geology from it. But with the help of other books there can be no doubt that these skeletons of courses of lectures, which contain perfectly intelligible references to a vast mass of details, may be of great service by the admirable series of classifications of geological facts which they present; and we must also confess, in the author's justification, that the amount of instruction that he has compressed into so small a space is perfectly astonishing, when we study the contents of his book by means of its cross references and index, in the manner recommended by him. Moreover, as a work of instruction, this part is placed rather at a disadvantage by its appearance without the second part, or Geological Manual properly so called, which will of course contain the expanded details of the subjects here treated with extreme brevity.

There is yet another light in which the authors do not seem to have regarded their present work, but viewed in which it seems to us to promise to be exceedingly serviceable—namely, as a note-book for the use of those who have arrived at some proficiency in the study of geology. From its extreme comprehensiveness, there is scarcely a fact in general geology which is not alluded to in its pages; so that a student who has once acquired a knowledge of the science would be able, by a perusal of this little book, to refresh his memory of what he has learned. Interleaved and furnished with a few additional details and numerical data, it will form an admirable pocket-companion for the young geologist in his excursions.

The appendix contains, besides synopses of lectures, a valuable table of the geological formations occurring in the British Islands.

A Manual of Zoology for the use of Students, with a general Introduction on the Principles of Zoology. By HENRY ALLEYNE NICHOLSON, M.D. &c. Small 8vo. Blackwood: Edinburgh and London, 1870.

Advanced Text-Book of Zoology, for the use of Schools. By H. ALLEYNE NICHOLSON, M.D. &c. Small 8vo. Blackwood: Edinburgh and London, 1870.

THAT there has long been a great want of a good manual of zoology for the use of Students in this country there can be no doubt. Dr. Nicholson must have felt this in his position as Lecturer on Natural History in the Edinburgh Medical School; and in the first work indicated above he has endeavoured (not unsuccessfully) to supply the deficiency. His treatment of the subject is evidently founded chiefly upon Prof. Huxley's admirable 'Introduction to the Classification of Animals;' and in nearly all points which have been specially touched upon by that great zoologist the author generally follows him implicitly. Thus, as a matter of classification, Dr. Nicholson accepts Huxley's subkingdom of Annuloida in all its details, although, in his introduction, he lays down the principle that agreement in "morphological type" should constitute the foundation of every group, and we should think it rather difficult to demonstrate the existence of any unity of type in the groups referred to the Annuloida. We cannot think that the presence in both classes of a water-vascular system, and the agreement, such as it is, in the mode of development of *Nemertes* among the Scolecida and of the Echinodermata, can be held to furnish the necessary proof of unity of morphological type; and, on the other hand, if we were to admit that *Nemertes* and the Turbellaria (of which, however, *Nemertes* is a very aberrant form) might form a subkingdom with the Echinodermata, we should still be far from regarding the Turbellaria, Trematoda, Cestoda, Nematoda, Acanthocephala, Gordiacea, and Rotifera as constituting together only a single class. The fact is that the class Scolecida, as thus constituted, is, like Cuvier's subkingdom Radiata, really the residuary dusthole for the reception of every thing for which a suitable place cannot be found among the well-defined primary groups of the animal kingdom; and the Echinodermata are unfortunate in being here again associated in a provisional and untenable subkingdom with groups of animals with which they appear to have nothing to do. It seems to the present writer that the Echinodermata may fairly stand as forming one of the primary types of animals—that the Turbellaria and Rotifera may be placed without violence in the neighbourhood of the Annelida—and that the most natural direction in which to look for the real affinities of the parasitic groups is also among the Annulosa, in which the phenomenon of parasitism, with all its phases of structural degradation, is so familiar to us. We may remark, in connexion with this part of the subject, that Dr. Nicholson quotes, as Prof. Allman's character of the Annuloida, a diagnosis which can apply only to the Echinodermata (p. 135).

In other respects, it seems to us, Dr. Nicholson has succeeded well in his object of producing a useful handbook for students of zoology. His introductory essay on the principles of zoology contains good and useful ideas, clearly and intelligibly put before the reader, except that here, as indeed throughout the book, the author has indulged rather more freely than is desirable in the direct use of technical terms. Upon the vexed question of the origin of species our author leaves his readers to form their own opinions.

In classification, as we have already stated, Dr. Nicholson follows Professor Huxley in his broad outlines, filling up the details from the works of other authors. The classification is in all cases carried as far as the orders; and under most of these, synopses of the families are given. The illustrations, although by no means admirable as works of art, are generally distinct and intelligible, and quite sufficient to give the student a clear idea of the objects described in the text.

We have noticed a few minor points in which, it seems to us, Dr. Nicholson's manual is susceptible of improvement. The author frequently uses the term "mimetic" to express a general resemblance or "homomorphism" of different organisms when no "mimicry" is in question; and this will be liable to mislead his readers. At p. 95 he uses the term Discophora for a subclass of Hydrozoa, quite different in its limitations, so far as we are aware, from any group to which that term has been applied—including, namely, those naked-eyed Medusæ whose origin by gemmation from a polype-like form has not yet been demonstrated. We do not think that the group should be maintained; but at any rate some other name should be given to it. There is some confusion as to the true position of *Hyalonema*: first (p. 116) it forms a family of Sclerobasic Zoantharia; then (p. 117) the opinion that *Hyalonema* should be placed among the siliceous sponges is said to be probably the true one; but again (p. 123) the Hyalonemadæ appear as a family, and the characters of their corallum are indicated. To a student this will prove rather puzzling. Among the Crustacea no notice is taken of those remarkable parasitic allies of the Cirripedes, *Peltogaster* &c., of which Fritz Müller has formed the subclass Rhizocephala; the order Læmodipoda is retained, although it is now generally admitted to have been founded merely upon abnormal forms of Amphipoda; and the prevalence of transformations throughout the Decapoda is not indicated, the only reference to the larval forms being under the head of Brachyura, and calculated to lead the student to the supposition that a metamorphosis is peculiar to that group of Decapods. Under the Myriopoda Sir John Lubbock's curious genus *Pauropus* ought to have received some notice. These are small matters; and we must congratulate the author on having so well accomplished his task.

Of the 'Advanced Text-Book,' we need only say that it is an abridgment of the Student's Manual, and follows the same general course of treatment and classification. It seems to us well suited for school purposes.

MISCELLANEOUS.

On the Assumption of the Adult Form by the Genera Cypræa *and* Ringicula, *and by certain Species of the Genus* Astarte.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—In the 'Eocene Bivalves,' just issued by the Palæontographical Society, several species of *Astarte* are described; and I have there stated my belief that some species of this genus have the peculiar character of producing an alteration in the ventral margin of the adult shell, the young and growing animal having this part always smooth, but that when full-grown it adds a row of denticulations to the inside of the ventral magin; and I called attention to the peculiarities of the genus *Cypræa* as throwing light upon the subject. It has always been said that the young of the *Cypræ* have invariably the outer lip sharp and plain, with a visible spire, but that, when full-grown, the animal contracts the aperture, inflects the outer lip, forms a row of denticles on each side of the opening, and covers over the spire; and when we find a shell in this last condition, we have supposed it to be an animal that has attained to its full proportions.

In the Red Crag the species *Trivia* (*Cypræa*) *europæa* has been found in great abundance; specimens have been obtained from that formation by hundreds; and it is by no means rare in the Coralline Crag; but in all my search in these deposits, I have never seen one of these shells that was in any other condition than that which is assumed by the full-grown individual. The specimens of this species in my own cabinet vary in size from $\frac{1}{8}$ to nearly $\frac{5}{8}$ of an inch in length.

There is another shell exceedingly abundant in the Coralline Crag, viz. *Ringicula buccinea*; and I have between three and four hundred specimens before me, every one of which has a thickened margin to the outer lip, and is presumably a full-grown shell. Now, although I have closely examined these, and many others of the same species, and have for years sifted great quantities of Crag, I have never seen one that had not a thickened margin to the outer lip (with the exception of about half a dozen which seemed to be, and probably were, fractured); and this is the more extraordinary, as all my Coralline-Crag specimens of this species have come from a locality, at Sutton, where at least nine tenths of the shells found are young, or at least specimens which have not attained to their full growth. The difference in size among my specimens of this *Ringicula* is very considerable, as might be supposed, some being as long again as others; and if the small ones had not been furnished with a thickened lip, there would have been no hesitation in referring them to the immature condition of the species. If these small specimens with a thickened lip be not in many instances young shells, may we not ask what has become of the immature specimens? Have they never died from any other causes than predaceous ones while under full age? I am inclined to believe that the small shells of *Trivia* and *Ringicula* may be mostly immature individuals which, by a law attaching to their structure, assumed, in anticipation of a natural death, this thickened margin to the outer lip. Of course, any immature specimens killed suddenly would retain their juvenile forms, but we must assume that nearly all killed suddenly were so killed for food, and consumed; so that we do not find these fossil, though in the recent state the immature forms ought to occur frequently as *living* shells.

In the genera *Cassis* and *Cassidaria* we often see that after this apparently adult character of a thickened lip, or varix, has been formed by the young animal, it had continued growing to its full size; and this early thickened lip is denoted by a ridge (or ridges) left upon the spire of the full-grown shell; but I have in vain looked for this ridge upon the spire of any of my numerous specimens of *Ringicula*, either large or small.

Perhaps some of your correspondents can throw a light upon this question.

I am, Gentlemen,
Yours truly,
SEARLES V. WOOD.

Brentwood, Jan. 1871.

Observations on the Invertebrata of Massachusetts. By ALFRED BELL, Esq.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I shall be glad if you will permit me to make a few remarks upon the new issue of Dr. Gould's Report on the Invertebrata of Massachusetts, just published.

It is to be regretted that, in bringing out a second edition, the works of European conchological authors have been so little consulted. A very little care would have tended to the reduction of errors and the avoidance of useless synonymy, thus advancing our present scientific knowledge.

Tellina obliqua, Sow., is a very extreme form of *Macoma sabulosa* (=*Tellina calcarea, lata, proxima*, &c.), very abundant in all the English Crags, from the Coralline upwards. The typical form does not occur till higher up in the Crag series, and then but rarely at first.

Astarte sulcata, DaCosta.—The group for which Dr. Gould suggests the name *undata* is identical with the *Astarte Omalii*, La Jonkaire, a very characteristic English and Belgian Crag shell, in which deposits all the forms mentioned are to be found.

Yoldia limatula, Say, and *Y. myalis*, Couthouy.—Dr. Binney is in error in supposing *Y. myalis* and *Nucula hyperborea*, Lovén, to be the same species. The latter is the shell often quoted in European lists as *Y. limatula*, Say. Both *Y. myalis* and *hyperborea* are fossils of the English Tertiaries. *Y. myalis* and the typical *Y. limatula* are not known as members of the European fauna. *Y. hyperborea* is excellently figured in Torell's 'Spitsbergen Mollusker.'

Margaritana arcuata, Barnes.—I confess I am unable to separate American examples of this shell which have passed through my hands from Unios obtained in different European localities. Like all the freshwater shells, it varies according to circumstances. The same may be said of *Anodonta fluviatilis*.

Littorina palliata, Say, is probably the same as the *Turbo littoralis*, Linné,=*L. limata*, Lovén.

Scalaria multistriata, Say.—Under this heading two shells are mentioned, for one of which, if distinct, Prof. Adams has proposed the name *S. pulchella*. Bivona (1832) has already appropriated the specific appellation (Philippi, En. Moll. Sic. vol. i. t. 10. fig. 1).

Nassa trivittata, Say, = *Nassa* (*Buc.*) *propinqua*, Sow. Min. Con. t. 477. f. 2 (1824).—A Crag shell no longer known in the European seas.

Fusus islandicus, Gould (not Chemnitz).—This handsome shell differs in several respects from the type both in form and sculpture, and is the shell which Mr. Jeffreys has proposed to call *F. curtus*, and myself *F. americanus* (Ann. & Mag. Nat. Hist. Sept. 1870). This is another of the English Tertiary shells no longer found living in European waters.

I am, Gentlemen,
Your obedient Servant,
ALFRED BELL.

29 Grafton St., Fitzroy Square, London.
January 9, 1871.

On Oligochætous Annelids.

GENTLEMEN,—Please add to my paper as a *note*, or, if too late, as an addendum in your miscellaneous articles:—

"The bodies described by Hering as the testes agree in number and position with those I have seen; but he does not give illustrations of their microscopical structure.

"Max Schultze (Köll. und Sieb. Zeitschrift, vol. iv. p. 187) mentions that spermatophores exist in the Oligochæta as in the Leeches. Budge, in 1850, in Troschel's 'Archiv' (Wiegmann's), described the sexual organs of *Tubifex rivulorum*, with which he confused, as appears from his figure, a *Limnodrilus*, describing parts of both worms. He figured the bodies from the spermatic reservoirs, but roughly. Leuckart, in his notice of this paper (Bericht, 1848–53), states his belief that the bodies are spermatophores, and the pouches spermatic receptacles.

"D'Udekem, who observed filaments in the spermatic pouches of *Nais proboscidea*, considered them as destined to aid in forming the egg-capsule, but subsequently agreed with Leuckart that they were probably spermatophores (Bull. Acad. Belgique, 2nd ser. tome xii.).

"D'Udekem also describes two 'hard pieces' at the male generative orifice in *Chætogaster Mülleri*, which are apparently 'genital setæ.' He describes the generative organs of *Æolosoma* in probably an imperfect state.

"I am indebted to Professor Leuckart for these references."

I remain, Gentlemen,

Truly yours,

E. Ray Lankester.

January 26, 1871.

Abdominal Sense-organs in a Fly. By Dr. A. S. Packard, Jun.

While engaged in naming a collection of microscopic preparations of insects mounted on slides by Mr. T. W. Starr of Philadelphia, for the collection of Dr. T. d'Oremieulx of New York, my attention was drawn to a sense-organ situated on the female anal appendages of a species of *Chrysopila*, allied to *C. ornata* (Say), a genus of flies allied closely to *Leptis*. The female appendages are rounded, somewhat spatulate, and of the usual form seen in other species of the genus. The appendage is covered with stiff coarse hairs, about fifty in number, arising from conspicuous, round, clear cells, while the whole surface, as seen under a Zentmayer's $\frac{4}{10}$ (A eye-piece), is densely covered with minute short hairs. On the posterior edge of the *upper* side of each appendage is situated a single large round sac, with the edge quite regular. Its diameter is equal to a third of the length of the appendage on which it is situated. Dense fine hairs, like those covering the appendage, project inwards from its edge. The bottom of this shallow pit is a clear transparent membrane not bearing any hairs. There are no special sense-organs on the antennæ of the same insect.

With these organs, which I suppose to be olfactory in their function, may be compared a very similar single sac situated on the *under* side of the end of the labial and maxillary palpi of a species of *Perla*, mounted on a slide in the same collection. Its diameter is nearly half as great as the palpal joint itself. Instead of being depressed, the sac in *Perla* is a little raised, forming a slightly marked, flat tubercle, which is round, slightly ovate, under a $\frac{4}{10}$

objective. The surface of the membrane (tympanule of Lespès) is naked. It is strongly probable that this is an olfactory organ, and placed on the underside of the palpi, next to the mouth, so as to enable the insect to select its proper food by its odour, giving an additional sensory function to the palpi of insects. There are no special sense-organs in the antennæ.

Lespès, in his note on the auditory sacs which he says are found in the antennæ of nearly all insects, says that, as we have in insects compound eyes, so we have *compound ears*. I might add that in the abdominal appendages of the cockroach we have a *compound nose*. In the palpi of *Perla*, and the abdominal appendages of *Chrysopila*, the "nose" is simple.

On examination I have found sense-organs in both pairs of antennæ of *Homarus americanus* (the lobster), such as are described by Farre, and also the more rudimentary form of supposed auditory organs in the common spiny lobster (*Palinurus*) of Key West, Florida.—*American Naturalist*, vol. iv. Dec. 1870.

On the Carboniferous Flora of Bear Island (lat. 74° 30′ N.). By Professor Oswald Heer, F.M.G.S.

The author described the sequence of the strata supposed to belong to the Carboniferous and Devonian series in Bear Island, and indicated that the plant-bearing beds occurred immediately below those which, from their fossil contents, were to be referred to the Mountain-limestone. He enumerated eighteen species of plants, and stated that these indicated a close approximation of the flora to those of Tallowbridge and Kiltorkan in Ireland, the greywacke of the Vosges and the southern Black Forest, and the *Verneuilii*-shales of Aix and St. John's, New Brunswick. These concordant floras he considered to mark a peculiar set of beds, which he proposed to denominate the "Ursa-stage." The author remarked that the flora of Bear Island has nothing to do with any Devonian flora, and that consequently it and the other floras, which he regards as contemporaneous, must be referred to the Lower Carboniferous. Hence he argued that the line of separation between the Carboniferous and Devonian formations must be drawn below the yellow sandstones. The presence of fishes of Old-Red-Sandstone type in the overlying slates he regarded as furnishing no argument to invalidate this conclusion. The sandstones of Parry Island and Melville Island are also regarded by the author as belonging to the "Ursa-stage," which, by these additions, presents us with a flora of seventy-seven species of plants. The author remarked upon the singularity of plants of the same species having lived in regions so widely separated as to give them a range of 26½° of latitude, and indicated the relations of such a luxuriant and abundant vegetation in high northern latitudes to necessary changes in climate and in the distribution of land and water.—*Proc. Geol. Soc.* Nov. 9, 1870.

The Caudal Styles of Insects Sense-organs, i. e. *Abdominal Antennæ.* By Dr. A. S. Packard, Jun.

Dr. Anton Dohrn has published a note, in the 'Journal of the Entomological Society of Stettin' (1869), to the effect that the abdominal appendages of the female of the mole-cricket (*Gryllotalpa*) are true sensory organs (Tastorgane).

In the 'Proceedings of the Boston Society of Natural History,' May, 1866, the writer states that "while, as we have shown above, the genital armour of insects is not homologous with the limbs, there are, however, true jointed appendages attached to the ninth or tenth abdominal ring, or both, which are often antenniform, and serve as sensorio-genital organs in most [many] Neuroptera and Orthoptera" (p. 290).

In the same 'Proceedings' for February 26, 1868, he thus writes: "Regarding the insect as consisting of two (fore and hind) halves, the two ends being, with this view, repetitions of each other, these anal stylets may be considered as abdominal antennæ, so that the antennæ look one way, and their homologues, the many-jointed antenniform anal stylets, the opposite" (p. 398).

The subject is also referred to in the 'Guide to the Study of Insects,' p. 17; and the remarkable antenniform abdominal appendages of *Mantis tessellata* are figured in illustration.

I have been able to detect sense-organs (probably endowed with the sense of smell) in the short, stout, jointed anal stylets of the cockroach (*Periplaneta americana*), beautifully mounted by Mr. E. Bicknell, having recently, after reading Dr. Dohrn's note, observed the sense-organs and counted about ninety* minute sacs on each stylet, which are probably smelling or auditory organs, such as are described by Hicks (see 'Guide,' p. 26). They are much larger and much more numerous than similar sacs in the antennæ of the same insect, and are situated in single rows on the upperside of each joint of the stylets. During the breeding-season a peculiar odour is perhaps emitted by the female, as in vertebrate animals; and it is probable that these caudal appendages are endowed with the sense of smell rather than of hearing, that the male may smell its way to its partner. This is an argument that the broadly pectinated antennæ of many moths are endowed rather with the sense of smelling than of hearing, to enable the males to smell out the females. I have observed the same organs in the lamellæ of the antennæ of the carrion-beetles, which undoubtedly depend more on the sense of smell than that of touch or hearing to find stinking carcasses in which to place their eggs.—*American Naturalist*, vol. iv. Dec. 1870.

* Mr. Bicknell has counted more carefully than I did the exact number of these pits, and made out ninety-five on one stylet and one hundred and two on the other, adding, "there were none on the underside of their appendages that I could see."

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 39. MARCH 1871.

XXI.—*On* Saccammina Carteri, *a new Foraminifer from the Carboniferous Limestone of Northumberland.* By Henry B. Brady, F.L.S., F.G.S.

[Plate XII.]

Introductory.—Notwithstanding the prominent place occupied by the Mountain Limestone amongst the geological formations of Great Britain (its geographical extent and its enormous thickness), but little is known of the Foraminifera of the earlier Carboniferous age. The organic remains of which the calcareous beds are at times almost entirely composed afford abundant evidence of their marine origin, and analogy with other limestone strata would lead to the expectation that Foraminifera would constitute an important part of their fossil fauna; yet were a catalogue drawn up representing the present state of our knowledge of Carboniferous Invertebrata, the whole of the subkingdom Protozoa would be told off in a few lines. Nor have we far to seek for the reason of our comparative ignorance of the minuter fossils; indeed we need hardly look further than the physical characters of the material forming the beds to see where the cause of difficulty lies. The rock of which they are composed is almost always exceedingly hard and compact, sometimes even subcrystalline, and scarcely ever admits of examination in respect of its Microzoa otherwise than by means of transparent sections, which yield but little reliable information. It is only here and there that pieces can be met with soft enough to allow the separation of their constituent fossils by washing or other mechanical means; and the cases are still rarer in which any chemical process can be resorted to with advantage to the same end. But possibly an even greater difficulty exists in the Microzoa themselves. The Rhizopoda, at least, either from natural deficiency of marked characters, the obliterating effects of time, or the alteration produced by the process of mineralization, present serious obstacles to accurate study.

Under these circumstances the discovery of Foraminifera of a well-defined and easily understood type in the Carboniferous Limestone is a matter of some importance; and an additional interest pertains to those about to be described, on the ground of their zoological relationship.

Amongst the fossils met with by Mr. Charles Moore in his examination of mineral veins and the adjacent rocks, were two or three almost spherical bodies, $\frac{1}{20}$ of an inch in diameter, somewhat produced at two opposite portions of their periphery, and having a nearly smooth arenaceous exterior. In the absence of material for a definite conclusion as to their nature, I suggested that they were probably segments of a gigantic *Lituola*; and as such they were mentioned in the list of fossils appended to Mr. Moore's report presented to the British Association at the Exeter meeting in 1869. As the geological source of these specimens could not be determined with accuracy, much significance was not attached to them; but shortly after the presentation of the paper referred to, my attention was directed by Mr. G. A. Lebour, of the Geological Survey, and Mr. Howse to a limestone of somewhat unusual character occurring in the heart of Northumberland. The specimen placed in my hands by Mr. Lebour appeared to be made up almost entirely of spheres, which were at once recognized as identical with those in Mr. Moore's collection. Through the kindness of Sir Walter C. Trevelyan, on whose estate the limestone occurs, and to whom its discovery is due, every facility has been afforded for studying the structure of the rock; and the following notes embody the results arrived at.

Geological.—The bed from which the specimens were taken is the so-called "four-fathom limestone," one of the thickest and best-defined members of the Carboniferous-Limestone series throughout the north of England. At Elfhills, a point situated a mile or two west of Cambo, near the Wansbeck-Valley railway, it is quarried to a considerable extent, the stone being burnt for agricultural purposes; and a section of from 20 to 30 feet in height is there exposed. This exhibits beds of limestone varying somewhat in physical characters, with one or two thin beds of shale, and an intruded mass of whin, apparently the overflow of a larger whin-sill interbedded with it. In some places the limestone is a good deal altered by its proximity to the volcanic rock.

The uppermost bed exposed in the quarry appears to be entirely composed of spheroidal or fusiform bodies, but so aggregated and infiltrated that they form an intensely hard dark-coloured limestone, the freshly fractured surface of which appears almost homogeneous and sometimes subcrystalline. It is, however, readily acted upon by the atmosphere; and the weathered portions reveal a spheroidal structure that might at the first glance be assigned to purely physical causes depending on some peculiarity in the mode of deposit. A fair idea of the characters of the rock forming this bed may be gained from Plate XII. fig. 1, which represents an average specimen, with the upper surface considerably weathered. Very frequently the disintegration, instead of being merely superficial as in the figured specimen, extends to a considerable depth, leaving the stone in the condition of a crumbling mass of spheres. A layer in this state exists between the surface-soil and the hard rock; and by a little treatment the fossil portions may be obtained from it quite clear of the matrix.

A few feet below this bed (in the same section), and separated from it by a thin layer of shale and a stratum of limestone containing Bryozoa, is a second and more considerable bed, with the same sort of fusiform bodies distributed through its entire length and thickness. The individual specimens are larger than those occurring in the later deposit, but they do not constitute nearly so considerable a proportion of the entire rock. The segments do not appear to differ in structural characters from those found in the upper bed.

Mr. Topley, of the Geological Survey, has furnished me with a rock specimen from another section in the neighbourhood of Elfhills, but at some distance from the main quarry. The point from which it was taken is apparently about sixteen feet higher in the series than the top of the quarry; but not improbably it is only the upper bed, faulted: it immediately overlies one of the branches of the whin-sill, and seems to have been a good deal altered by heat; but portions at least of it are entirely composed of the same fossil remains.

The Elfhills bed appears again on the banks of the Wansbeck above Wallington Hall, where it has more or less of the same spheroidal structure, determined by the presence of its characteristic fossil.

As the "four-fathom limestone" traverses the Alston-Moor district, it can scarcely be doubted that the specimens originally found by Mr. Charles Moore amongst other Foraminifera, associated with the mineral veins of the higher part of Weardale, have been derived from it; but hitherto no fossil similar in character to those of the Northumbrian bed has been discovered, though carefully sought for by my friend Dr. Savage, of Nenthead, who is thoroughly conversant with the geology of that region.

It seemed desirable to compare the Elfhills rock with other spheroidal and concretionary limestones of palæozoic age; and for the means of doing so I am indebted to the kindness of Mr. Etheridge, the palæontologist to the Geological Survey, who has furnished me with a number of specimens of such limestones, some of them Carboniferous, others from the Wenlock and Bala beds. In each of the specimens there is some *primâ-facie* resemblance to the Elfhills rock; and in one or two the similarity is so striking that the naked eye is hardly sufficient to discern the wide difference that really exists between them. By means of transparent sections and a good microscope, the true structure is readily made out; and in all the specimens sent by Mr. Etheridge it is essentially the same. They are composed of laminated spheres of carbonate of lime, formed by the common process of spherical coalescence; and that their physical peculiarities are in no way due to organic remains may be asserted with certainty in every instance.

Chemical.—Although the Elfhills limestone is as compact as many varieties of marble, considerable difficulty is experienced in obtaining a polished surface by grinding, owing to the different degrees of hardness of its constituents. The matrix is usually softer than the fossils imbedded in it; and frequently the infiltrated matter which occupies the interior of the spheres is harder than its investing shell. This was found to be due to the presence of silica unequally distributed. The matrix appears to be free from silica; but a number of unbroken spheres washed quite clean were submitted to analysis by my friend Mr. A. Freire-Marreco, and found to contain as follows:—

Silica	44·66
Iron and alumina	4·86
Carbonate of lime	48·33
Loss	2·15
	100 parts.

The casts and crystalline tufts which occupy the interior of the spheres were subsequently examined, and found to yield 92 per cent. of silica. The analysis was made from forty or fifty of the "cores" taken at random; but the percentage named can scarcely be said to represent accurately the proportion of siliceous and calcareous infiltration. The siliceous casts are usually amorphous (colloid), and completely fill the cavities; and if the interior be smooth, they enucleate themselves as solid spherical masses on the fracture of the arenaceous investment. The crystalline cores, on the other hand, usually adhere by points to the interior of the shell; so that the siliceous casts are not only far more commonly met with clear of the test than the calcareous, but they are also individually heavier.

There is considerable difference in the appearance under the microscope of the chambers under different conditions of infiltration. Sometimes a sphere may be found partially filled with silica and partially with carbonate of lime. A section of such a one is shown at Pl. XII. fig. 5. The lobe of silica which occupies part of the right side of the chamber (*a*) is amorphous, and has a yellowish tint by transmitted light, whilst the remainder is calcareous and crystalline. Under these conditions it is useless to attempt a comparison between the chemical composition of the test of the fossil under consideration and that of recent species of the same genus or other allied arenaceous Foraminifera—a circumstance the more to be regretted as the process of mineralization has also obscured the minuter structure of the former so far as to prevent accurate observations on the nature of the sand-grains and cement used in building its investment.

Zoological.—To revert to the Elfhills specimens. The subspherical bodies which constitute the mass of the rock may be examined to some extent by means of sections, but far more completely and accurately by washing the marly or crumbling mass resulting from partial disintegration by the long-continued action of air and moisture. The residue after washing this material consists chiefly of the arenaceous spheres, fragments of Encrinites, and a few kindred fossils. The spherical or, rather, fusiform bodies average about $\frac{1}{8}$ inch in length, and $\frac{1}{12}$ inch in transverse diameter: large specimens may be found measuring $\frac{1}{6}$ or even $\frac{1}{5}$ inch by $\frac{1}{9}$ or $\frac{1}{8}$ inch; but such are of rare occurrence. Sometimes they are more elongate; and extreme examples have been noted in which the conjugate and transverse diameters were in the proportion of 3 to 1. The two ends are usually produced and tubular, apparently for the passage of sarcode stolons or pseudopodia: they are sometimes symmetrical; but more frequently one end tapers more gradually than the other: occasionally the base is rounded, and the shape is completely pyriform. The question arises whether these bodies represent individual animals, or to what extent they may have been connected with each other when living. It is not at all unusual to find on any weathered piece of the rock two segments connected by a stoloniferous tube; rarely three are found in this condition; and in one or two instances four or five have been noticed still retaining connexion with each other. The bulk and weight of the segments and the comparative tenuity of the intermediate processes would be sufficient to account for the separation into single chambers, were this less constant than it is; but there is no need to suppose that the single segment may not represent a perfect animal equally with the many-chambered shell. Occasionally, though very rarely, a chamber is found with a round imperforate base and a single orifice at its apex; and if this is taken to correspond to the ordinary form of *Lagena*, the fusiform chambers may be regarded as analogous to the distomous varieties of that genus. The moniliform fossils might be compared to the *Nodosariæ*, but that all that have as yet been met with have an aperture at each end of the series of segments, and, for any thing known to the contrary, the test might extend itself indefinitely in either direction.

The test is composite and arenaceous, the constituent particles being fitted and cemented together so as to give a nearly smooth exterior. The size of the sand-grains and their mode of aggregation is a character of some importance amongst the recent *Lituolida*; but, as has been before stated, the process of mineralization has obscured the minute structure of the fossil in these particulars.

The interior of the test is commonly smooth, resembling the recent *Saccammina*; but it sometimes presents a surface of very short, delicate, labyrinthic, shelly ingrowths, as shown in Pl. XII. figs. 3 & 4. This cancellated or labyrinthic structure is often met with amongst the arenaceous Foraminifera, and in some genera it is developed to an enormous extent.

Here and there a specimen may be found with a sort of circular patch on the surface, which has the appearance of a cicatrix resulting either from the gradual closing-in of an orifice or possibly the reparation of some injury to the shell-wall. These slightly raised concentric markings, apparently deposited regularly from without inwards, occurring frequently and with considerable uniformity, can scarcely be accidental. The positions in which they are generally noticed, viz. the sides rather than the ends of the segments, is an objection, though possibly not a fatal one, to the supposition that they mark the closure of normal apertures.

When first investigated, the characters of the fossil seemed sufficiently distinct from those of any known type of Foraminifera to necessitate the establishment of a new genus for its reception, and the generic term *Carteria** was provisionally

* See Brit. Assoc. Reports, 1869 (Exeter Meeting), p. 381. I hoped to associate the *type* with the name of my friend H. J. Carter, F.R.S., who has laboured so assiduously and successfully amongst the Protozoa. As the matter stands, the *specific* term only is left at my disposal.

assigned to it; but I have since had the opportunity of seeing a number of type slides of deep Atlantic Foraminifera sent by Prof. Sars of Christiania to Dr. Carpenter, and amongst them specimens of his *Saccammina sphærica*, a species named in his paper on the deep-sea fauna*, but, so far as I know, not yet described. I am further indebted to Dr. Carpenter for a supply of specimens of this form, which appears to be common at great depths; and careful examination has convinced me of its very close relationship to the Carboniferous fossil, although sufficient difference appears to exist in minor particulars to justify specific separation. The following morphological characters will serve for diagnosis:—

Genus SACCAMMINA, Sars.

Saccammina Carteri, n. sp.

Test free, consisting either of a single chamber or of several joined end to end in a single series; chambers subspherical, fusiform or pyriform; texture arenaceous, compact; exterior surface nearly smooth, interior smooth or slightly labyrinthic. Long diameter of the chambers (average) about $\frac{1}{8}$ inch.

Hab. Carboniferous Limestone, north of England.

The distinction between the fossil species and Prof. Sars's type is based, first, on the form of the chambers, which in the latter are always subspherical and have but one aperture, whilst in the former they are, as a rule, fusiform and have two apertures; secondly, on the fact that the recent species always occurs in single segments, and there is no reason to believe that it is ever polythalamous; *S. Carteri*, on the other hand, is frequently many-chambered—how frequently so when living it is impossible to say; thirdly, the test of *S. sphærica* is somewhat thinner, and nearly smooth both inside and out, whilst that of *S. Carteri* often shows a tendency to produce loose cancellated structure on its inner surface. It is an interesting fact, however, that this palæozoic fossil should have its nearest known ally in a species living abundantly on the coast of Norway at a depth of 450 fathoms.

The *Saccammina*-beds have not yielded any great variety of Foraminifera, though subjected to very careful search. Small specimens of *Trochammina gordialis*, P. & J., are not uncommon; and a few examples of a somewhat peculiar modification of *Textularia*, which has attracted the attention of observers elsewhere, have been found. There still remain, how-

* See 'Vidensk.-Selsk. Forhandlinger' for 1868, p. 248.

ever, some doubtful organisms to be worked out. The *Textularia* alluded to is a stout arenaceous variety, frequently Bigenerine in its mode of growth, and with an anomalous aperture, sometimes labyrinthic, but more frequently consisting of two or three distinct circular pores. Mr. John Young, of Glasgow, has a number of beautiful specimens of this form; and I find, in my notes on his collection of Carboniferous Foraminifera, that I have the MS. name *Textularia antiqua* appended to it.

EXPLANATION OF PLATE XII.

Fig. 1. A piece of *Saccammina*-limestone from Elfhills, natural size. The upper portion of the figure shows a weathered surface, the lower a fresh fracture. The white spots on the latter indicate the tufts of crystals which often occupy the interior of the chambers.

Fig. 2. Polythalamous specimens of *Saccammina Carteri*, natural size.

Figs. 3 & 4. Broken specimens showing the occasional labyrinthic structure of the inner surface of the test and the crystalline calcareous masses occupying the interior. Fig. 3 magnified 10 diams., fig. 4 magnified 15 diams.

Fig. 5. Transparent section of a segment, infiltrated partially with carbonate of lime, partially with silica: *a* is a lobe of colloid silica. Magnified 29 diams.

Fig. 6. A portion of the last specimen, at *a*, more highly magnified, showing the structure of the infiltrated test in transverse section. Magnified 80 diams.

XXII.—*On* Melobesia unicellularis, *better known as the Coccolith.* By H. J. Carter, F.R.S. &c.

For some time past I have frequently noticed a cell in connexion with minute fragments of marine Sponges and Compound Ascidiæ obtained from the Laminarian zone here (Budleigh-Salterton) which have been placed under the microscope for examination, also among the calcareous stellates (spicules) of the latter which have been mounted in Canada balsam; and I have as often resolved to endeavour to know more about its history when opportunity offered.

Meanwhile, having been in London in April last, I then procured, through the kindness of my friend Dr. Carpenter, a little of the deep-sea mud from the bed of the Atlantic Ocean, to see what the coccolith was, of which I had previously read Prof. Huxley's excellent account in the 'Quarterly Journal of Microscopical Science' (No. 32, Oct. 1868), and immediately recognized in the coccoliths present in this mud facsimiles of the "cell" above mentioned.

Not content, however, with Prof. Huxley's analysis or his conclusions, as I could not divest myself of the idea which this eminent naturalist had first formed, in 1858 (*op. cit.*), viz. that it was a unicellular Alga, I still further became convinced of this by finding it abundantly in the alimentary canal of the large Ascidian (*Ascidia arachnoidea*, Forbes & Hanley) which is thrown ashore here during storms.

Referring, then, again to Prof. Huxley's paper and accurate illustrations of coccoliths, I observed that he came to the two following conclusions, viz.:—

(1) "That they are not independent organisms, but that they stand in the same relation to the protoplasm of *Bathybius* as the spicula of Sponges or of Radiolaria do to the soft parts of those animals;" and (2) "that the coccospheres are from the first independent structures, comparable to the wheel-like spicula associated in the wall of the 'seeds' of *Spongilla*, and perhaps enclosing a mass of protoplasm [of *Bathybius*] destined for reproductive purposes" (*l. c.* pp. 210 & 211).

Now, finding the coccolith so abundant throughout the Laminarian zone here that hardly any object can be examined microscopically without its presence in greater or smaller numbers, also that in the alimentary canal of the Ascidian just mentioned it is more abundant than the frustules of Diatomaceæ or the remains of any other organism of this kind, while it is in a more or less fragmental condition, indicative of the effect of digestion, I could not help feeling still more in favour of its being an organized cell.

Hence I subjected a portion of the contents of the alimentary canal of *Ascidia arachnoidea*, in which there were many entire as well as fractured coccoliths, to the following chemical tests, watching at the same time their effect, under a glass cover, with the microscope.

(1) Solution of iodine in iodide of potassium produced no visible alteration. (2) Acetic acid, being added in sufficient quantity to more than neutralize the former, caused the calcareous cell of the coccolith to become dissolved, leaving a granular disk of protoplasm, in the centre of which was the original oval transparent area containing one or more granules, as the case might be: all the granules were of a yellowish colour, both in the disk and transparent area; and as the cell became dissolved away, so the greenish tint, which is owing to the presence of the calcareous material, also disappeared; but still no further visible change occurred. (3) The sol. iodine &c. was again let in (by the aid of a piece of bibulous paper which was placed on the opposite side of the cover); but the granules &c. still remained unaltered, and did not present the blue tint indicative of starch. (4) Finally, the acetic acid was reapplied, without further change; and after the aqueous contents had

nearly all become dried up, this was again repeated, also with no further change, the granular protoplasmic disk &c. remaining as when the acetic acid first released it from the calcareous cell.

I now turned to look at the remains of the other entire coccoliths which were present; and they were all in the same condition, with the exception of the granule (nucleus?) in the centre of the transparent area (nuclear utricle?), which was single, double, quadruple, or still more divided in different cells respectively.

Thus, still more convinced that I had a unicellular Alga under examination, and taking a portion of the little arborescent fronds of *Melobesia calcarea* ("the chalk-*Melobesia*"), which, in about ten fathoms, occurs here in accumulated beds or banks of probably miles, certainly acres, in extent, I pulverized a portion for examination, and observed several fragments whose cells, but for their polygonal arrangement, presented very much the appearance of the coccolith in their concentric lines, transparent area, and central granule, together with the absence of blue colour under the iodine test.

Lastly, considering that the coccolith is so abundant in the Laminarian zone here, and so voraciously fed upon by the Echinodermata and Ascidiæ, also that it is so nearly allied in composition, structure, and habit to *Melobesia calcarea*, that it chiefly forms the bed of the Atlantic Ocean, and that it is found fossilized in the chalk, I cannot help inferring that it is a vegetable organism which contributes chiefly to form the calcareous deposits of the present day in many parts, and has done so in the formation of calcareous ones of the past, at all events that of the chalk.

With these views, then, leaving the terms "coccoliths" &c. for the fossilized forms, I would propose the following name and description for those now in existence:—

Melobesia unicellularis, mihi.

Cell calcareous, discoidal, obtusely elliptical, transparent, convexo-concave; consisting of two convexo-concave disks, one a little larger than the other, the larger one flattened on its convexity, and receiving the smaller one in its concavity; enclosing a granular protoplasmic disk with oval transparent area (nuclear utricle?), and within this a single granule (nucleus?); the granule subject to 1, 2, 4 or more division. Mode of propagation unknown. Size 1-1700th of an inch long and about 1-12000th of an inch thick.

Hab. Marine; accumulating in beds.

Loc. Atlantic-Ocean bottom; Laminarian zone, south coast of Devon. Probably universal.

Obs. There appears to be no difference between this species and the oval one of the Atlantic bed. It is also accompanied by the smaller and more simple forms designated by Professor Huxley "discoliths" (*l. c.* fig. 2, *a*, *b*, *c*), which, for reasons that will appear hereafter, I am inclined to consider immature or young specimens of *M. unicellularis.*

But there is another kind present in the mud of the Atlantic bed, which, although less plentiful, is, from its circular form (Huxley, *l. c.* p. 208, fig. 4, *a*, *b*, *c*), distinctly different from the oval *M. unicellularis*; and for this form I propose the following name and description.

Melobesia discus, mihi.

Cell calcareous, discal, circular, transparent, convexo-concave; consisting of two concavo-convex disks, one a little larger than the other, the larger receiving the smaller one in its concavity; enclosing a granular protoplasmic disk with central transparent area, which is circular and contains a granule. Mode of propagation unknown. Size about 1-2300th of an inch in diameter.

Hab. Marine, accumulating in beds.

Loc. Atlantic Ocean.

Obs. From the distinctly circular form of this species, from its being entirely absent in the Laminarian zone *here*, so far as my observation extends, and from its forming, as will be hereafter seen, exclusively the species which is present in some of the bodies described by Prof. Huxley under the term of "coccospheres," previously proposed for them by Dr. Wallich (Annals, 1861), I think there can be no doubt that it should have a special designation.

Coccospheres.

Seeing that the lower marine animals fed so plentifully on *M. unicellulares*, and that these as well as the coccosphere formed of them appear in the tag-like appendages of *Myxobrachia rhopalum*, Häckel (Quart. Journ. Microscop. Sci. Jan. 1871, pl. 5. fig. 4), while fully aware of the rotatory motion and spherical form of the food-pellets in the alimentary cavities of the Infusoria respectively, and the globular one in which the excrementitious parts are often voided, I at first thought that the coccospheres might originate in this way; but a subsequent examination of them as they occur in the deep-sea mud (for I have never met with any *here*) has induced me to change my opinion.

In the first place, there are two kinds of coccospheres, as figured by Prof. Huxley (*l. c.* fig. 6, *c*, *d*); but I do not allude to his division of them into the "compact" and "loose" types. One is formed exclusively of the frustules of *Melobesia unicellularis*, and the other as exclusively of the frustules of *M. discus*—the latter, together with its frustules, much less common than the former. Then, so far as my observation goes, the frustules in the coccosphere of *M. unicellularis* vary in size with that of this coccosphere, and never attain the dimensions or fully matured appearance of the free individuals, but for the most part retain that of those called by Prof. Huxley "discoliths." As the coccospheres vary a little in size, so the largest free frustules are longer than the diameter of the smaller coccospheres, and not far short of that of the larger ones, being in the proportion of about 3½ to 4½ 6000ths of an inch in diameter respectively. After this, we observe that the frustules in both kinds of coccospheres are compactly tessellated over the surface of the coccosphere-cells respectively, recalling to mind the way in which the gonimic contents of a unicellular Alga (which, it should be remembered, are always confined to the periphery and situated between the cell-wall and another more delicate membrane internally, enclosing the aqueous cavity of the cell) undergo division for a new progeny (see "Fecundation of *Eudorina*," pl. 8. fig. 2, vol. ii. 'Annals,' Oct. 1858)—and, lastly, that when the calcareous material of the frustules on the coccosphere is dissolved away by acetic acid, a membranous cell (that observed by Wallich) of the same size, with a faint appearance of the frustules, still remains behind.

Now, in the face of all this evidence, how can one come to any other conclusion than that the coccospheres are the sporangia of the two species of *Melobesia* respectively above described? And may not the division of the nucleus or central granule, which we can trace in the frustules of *M. unicellularis* from a single to a multifid state, when it assumes a globular form, be in some way connected with the reproductive process, if not an early condition of the coccosphere or sporangium?

If it be satisfactorily proved that *Melobesia unicellularis* is an Alga, then both the first and second conclusions of Prof. Huxley above quoted can be no longer retained; and if the frustules of *M. unicellularis* on their coccospheres can be shown to be developed in proportion to the size of the latter, then in the lower phases they represent Prof. Huxley's "discoliths." Hence my reasons for considering the latter immature or young forms of *M. unicellularis*.

The "loose type" of coccosphere figured by Prof. Huxley (*l. c.* fig. 7, *d*) I have not yet seen, but can easily conceive that this is a still more developed form of the sporangium or coccosphere, perhaps undergoing dehiscence.

By the use of acetic acid I have not been able to determine whether the frustules are on the inner or on the outer side of the membranous cell of the coccosphere. If the latter, then perhaps the outer cell of the sporangium is fugacious, leaving the frustules attached to the inner one, as in *Synura uvella*, Ehr. ('Infusionsthiere,' Taf. 3. fig. 9; and Pritchard, 'Infusoria,' pl. 20. figs. 29, 30). We, unfortunately, know much more about the different forms of matured sporangia than we do of their subsequent development; so that our means of comparison here are necessarily very restricted.

I prefer the name of "*Melobesia*" for these cells, as this associates them with the calcareous Algæ, to which they appear to me to be most intimately allied, and for which family Lamouroux first proposed the name. The two forms cannot be considered to belong to a diœcious species, because both have their respective coccospheres.

Thus we have another organism in the Laminarian zone *here* which descends to the greatest depths of the Atlantic Ocean, to furnish food for the lower animals of that region, as it does for those at the borders of the sea. I have already pointed out, in the last number of the 'Annals,' the way in which the pachytragian shore-sponges are continued down into the deep sea through *Stelletta* (*Tisiphonia*) *agariciformis*, Sdt., = *Wyville-Thomsonia Wallichii*, Wright,—to which I might have also added the Esperiadæ, culminating in the great shrub-like branching form noticed by Dr. Carpenter, of which a specimen was sent to the British Museum; and now, while examining the portion of deep-sea mud to which I have alluded for coccoliths, I observe a representative of the Geodidæ in the presence of one of their little siliceous balls with a surface-pattern differing from any with which I am acquainted. Thus, perhaps, when all is told of this remarkable and remote locality, we may find still more instances of the connexion of living organisms on the borders of the sea with those in the greatest depths of the Atlantic Ocean.

Had Prof. Huxley had time to give his attention specially to the coccoliths, with the other advantages afforded by a sea-side residence, his antecedents show that he probably would have anticipated me in much more than I have above stated.

XXIII.—*A few Remarks on* Dipterus *and* Ctenodus, *and on their Relationship to* Ceratodus Forsteri, *Krefft*. By Albany Hancock, F.L.S., and Thomas Atthey.

[Plates XIII. & XIV.]

In our paper on *Ctenodus*, published in the 'Annals' in February 1868*, while recognizing the close connexion between this genus and *Dipterus*, we deemed it prudent to keep the two forms asunder, for certain reasons therein expressed; and the time that has elapsed since then has only tended to confirm us in this opinion. Among other characters that influenced us, stress was laid on the differences in the scales in the two genera; and allusion was made to the fact that the *Dipteri* are all small fishes, and that the *Ctenodi*, on the contrary are, with one exception, all of considerable size.

In the paper alluded to, seven species were described, six of which were new. Three of the seven (namely, *C. cristatus*, *C. tuberculatus*, and *C. corrugatus*) cannot have been less than five or six feet in length. We originally estimated the length at four or five feet; but as larger specimens have since come to hand, we now think that that estimate was too low. Three others (namely, *C. obliquus*, *C. imbricatus*, and *C. ellipticus*) were probably upwards of three feet long. *C. elegans* is quite small. The latter is the only species of which an entire specimen has occurred; and though much crushed and disturbed, its dimensions can be determined with sufficient accuracy: it measures only three inches in length, but, judging from the size of detached dental plates, it probably reaches sometimes nearly twice that length. The *Dipteri* are usually about five or six inches long, and apparently never much exceed that length.

The scales are very different in the two forms. While in *Dipterus* they are circular and truly cycloidal, in *Ctenodus* they (Pl. XIII. fig. 3) are elongated and parallelogrammatic, with the posterior end well rounded, and the sides nearly parallel or a little hollowed or concave; they are in length nearly twice their width, and, though imbricated, can scarcely be called truly cycloidal: they are delicate and large for the size of the fish, and are longitudinally ridged or grooved; the ridges, becoming curved and nodose, form a sort of rosette in the centre of the exposed imbricated portion. This is very different from the ornamentation of the scales of *Dipterus*, which are either irregularly tuberculated, the tubercles being

* "Notes on various Species of *Ctenodus* from the Northumberland Coal-Field," Ann. Nat. Hist. ser. 4. vol. i. p. 77.

elongated and scattered, or striated and punctate. The scales alone would therefore seem sufficient for generic distinction.

There are other characters, however, which distinguish the two forms. When our paper on the subject was written, we had not access to Pander's valuable 'Monograph on the *Ctenodipterini*'*. Since then we have enjoyed this advantage, and are now in a position to point out other features that separate *Dipterus* from *Ctenodus*. In the former the upper dental plates are each adherent to the anterior extremities of the two bones named by Pander respectively the palatal and inner pterygoid. These are elongated flattened bones, and lie parallel to and in close contact with each other, being apparently united by a suture. These conjoined bones form on either side of the oral roof a flattened widish plate, with the posterior extremity somewhat expanded. The two plates are united in front along the longitudinal middle line, and diverge widely backwards.

Now the upper dental plates of *Ctenodus* are usually found attached to similar plate-like bones, which incline or diverge to the right or left accordingly as they are united to the right or left dental plate. These bony supports (Pl. XIV. *c*, *d*) are expanded at the posterior extremity, and are in general configuration exactly like the plate composed of the palatal and pterygoid bones in *Dipterus*. Indeed there can be no doubt that they are homologous; but the fact to which we wish to draw attention is, that while in *Ctenodus* the component bones are united so as to form but one bone, the suture being entirely obliterated, they are distinctly separated in *Dipterus* by a well-marked sutural line. This difference would seem to be of some importance; for it appears to be constant, as it occurs in all our species, of the whole of which, excepting *C. corrugatus*, these bones have been found.

The sphenoid bones in the two genera are likewise very different in character. In *Dipterus*, according to the same high authority already quoted, as well as according to Hugh Miller†, this bone is widely lozenge-formed, and does not extend backwards very much beyond the extremities of the palato-pterygoid bones to which the dental plates are attached, and fills up the entire space between them: this bone Pander considers the basi-sphenoid.

In *Ctenodus* the sphenoid is a much elongated depressed bone, with a wide lozenge-formed expansion near the anterior extremity. In other words, the posterior angle of the lozenge-

* 'Ueber die Ctenodipterinen des Devonischen Systems,' Dr. C. H. Pander. 1858.

† See 'Footprints of the Creator,' p. 58.

formed expansion is much produced, while the anterior angle is only slightly produced. The frontal portion (the pre-sphenoid) is rounded, inclining to conical at the extremity, and fits in between the divergent bones that support the dental plates. The lozenge-formed expansion lies partly behind these bones; and the elongated posterior extension (the basi-sphenoid) is continued for a considerable distance further back, in the large species for nearly five inches. It is therefore pretty clear that in *Dipterus*, in which the sphenoid reaches only a short way behind the extremities of the palato-pterygoids, the head is proportionately short in comparison with that of *Ctenodus*, in which it must be much elongated.

We have in our possession numerous sphenoids, belonging to five or six species, three of which demonstrably are those of *C. tuberculatus*, *C. obliquus*, and *C. elegans*, respectively. They are all very similar in character, varying only a little in the proportions of the parts. The largest are seven or eight inches long; the smallest, that of *C. elegans*, is only half an inch in length; the usual size is five or six inches. The basi-sphenoid at its junction with the lozenge-formed expansion is usually thick and nearly circular; elsewhere it is flattened.

In *Dipterus*, too, the vertebræ are ossified; but there is nothing to show that this is the case in *Ctenodus*. Indeed the total absence of any appearance of vertebræ in the specimen of *C. elegans* before referred to is a pretty good proof that in this genus the central axis of the skeleton was cartilaginous.

The above distinctive features will perhaps be considered sufficient to warrant the generic separation of these two forms, notwithstanding their evidently close relationship—and this without referring to the minute structure of the dental plates, which exhibits nevertheless some diversity in character.

In proof of the relationship of the two genera we have only to look to the general form of the oral armature, and to the manner in which the dental plates are placed in the mouth. We have already noticed the similarity of the palato-pterygoid bones to which the upper dental plates are attached, and have pointed out that, while in the one genus the bones are distinct, they are in the other united so that no suture is perceptible. The mandibles (Pl. XIII. fig. 1) are also very much alike in both genera, and so is their relationship to the dental plates.

The cranial bones of *Ctenodus*, so far as we are able to compare them, also closely resemble those of *Dipterus*, in which the whole of them appear to have been determined. Unfortunately, only those of the posterior part of the skull are known in *Ctenodus*. A fragmentary specimen of the occipital region of *C. tuberculatus* in our possession exhibits the occipitals, with a portion of the parietals and the lateral bones, all lying in their natural positions and united into one mass, the component parts being distinguished by well-marked sutures; and the whole so closely resemble the same bones in *Dipterus* that they might be taken to belong to a gigantic specimen of that genus. This fragmentary skull is eight and a half inches across the occiput.

The posterior portions of three other skulls have likewise been found: these belong to *C. obliquus*; they are nearly perfect, and one of them displays the bones up to and including the parietals. The surface is in excellent order, and is more coarsely pitted or punctate than in the former species, and exhibits throughout a semigloss; the sutures are quite distinct. The bones vary in form only specifically from those of *C. tuberculatus*: the occipital is the most characteristic, the frontal margin of which is deeply concave, while in the latter it projects and has a wedge-shaped process in the centre. This beautiful specimen measures seven inches across. The two other examples agree in all their characters with the above; but some of the lateral bones of one side are wanting. As in *Dipterus*, the component bones in *Ctenodus* are comparatively small, vary little in size, are many-sided, and fit together like a mosaic pavement or like the pieces of a Chinese puzzle. And that the anterior bones of the skull are of the same character, we have ample evidence in numerous separate bones that have occurred at Newsham, which, though differing in form from those composing the fragmentary skulls, undoubtedly belong to *Ctenodus*.

Another specimen, showing half of the bones of the occipital region, including the parietals, has occurred. This may perhaps belong to *C. cristatus*; at all events it is a portion of the skull of one of the larger species, for it is of considerable size. And that it cannot belong to either of the above two species is proved by the form of the median occipital, which differs greatly from that of both. It is strongly pointed in front, and the lateral posterior margins are remarkably sinuous; the surface-structure, too, is different.

The bones that are determinable in the above fragmentary skulls are the median and external occipitals, the anterior occipitals, the parietals, and the lateral or "skin bones" according to Pander, of which only the three posterior are present. The arrangement of these bones is precisely similar to that given in Pander's restored figure of the cranial shield of *Dipterus* (tab. 3. fig. 1), the principal difference being that they vary even less in size than those in the figure; the median occipital in *C. tuberculatus* is scarcely, if at all, larger than the other bones. And the surface of the whole, which is in a good state, is devoid of ornamentation, save that it is minutely and irregularly granular and punctate; but the species vary a little in these respects.

In Mr. Atthey's collection of separate cranial bones there are, besides specimens of the above, the median occipital of three or four other species, all varying a little in contour and in surface-character; so that we have here additional corroborative evidence that our shales contain six or seven species of *Ctenodus*.

The opercula likewise resemble those of *Dipterus*; they are large, stout, slightly convex, irregularly circular plates, with one side of the margin a little flattened, and slightly produced at each end of the flattened space; the surface is punctate and granular like the cranial bones. We possess six or seven different forms of these gill-covers, two of which have been identified as belonging to *C. elegans* and *C. obliquus* respectively. But, for a particular description of the various opercula, we must refer to our paper in the 'Annals' previously quoted, merely observing here that the largest are upwards of six inches in diameter; the smallest, that of *C. elegans*, about five sixteenths of an inch, though detached specimens of this species measure as much as nine sixteenths of an inch; all the others are very much larger than this.

The ribs are well ossified both in *Dipterus* and *Ctenodus*. Those of the latter are frequently found associated with other remains of this fish, many of them having been identified with the various species; they are well arched towards the proximal extremity, which is considerably enlarged; and the central channel is quite small, the cylindrical wall of bone being very thick; the ossification of the ribs is, in fact, almost complete. The largest ribs are from six to eight inches long.

The fins, so far as they can be made out in *C. elegans*, are arranged in the same manner as in *Dipterus*. The tail-fin is heterocercal and rhomboidal; and the anal and ventral can be traced, immediately before the caudal.

On the whole, then, it appears quite certain that these two genera are very closely related, as generally considered; but at the same time the several differences already pointed out would seem quite sufficient to justify their generic separation, at least for the present.

We may remark here that a peculiar hatchet-shaped or wedge-formed bone belonging to *Ctenodus* has occurred, which, though we are not able to determine the fact, we believe to belong to the shoulder-girdle*. Several specimens have

* In *Lepidosiren* the shoulder-girdle seems to be reduced to a single large bone having considerable resemblance to the above.

been found, which are divisible into five or six species by the modification in the form; they are paired bones. Their general character is that of a flattened elongated bone, with one end a little expanded, arched slightly, and gradually thinned out to a fine edge; it narrows a little towards the other end: one of the lateral margins is slightly thickened, and is somewhat convex; the opposite margin is a little concave. From the narrow extremity a strong wide process is given off at right angles, and extends considerably beyond the concave margin.

These bones vary a good deal in size and form: some are comparatively narrow and much elongated; others are short and broad; but all have the right-angular process at the narrow extremity. The largest are 4⅜ inches, and the smallest ⅝ inch in length.

These hatchet-shaped bones undoubtedly belong to *Ctenodus*, as they frequently occur with the remains of that fish; and a right and a left specimen have been found in connexion with a crushed head of *C. obliquus*, which fine cranial example exhibits three of the dental plates, both opercula, the sphenoid, the occipitals, and several other bones of the head. No jugular plates have been found; but as they are present in *Dipterus*, they may be expected to occur in *Ctenodus*.

The Hon. William Forster's most interesting discovery of the extraordinary fish which Mr. Gerard Krefft has described under the name of *Ceratodus Forsteri*, will, no doubt, in due course throw a flood of light on these curious Devonian and Carboniferous genera, with which it evidently has much in common. Its relationship to *Ceratodus*, however, is perhaps doubtful. From Mr. Krefft's description*, it appears that in *Ceratodus Forsteri* the skeleton is only partially ossified, in this respect agreeing with *Dipterus* and *Ctenodus*; but from what is known of *Ceratodus*, the latter is probably a true cartilaginous fish, and consequently a Selachian or Placoid. If this were not the case, surely something more would be known of it than the mere dental plates, which do not seem to be uncommon, but which are never found, so far as we know, in connexion with bony supports, with palatal or mandibular bones. In *Ctenodus*, on the contrary, which has the palatal bones and mandible ossified, the dental plates usually occur attached to them. Mr. Atthey has in his collection numerous specimens of the dental plates adhering to entire rami and perfect palato-pterygoid bones. Specimens of all the species, excepting *C. corrugatus*, occur in this state; and, in fact, some portion of the bony support is almost always present. The

* Proc. Zool. Soc. 1870, part 2, p. 221.

entire absence, then, in *Ceratodus* of any such bony support would seem to indicate that none had ever existed.

So long as *Ctenodus* and *Dipterus* were represented merely by the dental plates, they were placed with the Placoids; and no one would have been justified in placing them elsewhere. Therefore, until some further information is obtained respecting *Ceratodus*, it would seem best to allow it to remain as at present located, along with the Selachians. The form of its dental plates, too, is sufficiently characteristic to justify its separation generically from this interesting Australian animal as well as from *Dipterus* and *Ctenodus*. Certainly in the dental organs all three approximate to the Selachians; but the Ganoid characters so predominate that we apprehend no naturalist would hesitate to place them in that order, though they may be considered to a certain extent "synthetic" forms, as suggested by M. Agassiz*.

In the present state of knowledge respecting *Ceratodus*, it is, then, evidently hazardous to place Mr. Krefft's fish in that genus; but its affinity with *Dipterus* and *Ctenodus*, more especially with the latter, is clear enough. All three are covered with large cycloidal scales; the fins are arranged much in the same manner; the skeletons are nearly in the like state of partial ossification; the dental plates are much alike, there being four ridged plates—two palatal, two mandibular. And when the so-called *Ceratodus Forsteri* has been fully examined, there can be little doubt that this affinity will become only the more evident.

Nevertheless the relationship is perhaps closest with *Ctenodus*. Like most of the members of that genus, the Australian fish is large, measuring from three to six feet in length. And it is only necessary to look to the mandibles (Pl. XIII. figs. 1 & 2) of the two forms to be convinced how close this relationship is. In *Ctenodus* the ramus (fig. 2) is a stoutish bone, flattened vertically, with the upper margin turned over towards the external surface, to give support to the large dental plate; it is therefore channelled on the outer surface, and somewhat convex on the inner. The posterior extremity projects backwards beyond the dental plate a little more than half the length of the latter; and is for the greater part occupied by the glenoid surface, which extends from the upper margin, and is a deep, wide, circular notch, inclining backwards and downwards. In front the symphysial surface is straight, extending the whole depth of the ramus, and is grooved transversely. The dental plate is about two-thirds the entire length of the ramus, and is placed nearer the sym-

* 'Nature,' No. 61, vol. iii. p. 166 (1870).

physis than the posterior extremity. The ramus is upwards of three inches in length, and, including the thickness of the dental plate, is an inch deep.

Such is the description of the ramus of *C. obliquus*, which, with very little modification, would do equally well for all the other species, as they vary only in size and slightly in the proportions of the parts. On comparing this description and the figure of the ramus (Pl. XIII. fig. 2), as well as that of the entire mandible of *C. imbricatus* (fig. 1), with the representation of the mandible of the so-called *Ceratodus Forsteri* that accompanies the paper on the subject in the 'Proceedings of the Zoological Society,' previously quoted, it will at once be seen that these parts in this curious fish and those in *Ctenodus* closely resemble each other. So similar, indeed, are they, particularly in the dentition, that, were nothing more known of the two forms, they would both assuredly be considered to belong to one and the same genus.

And this likeness would be still greater if the cartilage were present that undoubtedly originally supplemented the ramus of *Ctenodus*. At present the outer border of the dental plate is unsupported, overhanging as it does the side of the ramus. This channel or cavity (Pl. XIII. fig. 2, *d*) beneath the dental plate must have been occupied by cartilage, which, passing backward to the glenoid notch, might, it can easily be seen, form here a semicircular cavity similar to that shown in the figure of the mandible of *Ceratodus Forsteri*. The ramus would thus assume a somewhat rotund form, instead of being a flattened or, rather, a semicylindrical plate, as it has all the appearance of having been, encasing incompletely a cartilaginous core.

But, notwithstanding the similarity of the so-called *Ceratodus Forsteri* to the *Ctenodipterini*, we are quite inclined to believe that it will be found to be generically distinct from all known forms.

The new Australian fish is described to have two "incisor" teeth in the upper jaw, placed a little in advance of the dental plates. There is no reason for believing that such additional teeth are present in either *Dipterus* or *Ctenodus*. Several entire heads of the former have been obtained; and we possess in the specimen before alluded to of *C. elegans* a crushed head of that species, and have also two crushed heads of *C. obliquus*; and in neither genus has there been found the least trace of any such "incisor" teeth. The four dental plates only are present—two palatal, two mandibular. And, again, these plates are not by any means uncommon at Newsham, where upwards of four hundred specimens have been obtained by Mr. Atthey. Had such "incisors" existed, about two hundred of them might therefore have been expected to occur; not one has been found.

This peculiar character alone would seem sufficient to separate generically the so-called *Ceratodus Forsteri* from *Dipterus* and *Ctenodus*, and shows very clearly the relationship of the former to *Lepidosiren*, which is provided with two small pointed teeth in front of the upper dental plates*, which latter do not differ much from those of this interesting Australian fish.

EXPLANATION OF THE PLATES.

Plate XIII.

Fig. 1. Mandible, natural size, with the dental plate attached, of *Ctenodus imbricatus*: *a*, dental plate; *b*, glenoid notch.

Fig. 2. Outside view, natural size, of the right ramus, with the dental plate attached, of *Ctenodus obliquus*: *a*, dental plate; *b*, symphysial margin; *c*, glenoid notch; *d*, channel or cavity overhung by the dental plate.

Fig. 3. Scale, much enlarged, of *Ctenodus elegans*: *a*, posterior or imbricated extremity.

Plate XIV.

The palato-pterygoid bones, natural size, with dental plate attached, of *Ctenodus tuberculatus*: *a*, anterior extremity of the bone; *b*, dental plate; *c*, palatal side of the bone; *d*, pterygoid side of ditto.

XXIV.—*Catalogue of* Zygopinæ, *a Subfamily of* Curculionidæ, *found by* Mr. Wallace *in the Eastern Archipelago*. By Francis P. Pascoe, F.L.S. &c., late Pres. Ent. Soc.

[Plates XV. & XVI.]

For the Zygopinæ of America and of the Old World Lacordaire sought to establish two sections depending on the, as a rule, greater breadth of the episterna of the metathorax in the former, and their narrowness in the latter, or, when in the latter the episterna are broad, on there being a funicle of only six joints, and the pectoral canal being absent. But, even with these limitations, the distinction will not now hold good, as several genera have broad episterna, either with a pectoral canal or with a seven-jointed funicle.

Lacordaire, however, was acquainted with but three of these Malasian genera, only one of which (*Arachnopus*) has narrow episterna; and this, with *Sphadasmus*, *Sympiezopus*, and their allies, it seems to me, had better be excluded from the subfamily. It is not at present my intention to swerve from Lacordaire's arrangement; still it may be desirable to show how the New-World Zygopinæ may be differentiated from the

* "Description of the *Lepidosiren annectens*," by Richard Owen, Esq. Trans. Linn. Soc. vol. xviii. p. 341, tab. 27. fig. 2.

normal species of the Old World. Having regard to the aberrant portion, these differences may perhaps be best shown in a tabular form :—

True Zygopinæ.—Episterna of the metathorax broad, parallel, separating the posterior coxæ from the elytra; eyes always large, generally occupying the whole of the head or nearly so.

A pectoral canal; funicle of seven joints. *All the New-World Zygopinæ.*

Without a pectoral canal, or, if with one, then with a funicle of six joints; or with a funicle of seven joints without a pectoral canal. *Old-World Zygopinæ.*

Aberrant Zygopinæ.—Episterna of the metathorax narrow (*Nauphæus*, ex.), often indistinct, leaving the posterior coxæ in contact with the elytra; eyes of moderate size.

Perhaps entomologists only can appreciate the really wonderful collections made by Mr. Wallace, especially when we consider how poor the collections are, even the Dutch ones, which are occasionally sent to Europe. In this family Curculionidæ, to which the Zygopinæ belong, exclusive of the other Rhynchophorous groups, it is probably within the mark to say that he obtained during his travels among the eastern islands not less than a thousand species; and I think I am not far out of the way in estimating the number of new ones at nine-tenths of the whole. But even the knowledge we have thus obtained is insufficient to enable us to place any great dependence on the distribution or limitation of their beetle-fauna. If we suppose that Mr. Wallace has collected even half the species inhabiting these vast regions, extending for more than 4000 miles in length and about 1300 in breadth, it is obvious that in doubling the number results might be obtained which would very considerably modify any conclusions we may arrive at now. For instance, in the great island of Borneo, Sarawak, a small district on the north-west was the only part visited by Mr. Wallace; it is quite possible that on the south-east coast, opposite to and in one part not more than seventy miles from Celebes, the fauna might be found as allied to the "Australian region" of the archipelago as the north-western or, rather, the Sarawak fauna undoubtedly is to the "Indian region"—that is, supposing the Malayan-peninsular fauna is to be called Indian.

Wallace's Straits (as that portion of the sea has been called which separates Borneo, Java, &c. on the west from Celebes and the islands to the east of it as far as New Guinea) may in other branches of the fauna mark off the two regions alluded to; but, it seems to me, for the Coleoptera they do not show any stronger line of demarcation than would probably be found in taking other parts of the archipelago of about equal extent. Taking, for instance, the 63 species noticed in this paper as belonging to the Malasian fauna, we find 5 genera and 17 species confined to the "Indian," 10 genera and 40 species to the "Australian," and 6 species, belonging to 4 genera, common to both regions, besides 4 other genera (*Dædania, Phylaitis, Pempheres,* and *Osphilia*) represented in both. They may be tabulated thus:—

	"Indian."	"Australian."	Common to both.
Mecopus	2	4	2
Talanthia	1		
Agametis	2	1	2
Ganyopis	1		
Odoacis	2		
Chirozetes	2	3	1
Dædania	1	1	
Phylaitis	2	2	
Pempheres	1	1	
Emexaure	1		
Heurippa	..	1	
Metialma*	..	1	1
Osphilia	1	3	
Brimoda	1		
Nauphæus	..	1	
Arachnopus	..	10	
Thyestetha	..	1	
Telaugia	..	1	
Idotasia	..	5	
Semiathe	..	2	
Elichora	..	1	
Xychusa	..	1	
Nyphæba	..	1	
	17	40	6

Again, if we divide this "Australian region" into two groups, the one consisting of the shallow-sea islands of the Papuan group, New Guinea, Salwatty, Aru, Mysol, and Waigiou, the other the deep-sea islands between these and Wallace's Straits, comprising, among others, Celebes, Gilolo, Morty, Batchian, Ceram, and Amboyna, we find the 46 "Australian-region" species, including the 6 common to the two "regions," to be thus distributed:—5 genera and 21 species confined to the shallow sea, 5 genera and 17 species to the deep-sea islands, 8 species belonging to 5 genera common to both groups, and 3 other genera (*Chirozetes, Metialma,* and *Osphilia*) represented in both. The table below will show their special distribution:—

* But this genus has species found in India and in China.

	Shallow-sea Islands.	Deep-sea Islands.	Common.
Mecopus	2	2	2
Agametis	1	1	1
Chirozetes	3	1	
Pempheres	..	1	
Dædania	1		
Phylaitis	..	1	1
Heurippa	..	1	
Metialma	1	1	
Osphilia	1	2	
Nauphæus	1		
Arachnopus	5	3	2
Thyestetha	1		
Telaugia	..	1	
Idotasia	2	1	2
Semiathe	2		
Xychusa	1		
Elichora	..	1	
Nyphæba	..	1	
	21	17	8

I do not attach much importance to these tables, or to any of the same character which may be drawn up on the strength of our present materials; but it would not be difficult to show that similar differences would be found to a greater or less extent in other cases. How very few species, for instance, are as yet known to be common to Dorey and Aru! and yet their faunas are probably almost identical.

Of the Australian Zygopinæ only two species have been described, *Ilacuris laticollis* and *Mecopus tipularius*. Another *Mecopus* and two *Idotasiæ* are in my collection; and these, as far as I know, are all that have at present been found in Australia—as when there are genera common to Malasia and Australia, they are frequently found in regions beyond the two: *Mecopus* and *Idotasia* have representatives in the Fiji Islands and New Caledonia respectively.

As to the habits of the species, Mr. Wallace tells me that the *Mecopi* are always found on dead trees in the forest, love the sunshine, and take flight rapidly. The members of the allied genera appear to have similar habits; but with the *Arachnopodes* it is different; they look like spiders and have the motion of spiders, frequent the edges of leaves, moving rapidly beneath when approached. *Idotasiæ* and their allies are also found on leaves, but are sluggish. The species observed by Lacordaire in Cayenne and Brazil "live exclusively on the trunks of trees, and are usually quiescent. At the approach of danger, they run rapidly round the tree; and when one attempts to seize them, they fall suddenly as though dead. But instead of dropping to the ground, they take flight in the middle of their fall, and go back to the point from which they departed."

In the following table, which is drawn up on the principle of taking the most obvious characters rather than the most important, it is thought desirable to include two genera not occurring in the Malayan archipelago—one (*Sphadasmus*) represented by an Indian species, the other the Australian genus *Ilacuris*. Thus all the known Asiatic and Australian genera are here enumerated.

a. No pectoral canal, or, if present, not passing the anterior coxæ.
b. Eyes closely approximate, occupying the whole head or nearly so.
c. Funicle six-jointed.
d. Anterior femora linear, elongate.
e. Scape not nearly reaching the eye .... *Mecopus*, Schön.
ee. Scape extending beyond the eye .... *Talanthia*, n. g.
dd. Anterior femora thickened, not, or only moderately, elongate.
f. Propectus canaliculate.
g. Second joint of the funicle very long.......... *Agametis*, Pasc.
gg. Second joint of the funicle scarcely longer than the others .... *Ganyopis*, n. g.
ff. Propectus not canaliculate.
h. Second abdominal segment as long as the third and fourth together.
i. Anterior coxæ contiguous.
j. Anterior tibiæ compressed, curved, or bisinuate . *Dædania*, n. g.
jj. Anterior tibiæ straight or nearly so.
k. Second joint of the funicle twice as long as the first .... *Pempheres*, n. g.
kk. Second joint of the funicle not longer than the first .... *Phylaitis*, n. g.
ii. Anterior coxæ not contiguous................ *Chirozetes*, Pasc.
hh. Second abdominal segment shorter than the third and fourth together .... *Odoacis*, Pasc.
cc. Funicle seven-jointed.
l. Tarsi elongate, linear....................... *Emexaure*, n. g.
ll. Tarsi less elongate, the three basal joints gradually broader.
m. Body rhomboidal or elliptic.
n. Three intermediate segments of abdomen equal . *Brimoda*, n. g.
nn. Second segment of the abdomen as long as the two next together.
o. Rostrum triangular at the base .... *Osphilia*, n. g.
oo. Rostrum cylindrical at the base.............. *Metialma*, n. g.
mm. Body oblong, parallel .... *Heurippa*, n. g.
bb. Eyes not closely approximate, nor occupying the whole head.
p. With ocular lobes.
q. Intercoxal process narrowed .... *Nauphæus*, n. g.
qq. Intercoxal process very broad .... *Arachnopus*, Guér.
pp. Without ocular lobes.
r. Intermediate segments of abdomen of equal length *Sphadasmus**, Schön.
rr. Second abdominal segment longer than the next two together .... *Ilacuris*, Pasc.

* *Sphadasmus* has been considered to be confined to South Africa;

aa. A pectoral canal passing behind the anterior coxæ.
s. Pectoral canal gradually effaced behind.
t. Rostrum in repose extending to the abdomen ...... *Thycstetha*, Pasc.
tt. Rostrum in repose not passing beyond the intermediate coxæ .... *Telaugia*, n. g.
ss. Pectoral canal limited behind.
u. Intercoxal process very broad, the posterior coxæ close to the elytra.
v. Metasternum of moderate length, intermediate and posterior coxæ on each side not approximate.
w. Femora canaliculate beneath, receiving the tibiæ in repose .... *Idotasia*, n. g.
ww. Femora not canaliculate beneath .... *Semiathe*, n. g.
vv. Metasternum very short; intermediate and posterior coxæ on each side nearly contiguous.
x. Pectoral canal not extending to intermediate coxæ . *Xychusa*, n. g.
xx. Pectoral canal extending to the posterior border of the intermediate coxæ .... *Elichora*, n. g.
uu. Intercoxal process narrower; posterior coxæ not near the elytra.............................. *Nyphœba*, n. g.

Mecopus.

Schönherr, Disp. Meth. p. 304; Lacordaire, Gen. vii. p. 157.

The new species of this genus described below are all very distinct, and cannot possibly be confounded with any others. This is not the case with *M. bispinosus**, Weber, on which the genus is founded, and from which I cannot separate *M. Audineti*, Rld. Of the numerous examples in my collection, from seventeen localities, extending from Java and Singapore to New Guinea, I am unable satisfactorily to separate apparently different forms which, if taken without the intermediate individuals, would seem to represent good species. Here "natural selection" may be said to have failed to strike out connecting varieties, without which any such graduated series of forms can be considered only to represent a single spe-

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but the following species, not uncommon in Indian collections, brings it into our table:—

Sphadasmus brahminus.

S. breviter ovalis, fuscus, infra griseo-squamosus; rostro prothorace breviore; funiculi articulo primo secundo duplo longiore, tertio secundo fere æquali; prothorace transverso, subconico, regulariter convexo, medio et utrinque griseo-squamoso; elytris profunde striato-punctatis, interstitiis latis, convexis, basi figura transversa triloba, plaga laterali et maculis conjunctis in medio et pone medium sordide griseis notatis; pedibus squamis filiformibus vestitis. Long. $4\frac{1}{4}$ lin.
Hab. Bengal.

* *Rhynchænus bispinosus*, Fab. (Syst. El. ii. 475), quoted in Schönherr, is surely very different from this. Fabricius connects it with *Cionus.*

cies. It may be added that there is no ground for believing these varieties to be local subspecies. The descriptions below are all made from males; and it will be seen that two of them are without pectoral spines. There are a few other species in Mr. Wallace's collection; one of them is *M. trilineatus*, Guér., which was found in the islands of Aru and Waigiou as well as in New Guinea.

Mecopus spinicollis. Pl. XV. fig. 8.

M. sat breviter obovatus, ater, supra maculatim albo-squamosus, infra squamis albis dispersis; rostro prothorace duplo longiore, supra quinquecarinulato, basi silaceo-squamoso; antennis nigris, funiculo articulo secundo quam tertio duplo longiore; prothorace transverso, ampliato, medio antice paulo gibboso, in utroque latere cavitate sat profunda impresso et extrorsum spinis duabus erectis instructo, supra granulis opacis plurimis sat vage inter squamas detectis; elytris basi prothorace angustioribus, dorso planatis et versus scutellum paulo excavatis, sulcato-punctatis, interstitiis 4°, 5°, 6° spinis brevibus uniseriatim remote armatis; cornibus rectis, subulatis; pedibus minus elongatis, albo-squamosis, concinne nigro annulatis. Long. 5 lin.

Hab. Java.

In my specimen there are only two, but in the British Museum there is one with four or five shorter spines on each side. In the female they are replaced by tubercles.

Mecopus cuneiformis.

M. oblongus, postice gradatim attenuatus, nigro-piceus, silaceo-squamosus, femoribus elytrisque aliquando squamis niveis irroratis; rostro prothorace duplo longiore, quinquecarinulato, basi genisque silaceo-squamosis; antennis nigris, funiculo niveo-piloso, articulo secundo quam tertio triplo longiore; prothorace plus minusve ampliato, utrinque fortiter rotundato, supra subvage granulato; elytris anguste cuneatis, dorso planatis, striato-punctatis, interstitio quinto uniseriatim spinoso, reliquis exterioribus asperato-elevatis, apicibus truncatis, angulo externo tuberculato-productis; corpore infra dense albo-squamoso, maculis fuscis dispersis; femoribus supra silaceo-squamosis, reliquis albo sparsis. Long. 4–5 lin.

Hab. Sarawak.

In one or two of my specimens there are brown spots on the middle of the elytra. What I take to be the female has the apices of the elytra rounded. Another species very close to this, from Java, has the elytra mucronate in both sexes; but my male specimen is in too poor a condition for description.

Mecopus pulvereus. Pl. XV. fig. 3.

M. oblongus, postice gradatim attenuatus, prothorace squamulis, subtus elytrisque indumento, griseis dense tectus; rostro capite cum prothorace vix longiore, supra quinquecarinulato, squamulis griseis fere usque ad apicem irrorato; antennis dense griseo-pilosis, clava, basi excepta, nigra, funiculo articulo secundo quam tertio triplo longiore; prothorace sat amplo, apice angustato, squamulis rotundatis tecto; elytris cuneato-cordiformibus, apicibus rotundatis, striato-punctatis, interstitiis omnibus granulato-spinosis, marginibus exterioribus nigris; cornibus nullis; pectore longe lanoso; pedibus anticis quam reliquis multo longioribus; femoribus, præsertim posticis, incrassatis, his corpus vix superantibus, griseo-squamosis; tibiis tarsisque minus squamosis. Long. $4\frac{3}{4}$ lin.

Hab. Macassar.

The same wedge-shaped outline as the last, but differently clothed, and the apices of the elytra rounded.

Mecopus tenuipes.

M. obovatus, fuscus, squamis grisescentibus albidisque variegatus; rostro prothorace fere triplo longiore, basi (præsertim lateribus) crebre rugoso-punctato, infra denticulato-granulato; antennis piceis, funiculo modice tenuato, articulis duobus basalibus fere æqualibus; prothorace valde transverso, ampliato, apice abrupte constricto, medio æqualiter fusco-squamoso, vittis tribus margineque basali subalbido-squamosis; scutello oblongo, griseo; elytris subcuneatis, supra subdepressis, apicibus rotundatis, interstitiis valde convexis, tertio postice bi- tridentatis, dorso griseo subvittatis, singulis pone medium macula fusca obliqua notatis; cornibus piceis, longiusculis, paulo recurvatis; corpore infra atro, albo marginato, abdomine segmento primo pone coxas brevi; pedibus tenuissimis; femoribus squamis griseis irroratis, posticis perparum incrassatis; tibiis posticis dense albo-squamosis. Long. 5 lin.

Hab. Dorey; Aru.

There is a vestige of another stripe on each side of the prothorax, making five in all; there are also a few nearly obsolete brownish spots on the base of the elytra; but in this genus colour is very uncertain *.

* Another species in my collection, from one of the Fiji islands, is very like the above in coloration and outline, but, *inter alia*, is finely granulated on the prothorax; it may be described as follows:—

Mecopus collaris.

M. forma et colore *M. tenuipedis*, sed rostro minus punctato, basi quadrangulari; antennis valde tenuatis, funiculo articulo secundo quam primo sesquilongiore; prothorace supra manifeste punctato, interstitiis tenuiter granulatis; elytris sutura postice subserratis, interstitiis 3°, 5°, 7°, granulis elongatis subapproximatis instructis; abdomine segmento primo longiore; femoribus posticis linearibus, nullomodo incrassatis; tibiis posticis dense nigro-squamosis. Long. 5 lin.

Mecopus serrirostris.

M. subellipticus, ater, squamis luteis, vel aurantiacis, albisque variegatus; rostro prothorace vix duplo longiore, squamoso, quinquecarinulato, carinulis, media excepta, subremote breviter spinosis, squamis carinulisque prope apicem evanescentibus; antennis tenuissimis, piceis, funiculo articulo secundo quam tertio quadruplo longiore; clava longe pedunculata; prothorace modice ampliato, granulis paucis inconspicuis instructo, atro, linea media nivea, lateribus luteis, sed plaga atra plus minusve ampliata signato; scutello niveo; elytris sat late subcuneatis, medio magis convexis, apicibus rotundatis, striato-punctatis, punctis oblongis, interstitiis angustis, acute elevatis, præsertim tertio pone medium, granulatis, granulis (propter squamas, vix conspicuis) atris, sutura vittisque duabus utrinque obliquis albis luteo lavatis; cornibus nullis; pectore integro, aurantiaco-lanoso; metasterno abdomineque atris, lateribus albo-squamosis; pedibus anticis elongatis, atris, femoribus intus aurantiacis, apicem versus apiceque ipso atris; femoribus intermediis et posticis (his modice incrassatis) plerumque aurantiacis. Long. 6 lin.

Hab. Batchian, Dorey, Saylee.

The yellowish tints of this species are more or less of a faded orange, but brightest on the breast, where, in the male, the scales are long and woolly-looking.

Mecopus lituratus.

M. obovatus, ater, squamis albis maculatim variegatus; rostro prothorace duplo longiore, valde arcuato, basi quinquecarinulato, utrinque vage squamoso; antennis subtestaceis, extrorsum infuscatis; funiculo articulo secundo quam tertio duplo longiore; prothorace sat brevi, vix ampliato, apice latiore, subtiliter creberrime punctato, maculis tribus albis basi notato; scutello oblongo, angusto; elytris breviusculis, utrinque modice rotundatis, striato-punctatis, interstitiis alternis elevatis, sat vage granulatis, apicibus rotundatis, basi suturaque, scutello incluso, literam T formantibus, maculis plurimis albo-squamosis decoratis; cornibus subulatis, paulo recurvatis; corpore infra atro, sparse ochraceo-squamoso, ad latera squamis magis condensatis, metasterno utrinque plaga magna atra notato; pedibus anticis posticisque longitudine æqualibus; femoribus, posticis exceptis, modice incrassatis, his infra dente magno armatis. Long. 4 lin.

Hab. Tondano, Macassar, Sarawak.

TALANTHIA.

Rostrum elongatum, tenuatum; *scrobes* subterminales. *Antennæ* longissimæ; *scapus* ultra oculum productus; *funiculus* 6-articulatus, articulis valde elongatis; *clava* ovata, basi pedunculata. *Prothorax* subquadratus, utrinque paulo rotundatus. *Scutellum* parvum. *Elytra* prothorace paulo angustiora, basi supra planata. *Pedes* longissimi, lineares; *femora* mutica; *tibiæ* fere rectæ; *tarsi* articulo basali longissimo. *Pygidium* obtectum.

With a habit very much like that of *Mecopus*, this genus is trenchantly differentiated by the unusual length of the antennæ—the scape alone, in (so far as I can judge) both sexes, extending to the posterior border of the eye.

Talanthia phalangium. Pl. XV. fig. 4.

T. oblonga, nigra, opaca; rostro nitido, corpore longiore, basi supra bicarinulato, ad latera sulcato, apicem versus arcuato, depresso; antennis piceis, funiculo articulo secundo longiore, primo tertioque æqualibus, cæteris gradatim brevioribus; prothorace subtiliter punctato, punctis majoribus vage interjectis, maculis septem albo-squamosis ornato, una basali lineari, tribus utrinque rotundatis; elytris latitudine duplo longioribus, lateribus sensim angustatis et parum rotundatis, sulcato-punctatis, punctis foveiformibus, interstitiis angustis, convexis, plaga communi scutellari, maculisque quatuor vel plurimis posticis, e squamis albis formatis, notatis; corpore infra ad latera albo plagiato; tibiis tarsisque infra concinne ciliatis, illis apice albis. Long. $3\frac{1}{2}$–5 lin.

Hab. Penang.

AGAMETIS.

Pascoe, Journ. Proc. Linn. Soc. (Zool.) x. p. 473.

The addition of four new species to this genus necessitates a slight modification of its characters as given by me in the work above quoted. The posterior femora of these species do not extend beyond the body as in the type; and all the femora, except in *A. deleta*, are more or less thickened towards the apex; the elytra, too, though still depressed, are not flattened. None of these species has a trace of the bright orange of their congener, *A. festiva*, but are of different greys and browns, with a few spots of whitish, which, as in other instances where these colours predominate, probably vary according to the individual. The forms of the femora and tibiæ seem to afford good characters.

Agametis agrestis.

A. subovata, fusca, squamis griseis sat dense tecta; rostro rufo-piceo, apice nigro, subtilissime punctulato, basi vage squamoso; antennis subtestaceis; prothorace valde transverso, modice punctato, sat parce squamoso, utrinque vitta indeterminata pallida notato; scutello haud conspicuo; elytris prothorace valde latioribus, sulcato-punctatis, punctis quadratis, interstitiis angustis, convexis, postice, prope apicem, subgibbosis maculisque duabus albidis notatis; corpore infra femoribusque dense griseo-squamosis; femoribus posticis incrassatis, medio macula nigra signatis; tibiis tarsisque rufo testaceis, squamis filiformibus albidis vestitis. Long. 4 lin.

Hab. Sarawak.

Agametis deleta.

A. subovata, ferruginea vel fusca, squamis grisescentibus vestita; rostro testaceo-piceo, subtilissime punctulato; antennis subtestaceis, funiculo articulo secundo sequentibus conjunctim haud longiore; prothorace valde transverso, sat dense squamoso, utrinque vitta indeterminata ochracea notato; scutello distincto, subquadrato; elytris prothorace paulo latioribus, sulcato-punctatis, punctis quadratis, squamigeris, interstitiis sat latis squamis elongatis remote uniseriatim munitis, sutura antice macula oblonga et pone medium maculis duabus albidis notata; corpore infra, lateribus thoracis, femoribusque dense albido-squamosis; femoribus posticis perparum incrassatis; tibiis posticis extus paulo arcuatis, anticis, apice solo crassiore, teretibus. Long. $2\frac{3}{4}$ lin.

Hab. Singapore, Sarawak, Morty, Saylee.

Agametis morata.

A. subovata, fusca, flavido-squamosa; rostro nigro nitido, apice rufo-piceo, subtilissime punctulato; antennis subtestaceis, funiculo ut in præcedente; prothorace valde transverso, sat dense squamoso, utrinque flavescente maculis indeterminatis notato; elytris prothorace paulo latioribus, sulcato-punctatis, punctis ovatis, interstitiis sat latis, convexis, squamis elongatis uniseriatim remote munitis, sutura antice, scutello incluso, albido-squamosa, pone medium albo binotatis, maculisque indeterminatis fuscis variegatis; corpore infra pedibusque flavescenti-squamosis; femoribus incrassatis, præsertim posticis; tibiis breviusculis, extrorsum sensim incrassatis, posticis valde arcuatis. Long. $2\frac{1}{2}$ lin.

Hab. Sarawak.

Agametis ortyx.

A. late subovalis, fusca, squamis ochraceis maculatim varia; rostro minus elongato, magis robusto, a medio ad apicem sensim latiore; antennis subpiceis, funiculo articulo secundo sequentibus conjunctim manifeste longiore; prothorace fortiter transverso, plaga media fusca, cruciatim separata, ornato, lateribus pallidis, indistincte fusco maculatis; elytris prothorace magis latioribus, sulcato-punctatis, maculis numerosis ochraceis fuscisque irroratis, quasi subtessellatis; corpore infra pedibusque ferrugineis, sat dense ochraceo-squamosis; femoribus incrassatis, posticis medio macula fusca notatis; tibiis anticis basi fortiter arcuatis, apice angustatis. Long. 3 lin.

Hab. Mysol.

GANYOPIS.

Caput inter oculos cristatum; *rostrum* subvalidum, basi incrassatum, supra compressum, inter oculos ascendens; *scrobes* præmedianæ. *Scapus* oculum haud attingens; *funiculus* 6-articulatus, articulis crassis, tribus basalibus paulo longioribus, cæteris breviter obconicis; *clava* parva obovata. *Prothorax* suboblongus, apice tubulatus et supra haud sinuatus. *Elytra* prothorace latiora, elongata, subparallela, postice subito declivia. *Pedes* mediocres; *femora* parum incrassata, infra dentata, postica longiora; *tibiæ* subrectæ; *tarsi* mediocres, articulo tertio fortiter dilatato; *coxæ* anticæ contiguæ. *Propectus* leviter canaliculatum, haud cornutum. *Abdomen* normale, suturis fere rectis.

In habit like *Agametis*, but the funicle different, the rostrum raised at the base, running up and forming a crest between the eyes, and the apical margin of the prothorax not sloped or sinuated above, as in that and many of the genera allied to *Mecopus*.

Ganyopis leucura. Pl. XV. fig. 7.

G. elongata, fusca; rostro prothorace breviore, ferrugineo, basi cristaque inter oculos silaceo-squamosis; antennis piceis, funiculo articulo secundo primo vix longiore, omnibus parce pilosis; prothorace latitudine longitudini fere æquali, fortiter sat crebre punctato, medio fusco, lateribus scutelloque dense silaceo-squamosis; elytris supra subplanatis, latitudine fere triplo longioribus, basi singulatim valde rotundatis, lateribus sensim angustatis, postice utrinque tuberculo conico et, apice ipso, tuberculo minore externo, munitis, fortiter seriatim punctatis, punctis approximatis, quadratis, lineis elevatis separatis, dimidio antico supra parteque declivi dense silaceo-squamosis; corpore infra femoribusque dense albo-squamosis; femoribus posticis macula fusca notatis; tibiis tarsisque minus dense squamosis. Long. 6 lin.

Hab. Malacca.

ODOACIS.

Pascoe, Journ. Entom. ii. p. 427 (1865).

Macrobamon, Lacordaire, Gen. vii. p. 158 (1866).

Lacordaire's description of this genus was based on a female from Ceylon, which is doubtless distinct from the species described by me, as well as from the following. The genus is allied to *Mecopus*, and, owing to the length of the hind femora, is of a remarkable appearance. The male in the type (*O. grallarius**) has the anterior coxæ spined, not the breast as in

* See Pl. XVI. fig. 5.

Mecopus. I have another species allied to it, from Singapore, but it is not quite perfect; it has a longer prothorax, with the posterior angles produced, and the sides of the elytra, for more than a third of their length, dilated, or forming a sort of ledge. The following is very distinct from both.

Odoacis pedestris.

O. ovalis, obscure fuscus, squamis sordide ochraceis sparse et submaculatim indutus; rostro nigro, basi quinquecarinulato; antennis piceis, griseo-pilosis; funiculo articulo secundo quam primo duplo longiore; clava subcylindrica; prothorace transverso, medio carinulato, angulis posticis producto-rotundatis, dorso reticulato foveato; elytris sulcato-punctatis, interstitiis alternis magis elevatis, quarto sextoque granulatis; corpore infra pedibusque squamis albidis irroratis; tibiis, præsertim posticis, valde compressis, his extrorsum nigris; tarsis posticis articulo basali valde compresso. Long. 4 lin.

Hab. Sarawak (and Labuan).

Chirozetes.

Pascoe, Journ. Proc. Linn. Soc. Zool. x. p. 447.

From a communication lately received from M. Chevrolat, I find that the species described by me, and from which I drew up the characters of this genus, had been long ago published by Wiedemann*, under the name of *Rhynchænus sphærops*, in a work which, at the moment, I had unfortunately overlooked. Of the species here described, the first three have a certain general resemblance to the type (*C. sphærops*); so have also, but in a less degree, the last two with one another. The following table will facilitate their recognition:—

Derm brown.
  Prothorax longer than broad .... *sphærops* (Wiedm.).
  Prothorax transverse.
    Elytra (♂) scarcely more than half as long again as broad.
      Prothorax granulate .... *auguralis.*
      Prothorax not granulate .... *junix.*
    Elytra nearly twice as long as broad .... *sectator.*
Derm black.
  Apex of the prothorax entire .... *nervosus.*
  Apex of the prothorax sinuate .... *grammicus.*

* Zool. Mag. Bd. ii. Stück i. p. 129 (1825).

Chirozetes sectator.

C. subellipticus, fuscus, squamis silaceis conspersus; capite inter oculos silaceo-squamoso; rostro nitido, sat fortiter punctato; antennis piceis; prothorace transverso, apice supra modice sinuato, granulato-punctato, squamis silaceis irrorato, in medio et in utroque latere condensatis, vittas tres formantibus; elytris sulcato-punctatis, interstitiis alternis elevatis, reliquis complanatis, maculis silaceis notatis, pone scutellum in singulo elytro macula curvata, postice divergente, signatis; cornibus gracilibus, acutis; corpore infra dense albido-squamoso; pedibus minus squamosis. Long. $5\frac{1}{2}$ lin.

Hab. Sarawak, Penang, Singapore.

Chirozetes junix.

C. breviusculus, fuscus; capite inter oculos silaceo-piloso; rostro sat fortiter punctato, basi vage silaceo-squamoso, apicem versus rufo; antennis testaceo-piceis; prothorace transverso, basi manifeste bisinuato, apice modice sinuato, haud granulato subcrebre punctato, squamis silaceis irrorato, in medio carinulato; elytris piceis, squamis silaceis flavescentibusque variegatim indutis, sulcato-punctatis, interstitiis 1°, 3°, 5° elevatis, hoc confertim punctato, reliquis subasperatis, plaga fusca pone medium notatis; cornibus gracilibus, acutis; corpore infra pedibusque albido-squamosis. Long. 4 lin.

Hab. Sarawak, Singapore, Mysol.

Chirozetes auguralis.

C. subovalis, fuscus; capite inter oculos genisque albidis; rostro ferrugineo, nitido, leviter confertim punctato; antennis testaceis, funiculo articulo primo secundo breviore; prothorace magis transverso, basi fortiter bisinuato, subgranulato-punctato, medio obsolete carinulato, squamis albidis irrorato plagisque quatuor notato, duabus apicalibus, duabus basalibus; elytris sulcato-punctatis, interstitiis plus minusve elevatis, præsertim prope basin, et interstitiis 1°, 3°, 5°, his asperatis, albido-squamosis, plaga in medio, ad suturam interrupta, nonnullis minoribus transversis ad latera notatis; corpore infra dense albido-squamoso, flavescente lavato; pedibus squamis albidis vestitis; tibiis posticis intus basi apiceque fuscis. Long. 4 lin.

Hab. Aru.

Chirozetes nervosus. Pl. XV. fig. 9.

C. ellipticus, niger; capite inter oculos genisque niveo-squamosis; rostro sat fortiter punctato; antennis piceis; prothorace latitudine vix longiore, apice supra perparum sinuato, confertim granulato-punctato, vittis tribus albidis notato, una mediana, una utrinque, infra vitta laterali fuliginea, leviter punctato; elytris striato-punctatis, interstitiis alternis asperatis, nitidis, convexis, lineis albis ornatis, una, scutellum includente, margine basali sita, in singulo elytro una obliqua abbreviata ante medium et prope suturam, una post eam interstitio quinto limitata et fere ad apicem protensa, alteraque exteriore interstitio octavo locata; cornibus pectoris apice dilatatis; corpore infra squamis albidis sat dense vestito, lateribus sterni abdomineque in medio fuligineis; pedibus squamis piliformibus albis minus dense tectis. Long. 6 lin.

Hab. Amboyna.

Scales on the median stripe of the prothorax oval, with a central longitudinal depression, and placed, in the middle, obliquely or almost transversely.

Chirozetes grammicus.

C. subellipticus, fusco-niger; capite inter oculos genisque pallide ochraceo squamosis; rostro sat fortiter punctato, basi valde incrassato; antennis piceis; prothorace transverso, apice supra valde sinuato, granulato-punctato, squamis silaceis irroratis, in medio et ad latera condensatis vittas tres formantibus; elytris ut in præcedente, sed lineis obliquis a scutello incipientibus; cornibus pectoris apice acutis; corpore infra fuligineo, sterno segmentisque abdominis marginibus ochraceo-squamosis; pedibus ut in præcedente. Long. $3\frac{1}{2}$ lin.

Hab. Mysol.

Scales on the median stripe of the prothorax narrowly wedge-shaped anteriorly, towards the base more oval, and without a central depression, arranged as in the last.

DÆDANIA.

Rostrum sat robustum, basi cylindricum, lineatum, apice depressum; *scrobes* præmedianæ. *Oculi* magni, contigui. *Scapus* basin rostri haud attingens; *funiculus* 6-articulatus, articulis duobus basalibus longioribus, cæteris submoniliformibus; *clava* pedunculata. *Prothorax* transversus, ampliatus, basi bisinuatus. *Elytra* prothorace haud latiora, subcuneiformia, supra subplanata, apicibus rotundata. *Pedes* mediocres, intermedii minores; *femora* incrassata, infra fortiter dentata; *tibiæ* compressæ, intus bisinuatæ; *tarsi* modice elongati, articulo tertio dilatato. *Coxæ* anticæ approximatæ. *Propectus* foveatum, bicornutum. *Epimera* mesothoracis haud ascendentia. *Abdomen* normale.

The anterior tibiæ in this genus have the inner edge bisinuate, owing to the tooth-like process at or near the middle;

the anterior femora also are much stouter, and have a large triangular tooth beneath.

Dædania mesoleuca. Pl. XV. fig. 1.

D. obovata, nigra; rostro prothorace paulo longiore, castaneo, fortiter crebre punctato, basi quinquelineato; antennis piceis; prothorace utrinque fere parallelo, subtiliter granulato-punctato, maculis duabus, una apicali, una basali, lateribusque niveo-squamosis; elytris striato-punctatis, interstitiis convexis, uniseriatim granulatis, plaga magna basali subtriangulari, scutellum includente, niveo-squamosa; corpore infra, medio excepto, femoribus basi, tibiisque medio niveo-squamosis, reliquis tarsisque nigris; femoribus posticis corpus superantibus; tarsis anticis dilatatis, ciliatis. Long. 3 lin.

Hab. Mysol.

One of my specimens, apparently a female, has the anterior tarsi also dilated, but to a less extent.

Dædania meleagris.

D. oblongo-obovata, nigra; rostro basi lineis abbreviatis minus elevatis; antennis testaceis; prothorace utrinque rotundato, crebre punctato, squamis silaceis irrorato, maculis duabus, una apicali, una basali, lateribusque etiam duabus, sed majoribus, niveo-squamosis; elytris striato-punctatis, interstitiis convexis angustis, uniseriatim granulatis, squamulis silaceis maculatim dispositis, macula communi pone scutellum, singulatim maculisque tribus, 2 juxta suturam, altera exteriore notatis; corpore infra toto albo-squamoso; femoribus tibiisque minus dense squamosis; femoribus posticis corpus haud superantibus. Long. $2\frac{3}{4}$ lin.

Hab. Sarawak, Singapore, Penang (and Cambodia).

The silaceous scales on the elytra are much smaller than those on the prothorax. A specimen, also from Sarawak, differs in having its markings pure ochre-yellow, and in its longer rostrum less rugose at the base.

Phylaitis.

Rostrum tenuatum, basi cylindricum haud compressum, lineatum, apice subdepressum; *scrobes* præmedianæ. *Oculi* permagni, contigui. *Scapus* basin rostri vix attingens; *funiculus* 6-articulatus, articulis duabus basalibus, longioribus, æqualibus, cæteris transversis vel subtransversis; *clava* basi elongata, vix pedunculata. *Prothorax* transversus, basi bisinuatus. *Elytra* prothorace vix latiora, subcuneiformia, apicibus rotundata. *Pedes* elongati; *femora* modice incrassata, infra dentata, postica corpus longe superantia; *tibiæ* graciles, longiusculæ, anticæ rectæ, reliquis flexuosis; *tarsi* elongati, articulo tertio dilatato. *Propectus* foveatum, bicornutum. *Episterna* metathoracis haud ascendentia. *Abdomen* normale.

In this genus the anterior tibiæ are slender, and of equal breadth throughout; the anterior femora are slightly thickened, and have a slender spine-like tooth beneath.

Phylaitis V-*alba*. Pl. XV. fig. 6.

P. obovata, nigra, albido-squamosa; rostro prothorace manifeste longiore, nigro-piceo, basi quinquelineato, squamis albidis adsperso; antennis fusco-testaceis, funiculo articulis duobus basalibus longiusculis, cæteris breviter obconicis; prothorace fortiter transverso, ampliato, squamis albidis irrorato, apice nigro marginato; scutello lanciformi; elytris striato-punctatis, interstitiis latis, sordide albido variegatis, basi squamis majoribus albido-coloratis, literam V formantibus; corpore infra dense albido squamoso; pedibus squamis filiformibus albis minus dense vestitis. Long. $2\frac{1}{4}$ lin.

Hab. Macassar, Celebes, Ternate, Mysol, Dorey.

Phylaitis lineata.

P. subelliptica, squamis angustis albidis conspersa; rostro prothorace cum capite manifeste longiore, basi quinquelineato; antennis fusco-testaceis; funiculo articulis duobus basalibus longiusculis, cæteris transversis; prothorace subtransverso, vix ampliato, utrinque infra dense albido-squamoso, dorso vittis tribus indistinctis notato; scutello punctiformi; elytris striato-punctatis, interstitiis vage squamosis, duobus juxta suturam octavoque magis dense vestitis, inde lineatis; corpore infra dense albido-squamoso; pedibus fuscis, femoribus tibiisque squamis albis angustis conspersis. Long. $2\frac{1}{2}$ lin.

Hab. Mysol.

Phylaitis pusio.

P. oblonga, rufo-fusca, variegatim niveo-squamosa; rostro nigro, extrorsum rufo-testaceo, prothorace vix longiore, æquilato, basi obsolete trilineato; antennis testaceis; funiculo articulis duobus basalibus breviusculis, cæteris modice transversis; prothorace valde transverso, basi omnino niveo-squamoso; scutello parallelogrammico; elytris minus cuneiformibus, striato-punctatis, basi sutura, fascia obliqua medio, maculisque indistinctis posticis sparse niveo-squamosis; pedibus testaceis, squamis niveis sparse vestitis; femoribus posticis valde ampliatis, infra dente magno instructis. Long. 1 lin.

Hab. Sarawak.

This is the smallest species of the Malasian Zygopinæ, and is a narrower form than its congeners; it has also a shorter funicle, and the rostrum is a little flattened at the sides at the base.

Phylaitis cyclops.

P. oblonga, fusco- vel testaceo-fusca, griseo-squamosa; rostro testaceo, prothorace manifeste longiore, fere æquilato, basi obsolete lineato; oculis peramplis, toto contiguis; antennis testaceis, scapo rostri basin fere attingente; prothorace valde transverso, ampliato, basi vix bisinuato, dorso sat dense griseo-squamoso, maculis quatuor brunneis transversim locatis; scutello orbiculari; elytris striato-punctatis, griseo-squamosis, singulatim maculis 3 v. 4 ornatis, 2 v. 3 antice ad latera, una pone medio sitis; corpore infra sat denso albido-squamoso; pedibus testaceis, minus dense squamosis; femoribus posticis valde ampliatis, infra dente magno instructis. Long. $1\frac{1}{2}$–$1\frac{2}{3}$ lin.

Hab. Sarawak.

A slightly aberrant form, owing to the greater length of its scape.

PEMPHERES.

Characteres *Phylaiti* approximantes, sed *scapo* basin rostri fere attingente; articulo secundo *funiculi* quam primo duplo longiore; cæteris obconicis; *femoribus* posticis corpus haud superantibus; *tibiis* anticis flexuosis.

The relative length of the two basal joints of the funicle in the species of this and the preceding genus seems, from its persistence, to be a good primary character for both genera; the form of the anterior tibiæ, however, is decisive of their generic difference.

Pempheres trilineata. Pl. XV. fig. 2.

P. anguste obovata, nigra, lineis albo-squamosis ornata; rostro prothoraci cum capite longitudine æquali, ferrugineo, basi sat fortiter crebre punctato, et medio subcarinulato, apicem versus punctis evanescentibus; antennis testaceo-piceis; prothorace valde transverso, ampliato, apice supra sulcato, leviter granulato-punctato, vittis septem albis ornato, una mediana, tribus in utroque latere sitis; elytris striato-punctatis, interstitiis latis, vix convexis, vittis tribus albis ornatis, una suturali communi, scutellum includente, una dorsali utrinque sitis; corpore infra dense sordide albido-squamoso; pedibus squamis filiformibus albidis vestitis. Long. $3\frac{1}{2}$ lin.

Hab. Batchian, Morty, Amboyna.

Pempheres habena.

P. anguste obovata, nigra, lineis abbreviatis læte ochraceo-squamosis ornata; rostro prothoraci cum capite longitudine æquali, fusco, basi leviter tricarinulato, crebre sat fortiter punctato, punctis apicem versus evanescentibus; antennis testaceo-piceis; prothorace transverso, paulo ampliato, leviter sat crebre punctato, vittis septem, ut in præcedente, sed ochraceis ornato; elytris breviusculis, striato-punctatis, interstitiis latis, regione scutellari, scutellum includente, vitta dorsali utrinque, medio interrupta, ochraceis ornatis, reliquo suturæ pilis albis instructis; corpore infra dense concinne ochraceo-squamoso; pedibus squamis filiformibus albis subvage vestitis. Long. $3\frac{1}{2}$ lin.

Hab. Singapore, Sumatra.

Emexaure.

Rostrum longum, tenue, basi incrassatum, compressum, apice depressum; *scrobes* præmedianæ. *Oculi* magni, contigui. *Scapus* oculum vix attingens; *funiculus* 7-articulatus, articulo primo breviusculo, crassiore, secundo elongato, tertio quartoque sensim brevioribus, tribus ultimis obconicis; *clava* oblongo-ovata, distincta. *Prothorax* oblongus, basi bisinuatus, medio lobo productus. *Elytra* breviuscula, obovata, prothorace paulo latiora. *Pedes* graciles; *femora* in medio incrassata, infra dentata; *tibiæ* subrectæ; *tarsi* tenuati, articulo basali valde elongato, tertio haud dilatato. *Epimera* mesothoracis ascendentia. *Pygidium* obtectum. *Abdomen* breve, segmento secundo ampliato, sutura lateraliter valde arcuato.

The diagnostic characters of this genus are the seven-jointed funicle and long linear tarsi; the scales on the species described below are narrow and hair-like. The male has a manifestly shorter rostrum.

Emexaure gallinula. Pl. XVI. fig. 1.

E. elliptico-rhomboidalis, fusca, griseo-squamosa; rostro arcuato, prothorace duplo longiore, basi vage silaceo-squamoso, extrorsum ferrugineo; antennis læte testaceis; prothorace latitudine paulo longiore, sat crebre punctato, medio sparse squamoso, ad latera vitta curvata e squamis formata; scutello orbiculari; elytris striato-punctatis, interstitiis latis, planatis, interstitio suturali squamis longioribus oblique locatis, reliquis squamis griseis, nonnullis saturatioribus variis; corpore infra pedibusque fusco-testaceis, illo sat dense, his sparse albido-squamosis. Long. 2 lin.

Hab. Sarawak.

Heurippa.

Rostrum longiusculum, tenue, basi compressum; *scrobes* medianæ. *Scapus* oculum haud attingens; *funiculus* 7-articulatus, articulis duobus basalibus modice elongatis, cæteris transversis; *clava* adnata, longitudine funiculo æquali. *Oculi* magni, contigui. *Prothorax* suboblongus, basi rotundatus. *Elytra* parallela, prothorace haud latiora. *Pedes* mediocres; *femora* incrassata, subtus dentata; *tibiæ* basi arcuatæ; *tarsi* breves, articulo tertio haud dilatato. *Epimera* mesothoracis ascendentia. *Pygidium* obtectum. *Abdomen* segmento secundo vix ampliato.

This is the only genus with an oblong cylindrical or subcylindrical body among all those with a seven-jointed funicle. The figure on the plate is far too broad, and gives a very inadequate idea of the insect.

Heurippa amœna. Pl. XV. fig. 5.

H. oblonga, angusta, nigra; rostro modice arcuato, ferrugineo, longitudine prothoracis, basi utrinque niveo-squamoso; antennis testaceis; prothorace basi longitudini æquali, antice angustiore, crebre punctato, maculis septem niveo-squamosis ornato, una basali lineari, tribus utrinque sitis; scutello ovato; elytris pone humeros paulo incurvatis, sulcato-punctatis, interstitiis subplanatis, cervino-squamosis, vitta suturali postice ampliata lateribusque nigris; corpore infra sat dense niveo-squamoso; pedibus rufo-testaceis, leviter albo-squamosis; femoribus posticis linea nigra obliqua notatis. Long. 2 lin.

Hab. Macassar.

Metialma.

Rostrum tenuatum, basi cylindricum, squamosum, supra lineatum; *scrobes* medianæ. *Scapus* oculum haud attingens; *funiculus* 7-articulatus, articulo primo crassiore, secundo longiore, cæteris brevioribus et gradatim latioribus; *clava* ovata, adnata. *Prothorax* transversus, subconicus, basi lobo mediano productus. *Elytra* cordiformia, supra planata, apice late rotundata. *Pygidium* detectum, transversum. *Femora* incrassata, præsertim antica, dente valido infra armata; *tibiæ* arcuatæ, intermediæ posticæque flexuosæ, extrorsum incrassatæ, apice oblique truncatæ; *tarsi* mediocres, articulo tertio dilatato. *Epimera* mesothoracis ascendentia. *Abdomen* normale. *Corpus* rhomboideum.

The species on which this genus is founded have a very uniform and distinctive appearance, and apparently are very widely distributed, two of them being found in Bombay and Hong Kong* respectively.

* I take this opportunity to describe them: the first probably marks the range of the subfamily to the north-west; and the other has perhaps very nearly attained the limit to the north or north-east.

Metialma scenica.

M. nigra, supra pedibusque squamis filiformibus flavidis albisque variegata; rostro fusco, nitido, quinquelineato; antennis testaceis, funiculo

Metialma nævia. Pl. XVI. fig. 4.

M. nigra, squamis filiformibus albis variegata; rostro fusco, nitido, apice luteo, basi crassiore, (♀?) supra quinquelineato parce squamoso; antennis subtestaceis, funiculo articulis quinque ultimis transversis; prothorace supra indistincte albo varia, basi macula majuscula alba, margine nigra, quadrifida circumdata; scutello oblongo, distincto; elytris striato-punctatis, interstitiis latis, planatis, basi, linea obliqua media maculisque incertis albo-squamosis, notatis; corpore infra dense albido-squamoso; pedibus minus squamosis; femoribus anticis dente triangulari maximo infra armatis, posticis extus in medio macula fusca signatis. Long. $2\frac{1}{4}$ lin.

Hab. Macassar, Gilolo, Tondano, Java.

There are slight differences among my specimens, but nothing that can be regarded as specific; that from Java has a rostrum not thickened at the base, and, judging from *Mecopus*, probably represents a male.

Metialma novata.

M. præcedenti affinis, rostro magis attenuato, basi in utroque latere obsolete lineato; funiculo articulis quinque ultimis longioribus; prothorace antice minus angusto, medio nigro plagiato, basi macula albida literam T formante; scutello orbiculari, distincto; elytris brevibus, lateribus magis gradatim angustatis, supra albido-

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articulis duobus basalibus minus longiusculis; clava magna, ovali; prothorace manifeste transverso, lobo medio triangulari, flavido squamoso, maculis fuscis sex, quatuor ante medium transversim sitis, duabus basalibus, ornato; elytris subcordatis, striato-punctatis, apice late rotundatis et macula nivea notatis, squamis albidis flavidisque intermixtis, maculis nigris concinne dispersis; corpore infra albido-squamoso, segmentis tertio quartoque medio nigris; pedibus nigro annulatis. Long. 3 lin.

Hab. Bombay.

Metialma signifera.

M. nigra, squamis filiformibus flavidis albisque interjectis subvariegata; rostro fusco, nitido, quinquelineato; antennis subtestaceis, funiculo articulis duobus basalibus longiusculis; clava breviter ovata; prothorace modice transverso, basi lobo medio producto, hoc maculis duabus notato, una postica alba, altera flavida, duabus conjunctis linea nigra fere circumdatis; elytris breviter subcordatis, apice latis, leviter emarginatis, striato-punctatis, flavido-squamosis, squamis albis parce intermixtis, maculisque nigris vage dispositis, apice macula læte flavida ornatis; corpore infra albido-squamoso; pedibus flavidis, femoribus apicem versus nigro annulatis. Long. $1\frac{2}{3}$ lin.

Hab. Hong Kong.

squamosis irregulariter nigro maculatis; pygidio fere obtecto; corpore infra dense albido-squamoso, epimeris mesothoracis nigro notatis; pedibus ut in præcedente. Long. 2 lin.

Hab. Aru.

From Saylee there is another species of this genus, probably allied to this, but very much worn.

Brimoda.

Rostrum modice robustum, prothorace vix longius, basi cylindricum, lineatum; *scrobes* medianæ. *Funiculus* 7-articulatus, articulis duobus basalibus longioribus, cæteris brevibus, gradatim crassioribus, ultimo clavæ adnato. *Prothorax* transversus, utrinque rotundatus, basi perparum bisinuatus. *Elytra* trigona, apice rotundata. *Pedes* breves; *femora* subincrassata, infra leviter dentata; *tibiæ* validæ, compressæ, arcuatæ, vel flexuosæ, apicem versus crassiores; *tarsi* breviusculi. *Epimera* mesothoracis parum ascendentia. *Propectus* canaliculatum. *Coxæ* anticæ sejunctæ. *Abdomen* segmentis tribus intermediis æqualibus.

A small dull-looking insect at present is the sole representative of this genus, which, however, is one of the most distinct of the group.

Brimoda pagana.

B. subelliptica, fusca, parce rude griseo-squamosa; rostro piceo, basi paulo squamoso; antennis subtestaceis; prothorace modice transverso, apice lato, utrinque manifeste rotundato, parce griseo-squamoso, in medio carina abbreviata valida munito; elytris fortiter striato-punctatis, interstitiis convexis, tuberculato-asperatis, squamis suberectis vestitis; corpore infra femoribusque piceis, dense albido-squamosis; tibiis parce squamosis. Long. $1\frac{3}{4}$ lin.

Hab. Singapore.

Osphilia.

Metialmæ fere congruens, sed *rostro* basi triangulariter compresso; *tibiis* intermediis posticisque rectis, sublinearibus; et *corpore* magis elliptico.

Whilst *Metialma* contains species nearly homogeneous, in this genus they are more diversified, although there are several which are so alike that, with my present materials, I have not attempted to describe them. Three of these are allied to *O. flavirostris* (two from Sula and one from Sarawak); and two to *O. undata* (one from Makian, the other from Batchian). They are all thinly clothed with narrow scales, so narrow in some as scarcely to be distinguished from hairs. A transverse section of the rostrum at the base would be nearly represented by the letter V reversed, = Λ; in *Metialma*, by an O. The antennæ also are situated much nearer the base of the rostrum; the scape is therefore much shorter.

Osphilia flavirostris.

O. elliptica, fuscescens, supra squamulis angustis griseis variegata, subtus æqualiter vestita; rostro fortiter arcuato, subtestaceo, nitido, basi genisque dense flavo-squamosis; antennis subtestaceis, scapo brevi; funiculo articulo secundo quam primo sesquilongiore, cæteris gradatim brevioribus, ultimis transversis; prothorace sat valde transverso, apice haud angusto, basi fortiter bisinuato, lobo medio rotundato, perparum producto, disco plagis quatuor fuscescentibus, cruciatim separatis, signato; elytris subcordatis, striato-punctatis, basi suturaque plus minusve maculisque plurimis griseo-squamulosis; pedibus subtestaceis, griseo-pilosis; femoribus anticis incrassatis, subtus dente valido instructis, reliquis minus robustis, posticis corpus longe superantibus; tibiis anticis gracilibus, modice arcuatis, intermediis posticisque parum compressis; tarsis articulo primo sat elongato. Long. 2 lin.

Hab. Mysol.

Osphilia onca.

O. subrhomboidalis, fuscescens, supra squamulis angustis griseis variegata; rostro ut in præcedente, sed longiore; prothorace etiam simillimo, sed lobo medio truncato; elytris magis late subcordatis, griseo-squamulosis, maculis fuscescentibus plus minusve conjunctis subfasciatim dispositis; corpore infra dense flavido-squamoso; pedibus ut in præcedente, sed femoribus anticis crassissimis, dente magno triangulari apice acuto spinoso instructis, posticis corpus haud superantibus; tibiis anticis fortiter arcuatis, ad apicem excurvatis. Long. $1\frac{2}{3}$–2 lin.

Hab. Morty, Ceram.

Osphilia apicalis.

O. subrhomboidalis, nigro-fusca, pilis flavidis parce vestita; rostro nigro, nitido, dimidio apicali subferrugineo, basi genisque parce silaceo-pilosis; antennis subtestaceis; funiculo articulo secundo quam primo vix sesquilongiore, tribus ultimis ovalibus; clava subcylindrica; prothorace latitudine longitudini in medio æquali, subtiliter confertim punctulato, basi vix bisinuato, lobo medio producto, truncato, lateribus margineque apicali flavido-pilosis; elytris oblongo-subcordatis, striato-punctatis, sutura postice, apice maculisque lateralibus flavido-pilosis; corpore infra nigro, lateraliter flavido-piloso; femoribus anticis valde incrassatis, infra dente oblongo-triangulari armatis; tibiis anticis fortiter arcuatis, prope apicem excurvatis; pedibus reliquis sat tenuatis, omnibus subferrugineis, flavido-pilosis. Long. 3 lin.

Hab. Sarawak.

Osphilia undata. Pl. XVI. fig. 6.

O. subrhomboidalis, fusca, variegatim griseo-pilosa; rostro nigro, nitido, prope apicem ferrugineo, basi parce flavido-piloso; antennis subferrugineis, funiculo articulo secundo quam primo fere duplo longiore, tribus ultimis transversis; clava elongata, subcylindrica; prothorace latitudine longitudini in medio æquali, lobo medio anguste producto, truncato; disco plagis quatuor fuscis, cruciatim separatis, signato; elytris subcordatis, striato-punctatis, griseo-pilosis, maculis fuscis fasciatim dispositis; corpore infra vix dense piloso; pedibus magis elongatis, pilosis; femoribus anticis dente triangulari magno armatis; tibiis anticis fortiter arcuatis, prope apicem excurvatis; tibiis intermediis posticisque tenuatis. Long. 3–$3\frac{3}{4}$ lin.

Hab. Batchian.

Nauphæus.

Caput sphæricum; *rostrum* modice arcuatum, depressum; *scrobes* præmedianæ, obliquæ. *Scapus* brevis; *funiculus* 7-articulatus, articulo secundo quam primo multo longiore, cæteris gradatim brevioribus et crassioribus; *clava* ovata, distincta. *Oculi* magni, verticem haud occupantes. *Prothorax* transversus, apice tubulatus, antice utrinque rotundatus, basi medio lobatus, lobis ocularibus manifestis. *Elytra* basi prothoracis haud latiora, subnavicularia, utrinque sensim angustiora, apicibus rotundatis. *Pedes* intermedii minores, antici longiores; *femora* compressa, incrassata, infra dentata; *tibiæ* compressæ, arcuatæ; *tarsi* modice elongati, articulo tertio dilatato. *Rima* pectoralis profunda, inter coxas anticas terminata, apice (in mesosterno) fornicato. *Episterna* metathoracis lata. *Epimera* mesothoracis haud ascendentia. *Abdomen* normale.

There is some doubt respecting the position of this genus, which, except for its large contiguous eyes, not covered by the ocular lobes in repose, I should have placed with Cryptorhynchinæ; but, assuming it to be a Zygopine, it would, according to Lacordaire's arrangement, take its place with the New-World forms, owing to the breadth of the metathoracic episterna conjointly with the presence of a pectoral canal and a seven-jointed funiculus. For the present I place it after *Sphadasmus*, partly on account of the eyes not occupying the whole of the head, and partly because it leads to *Sympiezopus*, which has a deep pectoral canal. The remarkable insect described below is closely covered above with black opaque spots, in the middle of each of which is a little shining granule: the effect of these among the pure grey scales is to give the upper surface an ashy colour; the under part is of a pure ivory-white.

Nauphœus miliaris. Pl. XVI. fig. 3.

N. oblongo-obovatus, niger, supra granulis nitidis nigro circumdatis confertim maculatus, interstitiis griseo-squamosis, medio prothoracis elytrorumque antice linea grisea notatis; capite supra oculos dense squamoso, maculis duabus fuscis decorato; rostro prothorace multo breviore, testaceo, subtiliter remote punctulato, basi squamoso; antennis testaceis; prothorace pone apicem utrinque macula obliqua nigra; scutello distincto, orbiculari; elytris lateribus modice rotundatis, basi pone scutellum paulo gibbosis, in medio dorsi utrinque perparum longitudinaliter excavatis, striato-punctatis, interstitiis latis, vix convexis, confertim uniseriatim granulatis, medio macula rotundata nigra ad suturam approximata, plagisque duabus oblongis margine externo, ornatis; corpore infra femoribusque densissime eburneo-squamosis; tibiis tarsisque squamis filiformibus minus dense vestitis, his infra flavo-tomentosis. Long. $4\frac{1}{2}$ lin.

Hab. Waigiou, Mysol.

[To be continued.]

XXV.—Ceratodus, *and its Place in the System.* By Dr. Albert Günther, F.R.S.

The general external appearance of this most remarkable fish has been described by Mr. Krefft in Proc. Zool. Soc. 1870, p. 221. My observations* are based on three specimens, viz. one without intestines, one fully developed male, and one female which does not appear to have attained to maturity. Differences in the number and microscopical structure of the scales seem to indicate the existence of a second species beside that described by Mr. Krefft as *Ceratodus Forsteri*. Its scales are considerably smaller and more numerous; and it may be named *Ceratodus miolepis*.

The skeleton represents the type which is so well known from Owen's, Bischoff's, and Hyrtl's descriptions of *Lepidosiren* and *Protopterus*. In certain points of detail, such as the arrangement of the bones of the skull, the form of the cerebral and acoustic cavities, the development of the first rib and apophyses generally, the structure of the scapular arch and pelvis, the resemblance of the genera named is perfect; and from an examination of the skeleton alone the conclusion might have been drawn that they belong to the same natural

* The following notes are a short *résumé* of a memoir presented to the Royal Society at the beginning of last month, and containing a detailed description of the entire organization of *Ceratodus*, with the exception of the nervous system.

group of fishes. The skeleton is notochordal, all its parts having a cartilaginous basis, more or less incompletely covered by thin osseous lamellæ. Some of the thickest bones of the skull have a spongeous texture, and there is also a cavity of considerable size in the pelvis; but otherwise the skeleton is composed of solid cartilage (that is, the primordial base of bone); and therefore it is scarcely correct to describe the skeleton of *Ceratodus* or of Cœlacanths as composed of bones "hollow like those of birds."

The ossifications of the skull may be designated thus:—

1. Ethmoid.

2. A pair of frontals separated by a "scleroparietal," which is membranaceous in *Lepidosiren.*

3. Basal. The vomer is cartilaginous and tooth-bearing, as in *Lepidosiren* and *Protopterus*, in which it has been described as intermaxillary.

4. A pterygo-palatine on each side of the basal—tooth-bearing, and suturally united with its fellow.

5. An os quadratum, represented by an osseous lamella coating the cartilaginous tympanic pedicle, which is provided with a double condyle.

6. Mandible with an articular and dentary lamella.

7. A well-developed rhomboid operculum and styliform suboperculum.

8. Hyoid arch, more complex than in *Lepidosiren*, consisting of a pair of cerato-hyals, a basi- and glosso-hyal.

There are about 68 sets of apophyses, 27 of which bear ribs. The apophyses are most differentiated about the middle of the vertebral column; and towards the end of the trunk the neural portion consists of the following pieces:—

1. Cartilaginous arch of neurapophysis for the formation of the medullary canal.

2. Semiossified gable-like portion of the neurapophysis over the ligamentum longitudinale.

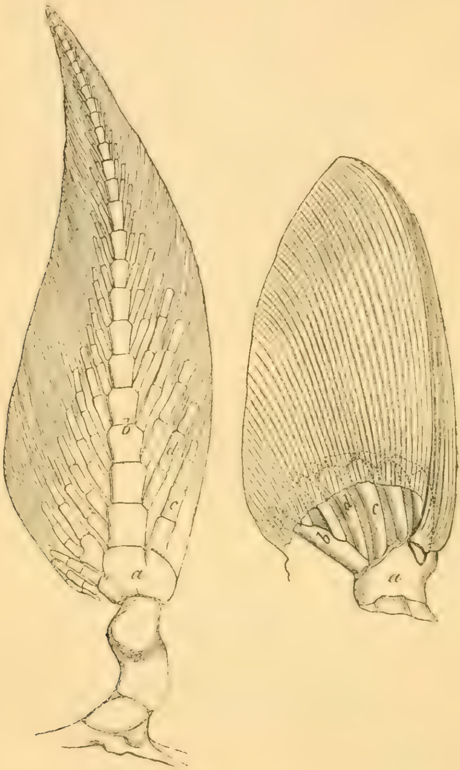
3. Neural spine.

4. Lower interneural.

5. Upper interneural, to which the dermo-neurals are attached in the same manner as in *Protopterus.*

The hæmal portion is of very similar construction.

The fore and hind paddles are supported by a cartilaginous axial skeleton—that is, by a median longitudinal series of joints with lateral divergent articulated branches, each joint forming the base for a right and left branch. I have no doubt that the Ganoids of the Devonian epoch with "acutely lobate" fins had the paddles supported by a similar internal skeleton. In *Lepidosiren* and *Protopterus* only the jointed axis is persistent, the lateral branches being either entirely absent (as in the former), or quite rudimentary (as in the latter). In all these cases the analogy of this structure to the diphyocercy of the terminal portion of the tail is apparent, whilst a heterocercal condition is represented in the pectoral fin of *Acipenser*. In this fish the axis (*b*) is not inserted in the longitudinal median



Ceratodus. *Acipenser.*

a, carpal cartilage; *b*, jointed axis; *c*, branches having the carpus as base; *d*, branches having the axis as base.

line of the carpus (*a*), but quite at the inner corner; consequently branches exist on one side of the axis only, viz. on that side on which they are needed for the support of the fin-rays. The axis is comparatively short and feeble, composed of three joints, and forming the base for three branches (*d*). Three other branches (*c*) are inserted immediately into the carpus: each branch consists of two joints. The fin-rays are attached to the cartilaginous branches exactly in the same way as all the fin-rays of *Ceratodus* or *Protopterus*. I may also observe that the "pectoral spine" of the sturgeon does not differ, either in structure or with regard to its attachment, from the other fin-rays; it is formed merely by confluent fin-rays, and can easily be split into two halves.

Eye without falciform process or choroid gland.

Ceratodus possesses a Dipnoous heart, as far as the ventricle and (single) atrium are concerned; but the valvular arrangement of the bulbus arteriosus is more of the "Ganoid" type. There is, at a short distance from the origin of the bulbus, a single cartilaginous papillary valve worked by a special muscle; then follows a transverse series of four small short valves (sometimes reduced to simple papillary prominences), then a series of four oblong raised strips (rudimentary valves?), and, finally, a third transverse series of four well-developed "Ganoid" valves. Four arcus aortæ enter the four gills without sending off branches; and four branchial veins are collected into the aorta descendens.

The branchial apparatus is composed of five arches, not differing from the Teleosteous type, but cartilaginous; four of them bear well-developed lamellated gills. The pseudobranchia does not receive blood which has not previously passed through the gills. Spiracles are absent.

The lung is single, but its cavity is composed of two symmetrical halves, each with a row of about thirty cellular compartments. Pneumatic duct and situation of the glottis as in *Lepidosiren*. The pulmonal artery is a branch of the arteria cœliaca, and the pulmonal vein enters the atrium separately from the sinus venosus.

Like *Lepidosiren*, *Ceratodus* is provided with one pair of vomerine teeth, and two pairs of molar-like palatine teeth. This dentition is modified for a carnivorous diet in the former genus, and for an herbivorous one in the latter, the intestine of all specimens having been found full of leaves of Myrtaceæ and Gramineæ. The microscopical structure of the teeth resembles much that of *Protopterus*, *Psammodus*, *Dipterus*, and other extinct genera, and is identical with that of the fossil *Ceratodus*-teeth from Triassic and Jurassic formations, confirming the correctness of Mr. Krefft's view, who referred the living fish to the genus which had been established for those fossils.

Intestinal tract perfectly straight, very wide, with a perfect spiral valve, along the axis of which large glands are imbedded; stomach merely indicated by a shallow double pyloric fold; no pyloric appendages; spleen represented by a diffuse glandular mass. Not only the liver, but also the paired lobed kidneys are provided with a portal system. The two ureters enter by a single opening into a small urinal cloaca, situated at, and partly confluent with, the dorsal wall of the rectum. Vent in the median line of the abdomen; a pair of wide peritoneal slits behind the vent. Testicle without developed vas deferens, but with a duct running along its interior, blind at both ends and without apparent outlet, but receiving the semen from the canaliculi seminiferi. Ovaries transversely laminate; the ova fall into the abdominal cavity, and are expelled by the peritoneal slits. A pair of narrow convoluted oviducts are present, each being confluent with the ureter of its side. It would appear, from the situation of the peritoneal openings of the oviducts in the foremost part of the abdominal cavity, and from the fact of one having been found closed, that these ducts have no function. However, it must be remembered that the female fish examined did not appear to have attained to maturity.

The evidence in favour of the close relationship between *Ceratodus* and *Lepidosiren* is so strong, that the difference in the arrangement of the valves of the bulbus arteriosus can no longer be considered to be of sufficient importance to distinguish the Dipnoi as a subclass from the Ganoidei. The Dipnoi form a suborder of Ganoid fishes which may be characterized thus:—*Ganoid fishes with the nostrils within the mouth, with paddles supported by an axial skeleton, with lungs and gills and notochordal skeleton, and without branchiostegals.* The Ganoids have hitherto been placed between the subclasses Teleostei and Chondropterygii; but they are evidently much more nearly allied to the latter than to the former, which, moreover, were developed in much more recent epochs. Therefore I propose to unite the Ganoids and the Chondropterygians into one subclass, PALÆICHTHYES, characterized thus:—*Heart with a contractile bulbus arteriosus; intestine with a spiral valve; optic nerves non-decussating.*

By a comparative study of extinct fishes, I have arrived at some conclusions the substance of which may be shortly indicated thus:—

1. The suborder Dipnoi was represented in the Devonian and Carboniferous epochs by the genus *Dipterus* (= *Ctenodus*), in which I have also found the internal nostrils and a pair of vomerine teeth; however, this genus is the type of a separate family, on account of its heterocercy.

2. The evidence with regard to *Phaneropleuron* (Huxl.) is less conclusive; and *Tristichopterus* (Egert.), with the complete segmentation of its vertebral column, should be excluded from this suborder.

3. The suborder Crossopterygii of Huxley contains two distinct types of "lobate fin," namely:—the "obtusely lobate," with a transverse series of cartilaginous rods; and the "acutely lobate" with an axial skeleton. Prof. Huxley has already drawn attention to the similarity between the paddles of *Lepidosiren* and the Crossopterygians; but only the acutely "lobate" type agrees with the structure of the Dipnoous limb. *Polypterus*, *Cœlacanthus*, &c., which are provided with fins of the former type, are genera sufficiently distinguished also by other characters to be placed in a separate suborder.

XXVI.—*On a new Genus and Species of Hydroid Zoophyte* (Cladocoryne floccosa). By W. D. Rotch, Esq.

Cladocoryne, nov. gen.

Generic character.—Stem simple or branched, rooted by a creeping filiform stolon, the whole sheathed in a thin chitinous tube, smooth or very sparingly annulated. Polypites terminal, clavate, with simple and branched capitate tentacula; the former set in a single row round the mouth, the latter in several whorls round the body, and multicapitate; with a prominent tubercle composed of thread-cells between each tentacle in the anterior and in the posterior rows. Reproduction unknown.

Cladocoryne has affinity with the families of Corynidæ and Stauridiidæ, but is, I think, more closely allied to the former. It agrees with the Stauridiidæ in having tentacles of two kinds, and resembles *Cladonema radiatum*, which has the tentacles of the gonozooid branched. The stem, general form, and polypite of *Cladocoryne* very closely resemble those of *Coryne* and *Syncoryne*, the branching of some of the tentacles in *Cladocoryne* being the most marked point of difference. The tubercles or bosses round the mouth and base of the polypite mark a point of resemblance between *Cladocoryne* and *Hydranthea*.

The reproductive history of *Cladocoryne* is unknown; and it is consequently uncertain whether it most resembles *Coryne* or *Syncoryne*.

Its present place must be provisional; and, until more is known of its reproduction, it might be placed in the family Corynidæ, after the genus *Zanclea*, in the Rev. T. Hincks's work on British Hydroid Zoophytes.

Cladocoryne floccosa, n. sp.

Stem slender, generally simple or very sparingly branched, often with a bend; polypary of a light straw-colour, generally smooth, but sometimes very slightly and irregularly annulated.

Polypites generally separate, and ranged at irregular intervals along the creeping filiform stolon; long, linear, and very slender, of a reddish-brown colour, merging at the base into the colour of the stem; the oral extremity of an opaque white; a silvery-white tubercle or boss of thread-cells between each tentacle in the anterior and in the posterior row.

Tentacles very long and tapering, capitate, of two kinds—simple and branched; one row of simple capitate tentacles, four to eight in number, immediately round the mouth, and three or four rows of branched tentacles set in whorls round the body, with three to four tentacles in each whorl, each of the branched tentacles having from six to fifteen short capitate ramuli set in somewhat irregular whorls round the tentacles, and terminating in three of the capitate ramuli of nearly equal length.

Gonophores not known.

Height from a $\frac{1}{4}$ to $\frac{1}{2}$ an inch.

The form and size of the tentacles are the most prominent points in *C. floccosa*: the branched tentacles are all long, and increase in length up to the middle whorl, and then diminish in length towards the oral whorl, those in the middle whorl being as long as the body of the polypite; the tentacles are pellucid, and taper gradually from the base; the ramuli are similar in appearance to the tentacles of *Coryne vaginata*.

The stem is rarely and sparingly branched.

The pearly bosses of thread-cells add considerably to the beauty of this zoophyte.

The polypites are generally separate, and rise at irregular intervals from the stolon, thus presenting a very different appearance from the long and branched tufts of *Coryne* and *Syncoryne*. The ramuli on the tentacles are pellucid, and give a fleecy aspect to the zoophyte as it is waved to and fro in the tide.

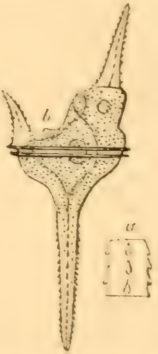
Hab. On stones at low tide at Herm, near Guernsey.

The Rev. T. Hincks, who has kindly corrected the above description, tells me that this species has "barbed thread-cells, very much resembling those of *Hydra*," and that he has met with a single specimen of *C. floccosa* among a quantity of Gulf-weed.

XXVII.—*Note on a Freshwater Species of* Ceratium *from the Lake of Nynee (Naini) Tal in Kumaon.* By H. J. Carter, F.R.S. &c.

Several species of horned Peridinea (viz. of *Ceratium*) from the Baltic Sea have been described by Ehrenberg and others, while those called by the former *C. tripos* and *C. furca* have been seen by MM. Pringsheim and Werneck, respectively, in fresh water also (Clap. et Lachm. 'Études sur les Infusoires' &c. vol. i. pp. 399 and 400). Perty (Zur Kenntniss &c. p. 161, pl. 7. fig. 13) describes one, under the name of *C. longicorne*, from the Swiss lakes, where they are found; and, lastly, we have them from the lakes of the Himalaya and Lower Bengal.

Thus my friend Dr. Forbes Watson, of the India Museum, has submitted to me for report a glass slide containing several mounted in gum from the lake of Nynee Tal.



Ceratium kumaonense, dorsal view, magnified. (Scale 1-24th to 1-6000th of an inch.) *a*, portion of horn more magnified, to show the disposition of the tubercles; *b*, point from which the fourth horn might be developed (?).

Of these, Mr. Stewart Clark, Inspector-General of Prisons, N.W.P., who forwards them, states that they are "perfectly visible to the naked eye, chiefly on the surface, 10–15 feet down, very few below 20 feet, and probably none at the very bottom of the lake, which is 95 feet deep.

"They are found in all the lakes of Kumaon at an elevation of from 4000 to 6500 feet above the level of the sea.

"The ordinary beautiful blue colour of the lake at Nynee Tal was at their capture, and had been for some months previously, changed to a rusty brown, by the presence of myriads of this kind of Infusorium."

The chief interest in the species is that, although it is closely allied to *C. furca*, Ehr., yet it must be regarded as a variety of this form, inasmuch as the posterior horn in the figures of the latter given by Ehrenberg ('Infusionsthier.') and Claparède ('Etudes'), respectively, is represented as smooth, while in those forwarded from the lake of Nynee Tal (see figure) all three of the horns are equally though minutely serrated by four or more longitudinal lines of tubercles obliquely projecting outwards in the direction of the horn.

There is another point of interest attaching to this Infusorium, viz. that just after I had shown that the occasionally blood-red colour of the sea round Bombay and the brown colour of some of the freshwater pools of the island were respectively due to the presence of myriads of Peridinea (Ann. & Mag. Nat. Hist. vol. i. p. 258, 1858), Major Stuart-Wortley, then (April 1859) at Calcutta, kindly sent me drawings of a *Ceratium* which he had found in the freshwater pools about that city.

These, however, had *four* horns, and so far resembled Perty's *C. longicorne*; but being hastily sketched, the microscopic features were not given, and therefore the serrated appearance which characterizes the species of Nynee Tal is absent. Still it is not improbable that this Infusorium (since they are subject to much variety) may occasionally have presented itself under the *four*-horned condition; for it is provided with the point (*b*), which, if somewhat more developed into a horn, would exactly represent one of Major Stuart-Wortley's sketches. At all events it is not likely that two distinct species of such a *Ceratium* inhabit the fresh waters of India.

I am unable to go further into the description of the specimens from the lake of Nynee Tal, on account of their dried state; nor is it probable that in the fresh one they differed from the same kind of *Ceratia* in any other way than that mentioned.

Perhaps, for the sake of distinction and future reference, we might call this species *Ceratium kumaonense*.

XXVIII.—*On Insects inhabiting Salt Water.* By A. S. Packard, Jun., M.D.*

In March 1869 the writer published an article on this subject in the 'Proceedings of the Essex Institute, Salem,' vol. vi. p. 41. Since then I have received an interesting collection of insects from Clear Lake, Lake Co., California, made by Prof. John Torrey in 1865, and which he kindly placed in my hands for examination. Prof. A. E. Verrill has also allowed me to examine several puparia of *Ephydra* from Great Salt Lake, and during the past summer has dredged, at the great depth of 20 fathoms, at Eastport, Maine, a living *Chironomus*-larva, undistinguishable from *C. oceanicus*, Pack., found by

* From 'Silliman's American Journal,' February 1871.

me in great abundance at low-water mark in Salem harbour, and also a species of marine mite.

With the hope of awakening an interest among biologists in the subject of brine-inhabiting insects, and of receiving further collections, especially from the salt lakes and salt-works of this country, the following notes are published.

Collection from Clear Lake.

In the collection made in Clear Lake by Prof. Torrey, besides the halophilous larvæ and pupæ of *Tanypus* and *Ephydra*, were a number of bees, ichneumons, ants, and a species of *Culex*, the latter very abundant in the male sex, with several Muscids and *Tipulæ*; also a species of *Chrysopa* and two species of Coleoptera*, one a *Stenus* and the other *Diabrotica soror*, Lec., all of which were probably drowned from having accidentally fallen into the lake. In the collection, however, two truly aquatic beetles occurred, one (*Laccophilus decipiens*, Lec.) a Dytiscidan insect, and the other (*Berosus punctatissimus*, Lec.) a member of the family Hydrophilidæ. These probably lived in the brine not only in the adult, but also in the larval state.

Salda interstitialis, Say, also occurred, and two other aquatic Hemiptera, a new species of *Hygrotrechus* and a *Corixa*, which are described by Mr. Uhler further on.

Tanypus, sp.—The larvæ and pupæ of a species of *Tanypus* (or closely allied genus or subgenus) were abundant at Clear Lake. The body of the larva is long, slender, cylindrical, gradually tapering toward each end. The head is long and narrow, half as long as wide, and one half as long as the prothoracic segment. There are no rudiments of antennæ or maxillary palpi to be seen. In this respect it agrees with a species observed in fresh water at Salem, Mass. The mandibles are long and slender, with the ends very slender, acute, simple, untoothed, and well curved, forming two minute hooks capable of being extended a considerable distance in front of the head. The labium is broad and rounded in front, untoothed; it is situated a little in advance of the middle of the head, and is supported on a pair of slender chitinous pieces, not very approximate, with the outer ends opposite the posterior ocelli. The labrum is broad and rounded, overhanging the mouth. There are two pairs of ocelli, situated a little behind the middle of the head; the anterior pair are the smaller, and touch the hinder pair. A few hairs are scattered over

* The Coleoptera were obligingly determined by Dr. Horn.

the head. There are no prothoracic or anal feet, and no anal bristles or appendages of any kind, not even the few long hairs observed in the Salem species. It is white, and 0·30 of an inch in length.

The pupa is rather slender, with the abdomen slightly flattened and rather broad, being nearly as wide as the thorax. The wings and ends of the third pair of feet reach to the posterior edge of the second abdominal segment. The antennæ are laid in between the wings and the second pair of feet, disappearing under the middle of the front edge of the wing. The third pair of feet are concealed by the wings; the tips of the tarsi only being in sight; they are even with the end of the wings. The second pair of feet are entirely concealed, their tips not appearing; while the first pair are entirely in sight, their tips reaching nearly as far as those of the third pair. On the vertex is a pair of acute minute spines, probably locomotive. From just above the base of the head, and in front of the insertion of the wings, arise a pair of mesothoracic respiratory tubes, which are broad and flat at their base, suddenly becoming cylindrical and slender a little beyond their middle, and projecting slightly beyond the head. The mesothorax is tergally full and rounded. The abdominal segments are very convex, with the sutures deeply marked, the edges of the segments being bevelled in toward the suture. The hinder edge of each ring is raised into an acute ridge, armed with a few short hairs. The terminal segment is slender, no wider than long, and with a small acute terminal spine on each side. No respiratory appendages. It is whitish, with a yellowish tinge, and is ·15 of an inch in length. No adult *Tanypus* occurred in the collection.

Stratiomys, sp.—With the young of *Tanypus* were associated several larvæ of this genus. They are long and slender, the body tapering alike toward both ends. The head is chitinous, subconical, and nearly as long as the prothoracic segment. On each side of the base of the head is a deep slightly curved sinus (closed anteriorly in older specimens), thus forming a rather long tongue-like lobe to the underside of the head. Above, the head is divided by two deeply impressed lines into three lobes extending nearly to the posterior third of the head; these lobes are acutely pointed, the middle one being the longest, and embracing the clypeo-labral region. On the side of the outer lobes and at the middle of their length are situated the two ocelli. The antennæ are minute acute tubercles situated at the ends of the outer lobes. The maxillæ (?) are 2-jointed palpus-like appendages, with long hairs at the extremity, and play with much freedom up and down on the underside of the head, between the inner and outer lobes. Mandibles not distinguishable. The mouth-parts are all inserted beyond the middle of the head. The body is rather flattened and broadest just in front of the middle; the segments are quite convex, with the sutures well marked. A pair of well-marked stigmata on the prothoracic ring; none behind. The body is horn-coloured, paler beneath, with the integument densely punctured; the upper surface of the body is marbled with alternate light and dark streaks, in the middle of the body fading out in the middle of each segment, but toward the end of the body disappearing toward the sutures. On the side of each segment are four rows of minute dark dots, the upper row passing over the back at nearly right angles, meeting the one opposite on the median line of the body. The anal segment is broad and flat, square at the tip, but a little rounded at the corners; it is nearly as long as the greatest width of the body. From a transverse terminal slit (not seen from above) projects a group of about ten radiating respiratory filaments, white and finely ciliated to the tip, the filaments being each a little over half as long as the anal segment. A little within the middle of this segment is a rather long slit, with thickened chitinous edges. A few hairs of varying length are scattered over the body. Length ·80 of an inch. This is, so far as I am aware, the first instance of the occurrence of this genus in salt water.

Ephydra californica, n. sp.—Several specimens of the larvæ of this species occurred, though the pupæ were far more numerous. Unfortunately, none of the adults were found; but as the puparia are abundant, and the flies could easily be reared from them, I venture to name the species.

The larva closely agrees with that of the European *E. riparia*, Fallén, described by Loew, but has one more pair of abdominal legs or tubercles. The body is white, long, and slender, cylindrical, the sides of the segments bulging out; and each abdominal ring has three transverse, broad, flat, tergal ridges, the thoracic segments being smooth above. The anterior end of the body, including the thoracic rings, tapers gradually, being subconical and truncated abruptly. The three thoracic segments are smooth, but minutely hairy on the anterior edge, the hairs being similarly arranged on the abdominal segments. The head is very small; the mandibles exist in the form of acute, curved, chitinous hooks, with a pair of papilliform antennæ (?) behind, and a pair of shorter tubercles (rudimentary palpi ?) in front of them and just behind the mandibles *. The upperside of the body and base of the

* These parts need to be studied in the living insect; they are not

respiratory tubes are covered with very minute fine stiff hairs; and there is a row of them on the front edge of the prothoracic rings. On the front edge and on the sternal side of the mesothoracic ring is a dark, chitinous*, transversely oblong area, with four clear pale dots, arranged in a transverse row, the space in front being broken up into chitinous spots; in other specimens this band is much narrower and less distinct. The integument on the tergal side of the body is a little thickened and chitinous. There are eight (Loew mentions only seven in *E. salinaria*) pairs of large, abdominal, fleshy non-articulated legs, like the abdominal fleshy legs of lepidopterous larvæ, ending in two curvilinear rows of well-curved dark-brown hooks, five or six in a row; on the terminal pair of feet are four rows, those of the fourth row being minute. The respiratory tube arises suddenly from the end of the terminal segment, stretching straight out posteriorly. The main portion of the tube is rather thick, and about as long as the body is thick; it is of the same thickness throughout; the terminal branches are about one half as long as the main portion; they also arise suddenly, like the joints of a telescope, not by the subdivision of the stalk, but by the sudden prolongation of the tracheæ with their surrounding membranes, and end in a minute nipple-like conical tip, separated by a deep suture from the end of the tube. These respiratory tubes vary in length in alcoholic specimens, as they are undoubtedly more or less retractile. Length, including tube, ·50 inch; length of tube ·15 inch.

The puparium differs from that of *E. halophila*, Pack., from the Illinois salt-works, in being about a third larger, and in having a large rounded tubercle on the side of the ninth and tenth segments, and sometimes a third situated higher up on the ninth ring. The seventh pair of feet are as large as the sixth, being large and quite long, while in *E. halophila* they are scarcely larger than the five basal pairs. While in *E. halophila* the respiratory tube is not half as long as the body, in the present species it is fully half as long. As in that species, they are attached to stalks of grass by curving the anal feet around them. Length ·55 inch; length of tube ·21 inch.

The pupa is white, naked, with the vertex of the head high

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clearly defined in alcoholic specimens. I cannot discover the spigot-like stigmata on the prothorax described by Loew.

* By the term "chitinous" is meant any honey-yellow portion of the integument hardened by the deposition of chitine. This term may be used to designate this honey-yellow colour, instead of the very vague word "testaceous."

between the eyes. The mouth-parts form a broad, flattened, thick mass, pressed to the breast and reaching the anterior coxæ. Legs folded along the abdomen, the tarsi of the first pair reaching to the distal end of the posterior coxæ; the wings reach halfway between the tarsi of the first and second pairs of legs; the third pair do not quite reach to the end of the abdomen. At a later stage, when the integument is more chitinous, long hairs clothe the body, the mouth-parts can be distinguished, and the legs are longer, the anterior tarsi reaching to the end of the wings, and the third pair of tarsi nearly to the end of the abdomen. All the appendages are enclosed in the pupal membrane of the earlier stage. The tarsal claws are now large and of mature form, while the wing-veins can be readily traced. Length ·25 inch.

Prof. A. E. Verrill has kindly loaned me specimens of the *Ephydra* from Mono Lake, Cal., "a body of water not only excessively salt, but also strongly alkaline." These belong, so far as the puparia indicate, to the above species. The puparium of *E. californica* differs from that of *E. halophila* in being about a third larger, and in having a large rounded tubercle on the side of the ninth and tenth segments of the body, while the seventh pair of feet are as large as the sixth, being in *E. halophila* scarcely larger than the five basal pairs. The respiratory tube is not half as long as the body in *E. halophila*. The Mono-Lake specimens are ·55 inch long, and the respiratory tube ·21 inch.

Ephydra gracilis, n. sp.—These insects occur so abundantly where they are found, and can be so easily reared, that I venture to name another form from Great Salt Lake, specimens of the puparia of which have been communicated by Prof. Verrill, from the collection of Mr. Sereno Watson, and by S. A. Briggs, Esq., of Chicago. It is much smaller and slenderer than any of the preceding species, the smaller specimens being ·25 inch long, the largest ·50 inch. The respiratory tube is much longer than in any other species known to me, being in several specimens as long as the body itself, the branches into which it subdivides being over one-third as long as the base of the tube. The body is of the shape of *E. halophila*, but is much slenderer, while the feet are larger and more prominent.

Three specimens of heteropterous Hemiptera, from Clear Lake, were submitted to Mr. P. R. Uhler, who has kindly given me the following description of them.

Salda interstitialis, Say, Journ. Acad. Philad. iv. p. 324.

A single ♀ specimen, from Clear Lake, California. If the specimen was taken out of the water, it had occurred there by accident. These insects do not live in the water, but affect the marshy ground sometimes adjacent to it. The specimen is immature, lacking the black colour proper to the hemelytra and wings, but having the clavus, except at its tip, the base of the corium, and two or three streaks thereon black. The nervures of the membrane are simply brown.

Hygrotrechus robustus, n. sp.

One female of this genus (belonging to the family Hydrometridæ), very much mutilated, alone serves us for the present notice. In form it resembles *H. remigis*, Say; but the abdomen is more uniformly robust towards the tip. The head is dark-brown, fuscous on the middle, sericeous pubescent on the sides and beneath, with a pale arc on the impression at the base of the vertex. Antennæ robust, brownish ochreous, the second joint just one-half as long as the basal one, the remaining ones destroyed. Rostrum brown, extending a very little way behind the anterior coxæ. Eyes pale brown, large. Thorax robust, pale brownish testaceous, beneath brownish ochreous, sericeous; the anterior lobe of pronotum blackish, divided in the middle by an ochre-yellow line; each side, between the eyes, adjacent to them is an abruptly elevated rufous tubercle; the mesial carinate line feeble, becoming obliterated posteriorly; humeri elongate-tuberculate, quite prominent; pleura darker than the pectus. Legs robust, brownish ochreous. Hemelytra milky white, as long as the abdomen, the nervures brownish ochreous. Tergum pale ochreous, brown at base, the sutures and lateral raised edge brown; connexivum with a silvery depressed dot adjoining each suture, the apical processes robust, of medium length, hardly acute. Venter smooth, dark ochreous.

Length, to tip of processes, 17 millims.; breadth across humeri 3 millims.

Corixa decolor, n. sp.*

Pale testaceous, dirty amber-yellow above. Form of *C. hieroglyphica*, Fieber, of Europe. Head large, cranium very convex, prominent, carinate on the middle, the vertex acutely

* The fact that bread is made by the Mexicans from the eggs of a brine-inhabiting *Corixa* is noticed in Westwood's 'Classification of Insects.' Prof. O. C. Marsh has informed me that these brine-insects are also noticed by M. Virlet d'Aoust in the 'Bulletin de la Société Géologique de France,' 1858, xv. p. 200, and also by E. B. Tylor in his 'Anahuac,' London, 1861. The latter says: "A favourite dish here [Tezcuco] consists of flies' eggs (*Corixa femorata* and *Notonecta unifasciata*, according to Méneville and

produced. Face very deeply concavely excavated, the cavity broad oval, occupying the whole width between the eyes, and extending from near the upper edge of the eyes to the base of the clypeus, the middle of the excavation densely clothed with silvery hairs. Pronotum narrower than the head, almost twice as broad as long, the middle line feebly carinated anteriorly; the surface minutely rastrated, with about eight transverse slender brown lines, each bounded in front by a faintly impressed line, the anterior line interrupted, the posterior one following the margin of the pronotum; the posterior margin triangularly rounding, extending pretty far back. Pleural pieces whitish; sternum honey-yellow. Anterior legs short, wide, pale honey-yellow, their tibiæ broad, compressed, blade-like on the anterior margin, oblong oval, but little longer than the palæ; palæ subtriangular, a little longer than broad, fringed with long white cilia; the basal angles prominent, feebly rounded, the inner edge a little concave, tip acute. Intermediate and posterior legs slender, paler than the anterior ones; cilia and pubescence whitish. Hemelytra pale yellowish, the costal area whitish, the cross nervule and a spot at tip brown; clavus at base with short narrow brown lines running transversely from the outer and inner margins, beyond the middle to tip the lines run completely across; lines of the corium transverse, slender, slightly waved, many of the intermediate ones entire; membrane pale brown, with short vermiculate white lines. Venter and metasternum faintly dusky; the connexivum and genital segments whitish.

Length $4\frac{1}{2}$ millims.; breadth across the pronotum $1\frac{1}{2}$ millims. This species must be closely related to *C. Burmeisteri*, Fieber, of Europe. The shape of the palæ and markings of the hemelytra of our species do not agree with Fieber's description. The specimen described is a male, which appears not to be fully mature. From Clear Lake.

Virlet d'Aoust) fried. These eggs are deposited at the edge of the lake, and the Indians fish them out and sell them in the market-place. So large is the quantity of these eggs that, at a spot where a little stream deposits carbonate of lime, a peculiar kind of travertine is forming, which consists of masses of them imbedded in the calcareous deposit."

The flies which produce these eggs are called by the Mexicans "Axayacatl," or *water-face*. The eggs are sold in cakes in the market, pounded and cooked, and also in lumps *au naturel*, forming a substance like the roe of a fish. This is known by the characteristic name of "ahua-uhtli," that is, *water-wheat*.

In this connexion we may remark that, according to the late Mr. Horace Mann, Jun., the Indians about Mono Lake eat large quantities of the puparia of *Ephydra*.

Marine Insects from Deep Water.

During his explorations at Eastport in the past summer, Prof. Verrill dredged, at the depth of 20 fathoms in Eastport harbour, a larva of *Chironomus oceanicus*, Pack. (Proc. Essex Inst. vol. vi. p. 42). It does not differ from specimens found by me at low-water mark in Salem Harbour. It is evidently the same as the supposed larva of *Micralymma* (?) mentioned and rudely figured in the 'American Naturalist,' vol. ii. p. 278, found by me many years ago at low-water mark in Casco Bay. It is of the same size as the Salem specimens, being ·25 inch in length.

Thalassarachna Verrillii, n. sp.—This species differs in important particulars from our best-known species, *Hydrachna formosa*, Dana & Whelpley (Amer. Journ. Sci. 1836, xxx. p. 354), found near New Haven, in freshwater Unionidæ. The body of that species is much longer, the maxillary palpi are stouter, and the relative length of the joints very different; the claws are very different, the forks of each claw being large and of equal size, and there is no brush on the base of the claw. At first I was disposed to place this halophilous species in the same genus as Dana and Whelpley's *Hydrachna formosa* and *H. pyriformis*; but having since then, through the kindness of Prof. Verrill, had the opportunity of studying a freshwater mite closely allied to *H. formosa*, which is described below*, I am led to consider the salt-water mite the type of a new genus, *Thalassarachna*, with the following differential generic characters:—A conical head distinct from

* *Hydrachna tricolor*, n. sp. Under this name I describe a beautiful mite, brought me from New Haven by Prof. Verrill, after the present article was sent for publication. It is 0·07 inch in length, including the palpi. It is elliptical in form, a little broader behind, being two-thirds as broad as long. Ocelli situated over the insertion of the second pair of legs, the distance between them equal to half the width of the body. Body orange-red, middle portion of the body black-brown, due to the colour of the large liver, with a Y-shaped mesial line, pale straw-yellow in colour, formed by the interspace between the two halves of the liver; the forks of the Y clavate. Appendages very pale grass-green. Legs much as in *H. formosa*, but the hairs are longer. Maxillary palpi the same as in *H. formosa*, there being two pairs of minute spines on the fourth palpal joints. Mouth and lancet-formed organ (languette) protruded as in *H. formosa*. "Bifid linguette" at the base of maxillary palpi as in *H. formosa*. The rudimentary mandibles form a conical protuberance, the base situated within the body, each mandible being twice as long as broad, and reaching to the basal third of the second maxillary joint.

Twelve eggs, ten of them fully formed, being as long as the basal joints of the legs, could be seen on the underside of the body. The mite was alive December 30, showing that the eggs, probably laid in the spring, are formed in the preceding autumn.

the rest of the body; maxillary palpi 5-jointed, each ending in an incurved spine (the fifth joint). Mandibles large, forming an ensiform beak nearly as long as the palpi. Claws long; the upper hook minute; a single row of hairs on the underside of the lower hook, forming a brush. Otherwise closely allied to *Hydrachna*.

The body is globular, convex above, with the abdomen obtusely rounded behind, the skin being minutely lineated. It is blackish when alive, with the head and edge of the body white. The head is minute, conical, subacutely pointed in front. The maxillary palpi are 5-jointed, a little more than twice as long as the head, and about one-fourth as long as the fore legs; the second joint short; the third joint one-third as long as the entire palpus; the fourth as long as it is thick; the fifth minute, and carrying a long, slender, slightly incurved spine bifid at the tip, the outer fork projecting considerably beyond the inner one. The mandibles form an ensiform acute beak, reaching to the middle of the terminal palpal spine. The two eyes are remote black dots situated on the anterior fourth of the body; over the insertion of the second pair of legs, and just in front of them is a well-marked transverse groove crossing the body. The legs are 6-jointed, much alike in structure, moderately hairy. The claws are alike in size, the hook being moderately curved, rather long, bifid at the end, the upper fork being much the smaller, especially on the anterior pairs, forming a small acute tubercle; in the middle of the underside of the claw (on all the feet) is a brush of fine hairs of equal length, arranged in a single row. On the penultimate joint of the anterior tarsi are five stout hairs; on the other tarsi three, the two proximal hairs being contiguous. External female genitalia with two bivalve contiguous plates, like those of *H. formosa*, Dana and Whelpley. Length ·07 of an inch. The body of the young is whitish, longer, more ovate than in the adult, the abdomen being a little pointed behind.

With the exception of Philippi's *Pontarachna punctulata* (Wiegmann's Archiv, 1840, vol. vi. p. 191, pl. 4. figs. 4, 5), which was discovered by him in the Bay of Naples (he does not state at what depth; consequently I infer that it was in shallow water), the species under consideration is the only one which, so far as I am aware, has been found to be exclusively marine*. The genus *Pontarachna* is very different from *Hydrachna* and *Thalassarachna*; and I should judge that it rather approaches *Atax*. It differs from *Thalassarachna* in the shorter, unarmed palpi, and in the apparent (Philippi does not

* [Mr. Gosse has described (Ann. Nat. Hist. ser. 2. vol. xvi. pp. 27 & 305) three species of marine mites found on the British coasts.—Ed. *Ann.*]

mention or figure them) absence of a mandibular beak. The palpi are half as long as the fore legs.

The present species was dredged by Prof. Verrill in 20 fathoms, on Clark's Ledge, in Eastport Harbour. It was found (four or five specimens, young and adult) "on Hydroids" &c. It will be an interesting point to determine whether, like the other species of the genus, it also lives in the earlier or even in the adult state among the gills of Lamellibranchs, and also whether it lives between tide-marks, thus agreeing with the distribution of *Chironomus oceanicus*. At any rate, we have here an insect and a mite breathing by tracheæ, and extracting the oxygen from the water at the great depth of 120 feet, and, in the case of the Dipterous larva, with no apparent variation from specimens living at low-water mark. In this connexion I might notice the fact that we have on our New-England and Labrador shores several species of mites of the family Trombidiidæ which run over seaweeds and live under stones between tide-marks; and I have observed similar species at Beaufort, N.C., and Key West, Florida.

As regards the distribution of the species of brine-insects, several questions of interest arise. How are we to account for the origin of the *Ephydra halophila* in such prodigious quantities in the vats of the Equality Salt-works of Illinois, a locality remote from salt lakes and the ocean shores? Are the brine species of the salt lakes of Utah and California remnants of an oceanic fauna and of the Tertiary period? or are they of recent and local origin? Have these brine-insects acquired their singular tastes within a recent geological period (say, the Quaternary), having lived at first, as do their allied species, in foul fresh water, or amid decaying matter in damp localities? Before these and other questions can be answered, we must have analyses of the waters, and a review of the European literature of the subject*, and larger collections of brine-animals from our own country.

Peabody Academy of Science, Salem, Nov. 16, 1870.

* I am indebted to Mr. F. Walker, of London, for the following note on the habits of the English species of *Ephydra* and its allies. He writes under date of December 6, 1870:—"I have observed species of *Ephydra* along the sea-shore, as well as several inland aquatic species. I am indebted to my friend the late A. H. Haliday for the descriptions of the species of this and the neighbouring genera in my 'Diptera Britannica,' vol. ii. I am not aware that the species are very different in their habits; and he does not mention them as such. He writes of the following species as occurring on the sea-shore:—

"*Hecameda albicans*, on sandy coasts, especially on fresh rejectamenta.
"*Hydrellia thoracica*, on the sea-coast.
"*Atissa pygmæa*, in a salt marsh.
"*Glenanthe ripicola*, muddy sea-coast.
"*Scatella sibilans*, sea-coast.

XXIX.—*Descriptions of three new Species of Asiatic Birds.* By ARTHUR, Viscount WALDEN, P.Z.S.

Phyllornis chlorocephalus, n. sp.

The Burman representative of the Sumatran and Malaccan *Phyllornis icterocephalus*, Temm. *ap.* Bonap., has not been hitherto discriminated. It chiefly differs from that species by possessing a much longer bill, by having the crown of the head green and not yellow, and by wanting the intense golden colour of the nape. The frontal plumes are bright yellow. The female (perhaps the young male) has the forehead as well as the crown bright green. Bill from nostril full half an inch; other dimensions as in Malaccan examples (four in number) of *Ph. icterocephalus*, Temm. Described from three adult males and one female, obtained near Tongoo.

The next two species were discovered by Dr. Jerdon, who has kindly asked me to describe them.

Turdinus striatus, n. sp.

Feathers of the head, nape, and back cinereous brown, narrowly edged with a rich ruddy brown, changing to dark brown on the margins. Wings and tail pale brown, tinged with rufous. The long and lax upper tail-coverts brown, tipped with ferruginous; under tail-coverts bright rust-colour. Chin, throat, and upper breast-feathers white at the base and on the edges, with brown centres. Abdominal region and flanks pale brown, tinged with rufous. Lores, cheeks, and ear-coverts pale brown. Upper mandible horn-brown; lower paler, inclining to yellow. Legs yellowish brown. Bill from forehead $\frac{6}{8}$ of an inch, wing $2\frac{3}{8}$, tail 2 inches, tarsus $\frac{7}{8}$.

Khassia hills, near Cherripoongi.

This interesting species is a diminutive member of the Indo-Malayan genus *Turdinus*. It closely resembles, in its general aspect, *Turdinus macrodactylus* (Strickl.), but is a great deal smaller, and has the throat striated and not pure white.

Cisticola ruficollis, n. sp.

Stripe over the eye, ear-coverts, thigh-coverts, flanks, under

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" *Scatella leucostoma*, marine rejectamenta.
" —— *æstuans*, among Fuci.
" —— *despecta*, sea-coast and sandy places.
" *Teichomyza fusca*, on chalk cliffs a little above high-water mark; swarms also occur in urinatories in London and other towns. Von Heyden, in the 'Entomologische Zeitung, Stettin,' mentions *Cœnia halophila* as a sea-side insect. I believe that no European *Stratiomys* has been discovered to live as a larva in sea-brine."

tail-coverts, and a broad band extending from the sides of the neck across the nape bright rufous. Feathers of the head pale fulvous at base, changing to rufous at the extremity; many with broad black centres. Dorsal feathers and wing-coverts black, with narrow fulvous edgings; those on the rump edged and tipped with rufous. Quills dark brown, with yellowish-rufous edgings. Rectrices above also dark brown, the outer webs washed with tawny rufous; tips pale fulvous. Rectrices underneath ashy brown; a bold black bar or spot near the end of each feather, which is terminated with pale fulvous. Lores, chin, cheeks, throat, and remaining under surface fulvous white, more or less tinged on the breast with pale rufous. Upper mandible dark brown; under mandible yellowish at base. Legs reddish yellow. Bill from forehead $\frac{3}{8}$ of an inch, tarsus $\frac{5}{8}$, tail $2\frac{1}{8}$, wing $1\frac{11}{16}$. In another example the rectrices above want the pale terminal fringe.

Obtained at Debrooghur.

This very distinct species, in its style of coloration, greatly resembles *Graminicola bengalensis*, Jerd. Dr. Jerdon informs me that it occurs all through Assam, but only in dense long grass.

BIBLIOGRAPHICAL NOTICE.

Natural History of the Azores, or Western Islands. By F. Du Cane Godman, F.L.S., F.Z.S., &c. 8vo. London: Van Voorst, 1870.

The last thirty or forty years have much advanced our knowledge of the physical conditions and productions of those interesting archipelagos or groups of islands which, from about the latitude of Lisbon to a few degrees within the northern tropic, stud the eastern confines of the great Atlantic. We have in the work before us a very useful and valuable addition to our acquaintance with the most northerly and hitherto least thoroughly explored of these four groups.

Mr Godman's personal narrative and observations occupy the smaller portion of the volume. But it brings together various contributions by other able writers on the collections made by him, so as to present a complete *conspectus* of the present state of our acquaintance with the Zoology and Botany of the Açores. Why, by the way, must we ask, does Mr. Godman retain the English barbarian and entirely unwarrantable spelling of the word (arising either from a mistake of the *ç* for the letter *z*, or from a bad representation in English of the Portuguese pronunciation)?

The author's own short narrative of his four months' visit, and account of the few Mammals, Birds, Reptiles, Batrachians, and Freshwater Fishes hitherto observed in the islands, is followed by a long and careful enumeration of the Insects (mainly Coleoptera), from the pen of Mr. Crotch. This is extremely valuable, from its affording accurate data for comparison with the more elaborate works of Mr. Wollaston on the Coleopteran Faunas of Madeira, the Canaries, and Cape Verdes.

A short survey of the Land Mollusks, by the Rev. H. B. Tristram, enumerates (with a few others) all Morelet and Drouet's species—confirming some of the latter by examples found by Mr. Godman, but leaving a majority, and indeed all the *Limacidæ* and *Vitrinæ*, in the same apocryphal category in which they stand as exhibited in M. Morelet's book. The apparent absence of any member of the Pulmonibranchiate group is a remarkable fact—if a fact. Their extreme rarity seems at least established—a fact which, considering the favourable conditions pointed out for their occurrence by Mr. Tristram, is scarcely less curious than their supposed entire absence.

In Mr. Hewett Watson's elaborate and valuable history, catalogue, and general survey of the Flowering Plants and Ferns, we do not fail to find the usual characteristics of their well-known author, viz. a most careful accuracy, not to say nicety, in all minute points of detail, in the case especially of plants of doubtful or subordinate specific rank, combined with a clear and logical precision in adjusting the balance fairly between the weight of facts or evidence for or against his final, particular and general conclusions. He reviews *seriatim* each one of the species originally discovered by himself or subsequently by others, showing, in very many instances, the extreme looseness and incorrectness of Drouet's Catalogue, and amending critically that of Seubert, with reference especially to habitats. Thus, this new Catalogue is indeed, as intended by its author (p. 124), " a key or index to all the earlier-dated floral lists for the Isles," and " a more true list of the presently (*sic*) known species, approximately complete and correct for the time being, although doubtless further additions and corrections will be made in the future."

With Drouet's List especially in view, and indeed the works of others here and there, we cannot but largely participate in Mr. Watson's amusingly strong and repeated expressions of distaste for " little distinctions" (p. 172), "petty and inconstant technical distinctions" (p. 123). This is a mere question, however, where to draw the line; and each man draws it, of course, below himself. Nor does Mr. Watson really, we believe, go so far on this point as his words in some places by themselves imply. For not only does he except expressly from his censure, as " a bias towards the safer side" (p. 123), or as " useful in local describers " (p. 172), such distinct treatment of ambiguous varieties or species, but he directly blames (p. 259) the late Sir W. J. Hooker for a tendency with Milde in pteridology " to an excessive aggregation of species, which," he justly adds, " so much lowers the scientific value and serviceableness of Sir William Hooker's works on the same group of plants." And to bring the matter still more closely home, we may refer to Mr. Watson's treatment (p. 211) of his own adopted bantling, as it may be called, *Lysimachia azorica*, Hochst.—a treatment, however, in which we heartily concur. In fact we are quite assured that, in the case of a *primâ facie* discovery of a new form, Mr. Watson is too sound a working botanist not to admit that in minute attention to "small differences" and "little distinctions"—occasionally stamped, for attracting or facilitating further observation, and whilst yet unproved to be really trivial or inconstant, with a special name—lies the very safest way to truth in settling the limits ultimately of a species, and this despite all liability to abuse that may accrue in thus "allowing nice opportunities to petty minds to make petty distinctions on paper" (p. 161).

This very valuable portion of the book is followed by a carefully compiled list by Mr. Mitten of all the Mosses and Liverworts (*Hepaticæ*) hitherto discovered in Madeira, the Canaries, and Açores. Of these, we have only time and space to observe that they appear entirely to confirm the conclusion arrived at by Mr. Watson (p. 276) with reference to the Flowering Plants and Ferns, viz. that "on the whole . . . . . they can hardly be said to yield any special evidence in support of the Darwinian theories;" though instead of admitting that "their affinities on the general view are more in support of those theories than adverse to them," we should rather have remarked that, in many signal and decisive points, they seem to us to run directly counter to them.

Mr. Godman concludes his interesting volume with a short summary and general remarks, followed by a full index of scientific names and two small maps, showing the relative position of the islands and of the whole group. It remains to be noted, for the encouragement of future investigators, that he has still left unexplored in Botany the Lichens, Algæ, and Fungi, and in Zoology the highly interesting provinces, in their relation to the Canaries and Madeira, of the Arachnida, Crustaceans, Radiates, Sponges, Corallines, Sea-Fishes, and Mollusks.

He has added, however, to our "helps to knowledge" a book from which not only the practical naturalist, but any one who is at all competent unbiasedly to sift and weigh the alleged "facts" of modern "science," and the varieties of airy theoretic superstructure attempted to be raised upon them, may derive not less profit than interest and entertainment.

MISCELLANEOUS.

The late Adrian Hardy Haworth.
By Dr. J. E. Gray, F.R.S. &c.

It has often occurred to me that English naturalists have hardly done justice to the great scientific merits of this industrious and far-seeing botanist and entomologist, no doubt in consequence of his being so far in advance of his age at a time when not to be a worshipper of the Linnean school as understood in England (which is most unlike the practice and example of Linnæus himself) was a sufficient mark of opprobium to almost exclude him from scientific societies. As a young man I was very intimate with him, and estimated his labours, but hardly so much as I have been induced to do in later years. He was one of the founders of the Botanic Garden at Hull, where he then resided; but he continued to cultivate plants when he resided at Little Chelsea, and at Church Lane, Old Chelsea; for he considered it desirable not only to study plants as they were kept in an herbarium, but also to observe them in a living state, that he might record their mode of growth. When we consider the manner in which he separated the fleshy plants, the Saxifrages, and the bulbous plants into groups, and especially regard the time in which it was done, we are astonished at the accuracy of his observations, which were so unlike the manner in which plants were then studied; and most of his groups are now acknowledged as genera or sections of genera. It was the same with his work on British Lepidoptera: there the various Linnean genera were divided into natural groups, which he fully characterized, all of which are now acknowledged as genera; and he would have been quoted as the author of those genera if he had given them generic names instead of the English or Latin adjective names which he applied to them. We must recollect that this was all original work, published before the writings of Cuvier, Latreille, and other founders of the French school (which was established during the early part of the despotism of the Great Napoleon), whose labours my late predecessor, tutor, and friend, Dr. Leach, first introduced to the knowledge of English naturalists.

On the Adult Form in the Genera Cypræa *and* Ringicula, *and in certain Species of the Genus* Astarte. By J. Gwyn Jeffreys, F.R.S.

Mr. Searles Wood, in the last Number of the 'Annals' (p. 172), invited communications on a question propounded by him, viz.:—"If small specimens [of *Cypræa europæa* and *Ringicula auriculata*] in the Crag, which have a thickened lip, are not in many instances young shells, what has become of the immature specimens?" I venture to suggest that young shells of both these species, having the usual thin and imperfect lip, will surely be found after further search. I have already given an explanation, in my work on British Conchology (vol. ii. pp. 309 & 310, and vol. iv. pp. 402 & 403) as to the front margin in *Astarte* and the outer lip in *Cypræa*, with reference to the age and size of specimens. I lately dredged in the North Atlantic *Ringicula auriculata*, Menard de la Groye (*R. buccinea*, Brocchi), *R. ventricosa*, J. Sowerby, and *R. acuta*, Sandberger (the last two species hitherto known as fossil only), all of which in their immature state had a thin and imperfect lip. The young of *Cypræa europæa* is the *Bulla diaphana* of Montagu.

I may also remark that any young shells "killed for food" would not be necessarily "consumed" or destroyed; so that I have no doubt they will occur in a fossil as well as in a recent state.

25 Devonshire Place, Feb. 15, 1871.

On Siredon-*metamorphoses &c.* By E. D. Cope.

The late observations by various writers on the metamorphoses of *Amblystoma*, especially those of Mr. Tegetmeier, indicate that some of the principal facts in the history of the subject have been overlooked by all of them.

In the first place, no one has seen any metamorphosis of true *Siredon*, *S. mexicanus*, Shaw (*S. pisciformis*, *S. axolotl*, and *S. maculatus* auctorum), which inhabits the lakes of Mexico, and of which the Smithsonian collections contain numerous specimens. Whether it undergoes a metamorphosis is entirely unknown to naturalists, though I would express the belief that it will be found to do so occasionally, under suitable circumstances. No *Amblystomata* have been brought from Mexico south of Tamaulipas and Chihuahua by any of the various naturalists collecting for the Smithsonian Institution.

In the next place, Prof. Baird was aware of the metamorphoses of all the North-American species of *Siredon* many years before the observation of it in the Jardin des Plantes, although at first he named one of them *Siredon lichenoides*, treating it as a mature animal. He regarded these creatures as larvæ in his essay on the North-American Salamanders, published in Philadelphia in 1847.

Thirdly, the important observation of Duméril * established the fact that the Siredons reproduced as such; and his account of the subsequent loss of larval characters by the offspring is the first of a positive character which we possess on that point.

After this, in 1867†, the writer recorded the various stages of metamorphosis in different structures to be observed in reproducing individuals of two species of *Amblystoma*, viz. *A. tigrinum* and *A. mavortium*. These embraced various *Siredon*-characters of the dental, branchial, and dermal organs, and of coloration. It was suggested that the metamorphoses observed by Duméril were those of *A. mavortium*, which was confirmed by an examination of specimens sent to the writer by Prof. Duméril a year afterward‡. At the same time the periods of metamorphosis of eight other species of the genus were stated, and the Mexican Axolotl was regarded as an *Amblystoma*, whether undergoing metamorphosis or not, owing to the irregularity of its occurrence in the most nearly allied species, *A. mavortium*, or from its *Siredon*-stage, *S. lichenoides*, Baird.

In 1868 Prof. Marsh of Yale College observed the metamorphosis of the *A. mavortium*, confirming the conclusions of previous writers. Since that time the changes have been observed by Mr. Tegetmeier and others.

The only point remaining to be determined is whether Siredons (i. e. *Amblystoma mexicanum*) undergo a metamorphosis or not. Among our numerous specimens I can find none that exhibit any tendency toward the change.

* Bulletin de la Société d'Acclimatation, 1865, ii. 348.
† Proceedings Acad. Nat. Sciences, Philad. 166.
‡ Origin of Genera, 1868, p. 47.

I might add here that I have had for a time, in a winter fernery, a large New-Jersey specimen of *Amblystoma tigrinum,* a foot in length. It is nocturnal in its habits, and remains during the day in its burrow. This extends through the long diameter of its prison, and has three outlets, which it keeps open. From one of them, as evening approaches, it projects its head, and watches with attention what is transpiring in the room.

In the same case are specimens of the common *Plethodon cinereus,* of both varieties. During this, as in former years, I observe that this species is nocturnal, and is a great climber. They will climb the rachis of a most slender fern or spear of grass, and lie in a coil on the end of a tall frond or other narrow support which may be sufficient to bear their weight, at a height of a foot or eighteen inches above the ground. They climb a plate of glass with great ease, by adhering closely to its smooth surface with their moist abdomen. When disturbed on some high perch among the herbage, they leap away by a sudden unbending of the coiled body, in the manner of some caterpillars.—*Silliman's American Journal,* Feb. 1871.

Note on the Infusoria flagellata and the Spongiæ ciliatæ.
By Prof. H. James-Clark, Kentucky University.

I send this note in hopes that it may be of interest to those readers of this Journal who have followed the recent discussions upon spontaneous generation and the doctrine of evolution. It is an effort to clear up the chaos of uncertainty which has reigned among the lower Protozoa for years past, and particularly in the heterogeneous group of so-called Sponges. The aim of the evolutionists is clearly, by refusing to recognize their truly organized structure, to depress these creatures to such a low level in grade that they shall appear but a step above the lifeless protoplasm which some think has been seen *almost* manufactured in the laboratory of the chemist. After hypothetically developing "organizable protoplasm" out of "inferior types of organic substances," which in the process, *per se,* under "the mutual influences" of its metamorphic forms, generates still more *sensitive* organic matter, until it finally attains to the possession of *vital* actions, the evolutionist imagines himself able "deductively to bridge the interval" between the so-called "nascent life" and the unmistakable vitalism of the slimy Rhizopod. (See Herbert Spencer, Appleton's Journal, Aug. 7, 1869, p. 598.)

My own researches have constantly tended in the opposite direction. In spite of the apparent physical simplicity of even the lowest of the Protozoa (*Amœba* and the like), their habits and the phenomena attendant upon their mode of locomotion, their determinate prehensile acts, so wonderfully like consciousness of an end to be accomplished, and their undeniably specialized digestive functions, all lead to the conclusion, which with me is a fact, that they possess a degree of differentiation *in esse* as marked as that which we recognize as *potential* in the earliest stage of the vertebrate embryo. In the former the organization is present, but not circumscribed into regions; in the latter it is also present uncircumscribed, but it is to be eventually differentiated. The Sponges, with their supposed slimy protoplasm-like simplicity, have been in former years the hunting-ground of the developmentalists; but of late that group has been slipping out from under the feet of those philosophers.

Carter first detected the true *criterion* of their animality, though erring as to their classificatory relationship. It was my good fortune to prove their close alliance with the *Flagellata*, in a memoir (Mem. Boston Soc. Nat. Hist. vol. i. pt. 3, Sept. 1867, "On the Spongiæ ciliatæ as Infusoria flagellata"*), published some few years ago. I described certain monad-like infusoria which possessed a single *flagellum* surrounded by a projecting membranous collar. Some forms were appended to branching stems (*Codosiga*), and others were ensheathed in a funnel-shaped or urnæform tube (*Salpingœca*). The monadiform body of these I showed to be identical with the ciliate bodies of one of the Spongiæ ciliatæ (*Leucosoleniæ*), and homologized the branching stem and the ensheathing tubes of the former with the gelatinous mass of the latter, in which its monads were imbedded. The connexion seemed not even a step wide, so clear and unmistakable was the relationship. That there should ever be discovered a form which would lie so intermediate between these as to make me hesitate whether it belonged to the one or the other, I did not even hope for; but it has come unexpectedly. In Schultze's 'Archiv für mikroskopische Anatomie' (Bd. vi. 4, 1870) Cienkowsky describes, under the name of *Phalansterium*, a genus which consists of monad-like bodies with a *flagellum* and a projecting collar like those of *Codosiga*, *Salpingœca*, and *Leucosolenia*. Of the two species which he illustrates, one (*P. consociatum*) has monads enveloped in a broad funnel-shaped slimy sheath; and these sheaths are closely packed side by side, radiatingly, so as to form a shield-like or a hemispherical mass. This comes nearest to the *Salpingœca*. The other species (*P. intestinum*) possesses similar monads; but they are imbedded basally in a gelatinous intestiniform mass of slime (*Schleim*), "with their vibrating lashes extending in every direction" about the cylindrical colony. Originally each monad is endowed with a separate slime-sheath; but eventually these are all fused together into one common mass. Beyond this, to make a true sponge, we need but the presence of spicula, and open interspaces in the slimy mass between the monads leading to one common cavity. Introvert the layer of monads, and we produce the desired effect without doing violence to their relative positions. It is a mere matter of proportions, just as the inverted cyathiform rose-hip is none the less an ovariferous disk than the globular receptacle of the strawberry.—*Silliman's American Journal*, Feb. 1871.

* 'Annals,' 1868, vol. i. p. 133 &c.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 40. APRIL 1871.

XXX.—*Descriptions of some new or little-known Species of Oaks from North-west America.* By ROBERT BROWN, of Campster, A.M., Ph.D., F.R.G.S., President of the Royal Physical Society, Edinburgh.

1. *Quercus Sadleriana*, R. Br. Campst.*

Leaf large, old ones broadly elliptical, young ones more ovate, acute at base and apex, edges remotely serrate, teeth submucronate, apex pointed; nerves distinct on superior surface, very prominent inferiorly, lateral nerves reaching the margin in the teeth; superior surface dark green, inferior paler (fading in drying), glabrous above and below; length $4\frac{3}{4}$ inches, breadth 3 inches, length of petiole $\frac{3}{4}$ inch (average of six leaves). *Fruit* shortly pedunculate, solitary, rarely twins; glans projecting more than half out of the cup; glans small, ovate, or in some cases compressed at both ends, terminating in a short blunt point, pale brown in colour; length $\frac{1}{2}$–$\frac{3}{4}$ inch, diameter $\frac{1}{2}$–$\frac{2}{3}$ inch: cup deepish, narrow inferiorly, expanding superiorly, very thin, the edges bevelling off; scales ovate, closely imbricate and appressed, swollen at base, covered with white pubescence, the lower whorls large and most distinct, the upper near the edge of the cup smaller and less distinct; depth of cup $\frac{1}{2}$ inch or less, breadth superiorly $\frac{2}{3}$ inch, length of peduncle $\frac{1}{3}$ inch. *Flowers* unknown. *Maturation* annual (?).

Hab. A spur of the Siskiyou Mountains, in Oregon, close to the California boundary line (lat. 42° N.), between Sailors' Diggings in Oregon and Smith's River in California, on the Crescent City trail.

* *Robertus Brown Campsteriensis*: by the advice of M. Alphonse De Candolle, I have adopted this distinctive mark for species described by me (*vide* Trans. Bot. Soc. Edin. vol. x. p. 437).

The species never attains a greater size than a shrub about 4 feet in height. I found it, in September 1865, growing in patches in the locality named, about 2000 feet above the level of the sea, but producing fruit very sparingly, and described it in my notes as "*Quercus*, sp. nov., No. 253," in 'The Farmer,' May 16, 1866. In the form of the leaf it is not unlike the chestnut-form of *Quercus densiflora*, Hook. & Arn.*; but it differs widely from that species in the form of the cup, which is not covered with recurved hooked scales, but with ovate appressed scales, tumid at the base, so as to look, as I have described them in my field-notes, like flattened tubercles. A very competent authority, Prof. Œrsted, in a private note to me regarding some specimens of this oak which were submitted to him, remarks:—"Your *Q. Sadleriana* is most interesting. The cupula is very peculiar, with its thin margin. I think it is nearest *Q. Griffithii*, Hook. f. & Thoms.†, from the Himalayas. There is none of the American species which it resembles." It comes therefore under Œrsted's third group‡ (Serratæ) of his second section (*Prinus*) of the subgenus *Lepidobalanus* of the restricted genus *Quercus*.

I name it in honour of Mr. John Sadler, Assistant Secretary of the Botanical Society, and Assistant to the Professor of Botany in the University of Edinburgh.

2. *Quercus Œrstediana*, R. Br. Campst.

Leaf small, oblong or obovate, petiolate, with from three to five rounded, shallow, acutely cut lobes on either side; base acute, inclined to be unequal; veins very prominent inferiorly, and reaching the edge at the termination of the lobes; glaucous above, inclining to pubescence inferiorly; dark glistening green above, paler brownish white or cinereous beneath; length $2\frac{1}{2}$ inches, breadth $1\frac{1}{4}$ inch, length of petiole $1\frac{1}{4}$ inch. *Fruit* solitary, rarely in twins (in which case the second fruit is usually dwarfed or abortive), supported on a moderately long, stout peduncle; glans large, ovate, flattened at lower end, terminating superiorly in an elongated conical point, overtopping cup $\frac{3}{4}$ of length, brown in colour, testa thin; length $1\frac{1}{4}$ inch, diameter $\frac{3}{4}$ inch: cup hemispherical, shallow, tubercular in appearance; inside dark brown, and covered with a slight whitish pubescence; walls thick, thinner superiorly; scales ovate (occasionally subulate), the base much swollen, so as to give the exterior of the cup the tubercular

* Botany of Beechey's Voyage, p. 391.

† De Candolle's 'Prodromus,' vol. xvi. p. 14.

‡ "Bidrag til Egeslægtens Systematik," Naturh. Forening Vidensk. Medd. i Kjöbenhavn, 1866, p. 68.

appearance, suddenly constricted and terminating in a sharp membranous point, the lower scales largest, upper much smaller, closely aggregated and indistinct, covered with a dense white pubescence; depth $1\frac{1}{4}$ inch, breadth $\frac{3}{4}$ inch, length of peduncle $\frac{1}{3}$ inch. *Flowers* unknown. *Maturation* annual.

Hab. in "gulches" from 2500–4000 feet above the sea, in the Siskiyou Mountains, but chiefly on Cañon Creek, in Southern Oregon, lat. 42° 10′ N.

In character this species approaches the group of which *Quercus Garryana*, Dougl.*, is the type, but differs entirely in the character of the cup, the size and lobation of the leaves, and in its being always a shrub. Like *Q. Garryana*, it prefers prairies and low lands; but the locality where I have seen it most plentiful was on spurs of the mountains, at elevations of 2500–4000 feet. It ought also to be noted that wherever found on level lands, these are situated at a much higher elevation than the open grounds affected by *Q. Garryana*. Though a shrub, it bears very plentifully; and the acorns are accounted very nourishing, the produce of forty or fifty bushes being sufficient to fatten a hog. As a species it is very distinct from any in North-west America, and, as far as I am able to learn, as yet undescribed. It is "*Quercus*, sp. (*d*), No. 249" of my catalogue (*l. c.*), and, like the former, was discovered by me in Sept. 1865. It belongs to the division Lobatæ of the section *Eulepidobalanus* of the subgenus *Lepidobalanus* (Œrsted, Section I. *Lepidobalanus*, A. DC. pro parte). I have the honour to dedicate it to Dr. A. S. Œrsted, Professor of Botany in the University of Copenhagen, and Inspector of the Polytechnic School there, a distinguished traveller and naturalist, and the author of the able memoir on the classification of the oaks to which I have already referred.

3. *Quercus echinoides*, R. Br. Campst.

Leaf perennial, small, lanceolate, oblong-elliptical or rarely obovate, shortly petiolate, serrate (except near the base), entire or with only a sinuate margin; nerves hardly distinct above, very distinct inferiorly, reaching margin at base of teeth when present, superiorly glabrous or slightly pubescent, inferiorly covered with a cinereous down; length of leaf $1\frac{1}{2}$ inch, breadth $\frac{3}{4}$ inch, length of petiole $\frac{1}{5}$ inch. *Fruit* solitary or clustered in groups of 2–5 in axils of leaves, united to stem by a short thick peduncle, densely covered with cinereous pubescence, or sometimes sessile or subsessile;

* Hooker in 'Flor. Bor.-Am.' ii. p. 159.

glans ovoid, flattened inferiorly, and terminating superiorly in a short, blunt, distinct point; pale brown in colour; testa thick, superior portion covered with a dense caducous cinereous pubescence; length $1\frac{1}{10}$ inch, diameter $\frac{6}{10}$ inch: cup shallow hemispherical, and densely covered with filiform, stiff, patulate, and generally reflexed scales, frequently terminating in stiff recurved hooklets, covered with a dense cinereous pubescence, which extends down to the peduncle; interior pale brown, and covered with a long fibrous pubescence; depth $\frac{3}{10}$ inch, breadth at mouth $\frac{6}{10}$ inch, length of peduncle, when present, about $\frac{4}{10}$ inch. *Flowers* unknown. *Maturation* annual (?).

Hab. Cañon Creek, Oregon, and up to 8000 feet above the sea-level on other portions of the Siskiyou Mountains.

This species I first found plentiful, in the autumn of 1865, in Cañon Creek, a locality peculiarly prolific in species of Cupuliferæ and Coniferæ, as my collection (of which it is "*Quercus*, sp. (*e*), No. 250") testifies. It is a small shrub, growing to a great height above the sea-level, which *Q. densiflora*, H. & A., to which it is closely allied, does not. I am, however, doubtful whether it is not identical with that species, of which *Q. echinacea*, Torr. (Botany of Whipple's Pacific Railroad Report, p. 137), is only a lanceolate entire or sinuately entire variety, both forms being frequently found on the same tree. I am therefore doubtful about its specific identity when the type of the group to which it belongs is so variable. For the present, however, I may indicate it as new, the specific name pointing to its nearest ally. It will therefore belong to Œrsted's subgenus *Eupasania* of the genus *Pasania* (*Quercus*, sect. *Pasania*, Miq., et *Chlamydobalanus*, Endl. pro parte) of the subfamily Castaninæ, the characters of which, however, require to be somewhat modified. *Q. echinoides*, among other characters, has much smaller leaves (which never assume the chestnut form) than *Q. densiflora*. The cup is deeper, and the acorns more ovoid and very bitter, so bitter, indeed, that nothing but squirrels will eat them; so bitter are they that even the black bear will not eat them, unless pressed by famine. The miners and hunters living in the section of country where it is found always look upon it as a separate species from the water-oak (*Q. densiflora*).

4. *Quercus oblongifolia*, Torr.

Leaf perennial, small, ovate or oblong-elliptical, quite entire, or rarely with a few serrations on the superior portion of the edge, and commonly only on one side; glabrous above and below, glaucous superiorly, darker green above, paler below; veins not prominent; shortly petiolate, equal at base; length of leaf $1\frac{1}{10}$ inch, breadth $\frac{6}{10}$ inch, length of petiole $\frac{1}{12}$ inch. *Fruit* sessile, solitary at the end of the branches; glans ovate and pointed, light brown, covered with a cinereous pubescence; length 1 inch, diameter $\frac{1}{2}$ inch: cup hemispherical, turbinate, obtuse at base and very small, covered with ovate, convex, appressed scales; scales abruptly narrowing and terminating in a blunt membranous brown point; lower portion of the scales tumid and covered with a greenish pubescence, largest in the lower whorls, indistinct near the lip; cup thin, interior greenish white, with a slight whitish glistening pubescence; glans overtopping the cup fully $\frac{3}{4}$ of its length; depth $\frac{1}{12}$ inch, breadth at mouth $\frac{1}{2}$ inch. *Flowers* unknown. *Maturation* annual.

Hab. In gulches in dry situations among the mountains in Southern Oregon, to the height of 2000 feet.

The specimens, of which the above is the description, were found by me, in Sept. 1865, on the sides of gulches (or deep ravines) in Cañon Creek, in Southern Oregon, about 2000 feet above the sea, but fruiting so sparingly that I could only find two specimens in fruit. It is a bush about 3 feet in height, and evergreen, and is "*Quercus*, sp. (*g*), No. 252" of my catalogue (*l. c.*). Though I have provisionally stated it to be *Q. oblongifolia* of Torrey*, I am by no means certain that it is not undescribed. I have seen no specimens of Torrey's plant; but, judging from the plate he has given (*op. cit.*) and the description (notwithstanding some discrepancies), it, if not identical with, approaches that species more closely than any other yet described. If identical with that New-Mexican species, the range of *Q. oblongifolia* must be extended north twelve degrees. *Q. oblongifolia*, De Candolle thinks, is closely allied to *Q. grisea*, Liebm., another New-Mexican species. The species, in the form of the leaves, is no doubt allied to *Q. agrifolia*, Nee†, though these are in our species not so glaucous; but it differs widely in the large size of the acorns, in the shape of the cup, and in the form of the scales, and is quite distinct from that very variable species. The whole group of closely allied species, of which *Q. agrifolia* is the type, is one involved in much obscurity, and requires a thorough revision, many forms to which specific importance has been given being nothing more than local varieties, produced by climate, soil, or other causes not so apparent to the senses, and regarding the influence of which we are as yet ignorant.

* Sitgreave's 'Report of an Expedition down the Zuni and Colorado Rivers,' p. 173, pl. 19.

† Anales de Ciencias Naturales, tomo iii. p. 271.

It is often loaded with fruit when not more than three or four feet high, though it will reach the height of more than forty feet. Mr. Bolander, a most observant Californian botanist, remarks that on river-banks and in exposures close to the coast, where it is almost daily enveloped in fogs, it exhibits a considerable uniformity, and elsewhere it varies infinitely within the type. The figure of *Q. oxyadenia*, Torr., in Sitgreave's Report, p. 173, pl. 17, represents the ordinary form of it very well when the acorns are fully developed. However, in the valleys of the interior of Oregon and California (for it is not found north of 43° N. lat.) the shapes of the leaves of one and the same tree are very different: some have entire margins, while others have them pretty deeply dentated; often one side is entire and the other dentate. Some trees occur of which the young shoots have the leaves "coarsely sinuate or obliquely sinuate toothed; teeth very sharply acute, with a broad base, cuspidate-awned," thus agreeing with Kellogg's *Q. Morheus* *, while the older branches have much smaller and entire leaves. In Anderson's Valley I saw several trees whose entire foliage agreed admirably with Kellogg's. Had I not seen that tree on the shore of Borax Lake exhibiting both forms, I should have been inclined to call it a good species. The cups of the acorns of both trees have the scales long and loosely imbricated, and the acorn is almost entirely immerged; but this is also the case with those of some trees that have a far different foliage. Thus far we have not been able to find good reliable characters. There are transitions in all parts, even in the same tree. As the tree has the habit of growing in groups, one might suppose that trees of one group at least should show a uniformity in botanical characters: but this is not so; just the very extremes may be found in one and the same group. On dry gravelly hill-sides in the interior this tree presents still another form, *Q. Wislizeni*, Englm.† The acorns ripen annually, and differ also essentially in shape and size. Soil, climate, and exposure offer in this case no satisfactory explanation for so great a variation in one species ‡. I am inclined to believe that it must be attributed to some intrinsic peculiarity which would lead certain species both of plants and animals to vary so much from their typical form as to almost lead one to believe that we see therein the species struggling to break off and establish new forms or races, allied to but differing specifically from the parent species.

* Proc. California Acad. Nat. Sciences, vol. ii. p. 36.
† DeCandolle's Prodromus, vol. xvi. p. 67.
‡ Proc. Cal. Acad. Nat. Sc. vol. iii. p. 229.

Quercus oblongifolia, or at least the form which I have supposed to be it, appears to belong, according to Œrsted's recent observations in his memoir on *Q. agrifolia* (Om den kristtornbladede Eg fra Californien *), to his section *Stenocarpœa* of the subgenus *Erythrobalanus* of the restricted genus *Quercus*.

5. *Quercus Jacobi*, R. Br. Campst.

I will not attempt in this place to do more than indicate the above species; for though it came under my notice as early as 1863, through a curious concourse of accidents I have never yet been able to obtain sufficient material for the publication of a complete diagnosis of the species. The only place where I ever observed it was in the south-eastern district of Vancouver Island, on the lawn and close to the house of Sir James Douglas, along with trees of its close ally, *Q. Garryana*, which afforded excellent material for comparison. The leaves of the species under notice, instead of being long and with three or four almost equal shallow lobes, acutely cut at the bottom, and the leaf of about equal breadth throughout, was more palmate, with five lobes, deeper and smaller than in *Q. Garryana*, the basal ones being broadest, the breadth of the leaf greatest at the middle. The form of the tree is also different. Instead of, as in *Q. Garryana*, being bare of branches for about twelve feet, it branches out near the base, the branching being much more umbrageous than in *Q. Garryana*. I was informed that the acorns were also different; and the one comes into leaf and flower later than the other. Sir James Douglas, who was at that time Governor of British Columbia and Vancouver Island, had for many years noticed these trees growing alongside of *Q. Garryana*, and was quite convinced of the specific difference of the one to which, in memory of his long and unvarying kindness to me and other naturalists during our exploration of North-west America, and in respect for the character of the founder of our North-Pacific colonies, I have attached his name. For the reasons mentioned, I will not at greater length describe this species or, at least, marked variety; but, as I hope to obtain in a short time sufficient materials for that purpose, I will postpone this until these are put into my possession.

In all, seventeen species of Cupuliferæ find a place in the flora of the region to the west of the Rocky Mountains, northward of and including Upper California, which immense extent of territory, so varied in its climate and physical features,

* Videnskab. Meddelelser fra den Naturhist. Forening i Kjöbenhavn, 1869, p. 59.

is generally known as North-west America. As I have already described and figured most of these species for a general work on the forests of that country (now in course of publication), I need not even mention them in this place; and for the same reason I have omitted to give figures of the species I have here described, these figures, with more extended descriptions, being intended to find a place in the same work.

Edinburgh, March 1, 1871.

XXXI.—*On two new Species of Birds from Moupin, Western Szechuen.* By Armand David.

Accentor multistriatus, n. sp.

Like *A. strophiatus*, Hodgs., of the Himalayas, but without rufescence on the upper parts, and with a narrower pectoral band; sides of the neck cinereous, with numerous black streaks; flanks and vent pale buff, covered with blackish-brown streaks, and the oblong spots on the crown, hind neck, and back darker and more abundant than in its ally. Somewhat larger in size, with larger legs and feet. This bird forms a good second species of this peculiarly coloured group of *Accentor*. Length 6 inches; wing 2·6, tail 2·4. Iris nut-brown.

Hab. Moupin, Western Szechuen.

Cinclosoma Artemisiæ, n. sp.

In size, form, and style of coloration very similar to *C. ocellatum*, Vigors, of the Himalayas. Head and broad patch on the throat black, leaving the chin, lores, and under the eye buff-coloured, and a partial half-eyebrow and a spot in rear of the ear-coverts white. Neck and underparts buff, a little rufous near the edge of the black gorget; back of the neck, breast, and flanks banded on each feather near its tip with an undulating black bar. Scapulars and back as in *C. ocellatum*, but with broader and yellower tip-spots and with much narrower black bars. Wings and tail as in its ally, but with the rufous more mixed with yellow. Length 12·75 inches; wing 5, tail 6·5. Bill variable in length; iris yellow.

Hab. Moupin, Western Szechuen.

Genoa, Feb. 20, 1871.

XXXII.—*On four new Species of Asiatic Birds.* By Robert Swinhoe, F.Z.S.

Pellorneum subochraceum, n. sp.

Like *P. ruficeps*, Swainson, of India, but smaller, with less deep bill and shorter tarse. Crown richer rufous, with a distinct pale buff eye-streak extending to the nape. Breast, flanks, and vent buff, leaving the belly nearly white; the breast streaked with a few long, olive-brown arrow-head marks. Length 5·8 inches; wing 2·7, tail 2·6.

My single specimen of this bird was collected in the Tenasserim provinces, and sent to me some years ago by Mr. Blyth. My *P. ruficeps* is from Mr. Beavan's collection.

Pœcile baicalensis, n. sp.

Like *P. carolinensis*, Aud., of North America, from which it differs in having the black throat-mark confined to the throat and under neck, and not expanding under the cheeks; the black feathers are, moreover, broadly edged with white. Its flanks have a very slight tint of brown. Its wing-feathers are more broadly edged with white; and the white is clouded with grey, and not so pure as in the other. It is paler on the back and rump, with but little tinge of buff. It is of similar size. Wings more graduated; tarse short; toes very short and thick.

Hab. Trans Baikal.

Two specimens of this interesting form were received from the Lake-Baikal region, in company with several of *P. kamtschatkensis*, Bp. They were sent to M. Jules Verreaux by M. Tacsanowsky of Warsaw.

Family **Alaudidæ.**

Mirafra borneënsis, n. sp.

Similar in coloration to *M. javanica* (Horsf.) of Java. Bill straighter and more conical, not so *pyrrhuline*, with much longer *crura* to the lower mandible; wing longer, and not so rounded; toes, especially the middle one, shorter. Entire length 5·75 inches; wing 2·9, tail 2·3.

Hab. Borneo (Banjermassing). Collected by Mr. A. R. Wallace.

Mirafra parva, n. sp.

Bill similar in form to that of the last; coloration similar, but with less rufous. Can at once be distinguished by its small bill and miniature size. Length 5·1 inches; wing 2·6, tail 2.

Hab. Flores. Collected by Mr. A. R. Wallace.

XXXIII.—*Catalogue of* Zygopinæ, *a Subfamily of* Curculionidæ, *found by* Mr. Wallace *in the Eastern Archipelago.* By Francis P. Pascoe, F.L.S. &c., late Pres. Ent. Soc.

[Continued from p. 222.]

Arachnopus.

Guérin, Voy. Coq. (Entom.) p. 127; Lacordaire, Gen. vii. p. 159.

Arachnobas, Boisduval, Voy. Astr. ii. p. 435.

Lacordaire, who was only acquainted with one species (*A. gazella*), considered this genus so aberrant that he hesitated whether he should not make it a distinct tribe. In my opinion it would have been quite right to do so, as the new forms described below, although all furnished with a pectoral canal, are evidently allied to it, and indicate a subfamily distinct from the normal Zygopinæ of Malasia and America. The chief structural peculiarities of this group are the great breadth of the intercoxal process, in all except *Nyphæba*, whereby the posterior coxæ are placed close to the edge of the elytra, and the narrow metathoracic episterna; then underneath the femora there is frequently an excavation or canal for the reception of the tibiæ, and the latter are often deeply scored or lined in a manner never seen in the genuine Zygopinæ. There are five species of this genus already described, viz.:—*A. striga*, Guér. (Dorey); *A. gazella*, Boisd. (Dorey, Waigiou, Aru); *A. persona*, Vollenh. (Waigiou, Batchian); *A. frenatus*, Vollenh. (Salwatty); *A. geometricus*, Vollenh. (Tondano).

Arachnopus binotatus.

A. ovatus, niger; rostro basi confertim rude punctato; antennis nigris; funiculo articulis duobus basalibus breviter obconicis, cæteris rotundatis, ultimo clavam quasi incipiente; prothorace subtiliter crebre punctato; elytris in medio prothorace latioribus, seriatim punctatis, punctis sat magnis sed leviter impressis et paulo approximatis, interstitiis latis, in singulo elytro macula magna rotunda densissime flavescenti-squamosa decoratis; corpore infra nigro; femoribus tibiisque nigro fimbriatis. Long. 6 lin.

Hab. Aru.

*Arachnopus Wallacei**.

A. ovatus, ater; rostro basi confertim rude punctato et vage albosetoso; antennis nigris; funiculo articulis duobus basalibus longiusculis; prothorace sat crebre punctato, basi in medio paulo excavato, antice utrinque maculis duabus niveis, basi linea griseo-

* A figure of this species is given in Wallace's 'Malay Archipelago,' vol. ii. p. 154.

squamosa marginato; elytris in medio prothorace paulo latioribus, seriatim conferte et grosse punctatis, interstitiis indistinctis, in singulo elytro maculis quinque niveo-squamosis decoratis; corpore infra nigro, pectore ante coxas anticas linea curvata, metasterno antice, segmentis abdominis tertio quartoque utrinque et ultimo toto, niveis; pedibus parce niveo-setosis; femoribus tibiisque albo fimbriatis. Long. 6 lin.

Hab. Gilolo.

Arachnopus phaleratus. Pl. XVI. fig. 9

A. ovatus, niger; rostro (♂) basi tenui, modice punctato, (♀) basi tumidulo, magis rude punctato; oculis supra albo marginatis; prothorace lateribus antice fortiter rotundatis, deinde subparallelis, confertim granulato-punctato, punctis plerumque griseo-squamigeris, linea laterali ab apice ad basin decorato; elytris grosse sulcato-punctatis, punctis approximatis, interstitiis tuberculatis, vitta suturali fasciisque duabus angustis niveis, una basali, altera curvata mediana; corpore infra nigra, pectore segmentoque basali abdominis confertim punctatis; femoribus subtiliter granulatis, parce albo-setosis; tibiis albo-fimbriatis. Long. 4–6 lin.

Hab. Ceram.

Arachnopus simius.

A. ovatus, niger; rostro basi utrinque albo lineato, rude sulcato-punctato, apicem versus sensim subtiliter punctulato; prothorace utrinque rotundato, leviter confertim punctato, supra lineis tribus albidis ornato, una mediana longitudinali, una obliqua in utroque latere; elytris breviusculis, fortiter sulcato-punctatis, interstitiis asperatis, vel subtuberculatis, in singulo macula basali vittisque tribus abbreviatis albidis, duabus apicalibus, quarum una suturali, altera humerali, ornatis; corpore infra nigro; metasterno, etiam aliquando segmento primo abdominis, griseo-squamoso; femoribus tibiisque ut in *A. phalerato.* Long. $3\frac{1}{2}$–$4\frac{1}{2}$ lin.

Hab. Mysol, Ceram.

Allied to *A. persona*, Vollenh., but, *inter alia*, the prothorax of that species is longer, very remotely punctured, and the interstices of the elytra have closer-set, shining, and mostly transverse tubercles; the elytra also are spotted so as to suggest in a rough way eyes, nose, mouth, &c.: hence the name.

Arachnopus sannio.

A. ovatus, niger, indumento squamisque interruptis griseis indutus; rostro antennisque fusco-ferrugineis, illo basi subsulcato, reliquo fere obsolete punctato; prothorace utrinque rotundato, subvage punctato, lineis sex, quarum una transversa pone medium, punctisque squamigeris notato; elytris striato-punctatis, punctis remotis, plerumque squamis obtectis, interstitiis convexis, uniseriatim remote nigro tuberculatis, griseo-squamosis, singulo plagis duabus basalibus alterisque tribus posticis, duabus subsuturalibus, tertioque elongata marginali; corpore infra nigro, nitido, pectore abdomineque griseo marginatis, metasterno toto griseo; pedibus parce griseo-squamosis; tibiis griseo fimbriatis. Long. 3 lin.

Hab. Aru.

Thyestetha.

Pascoe, Journ. of Entom. ii. p. 426.

Char. emend.—*Rostrum* cylindricum, tenuatum, perparum arcuatum, pone coxas posticas protensum; *scrobes* antemedianæ, infra rostrum desinentes. *Oculi* subgrosse granulati, antice haud approximati. *Scapus* oculum haud attingens; *funiculus* 7-articulatus, articulis duobus basalibus longioribus, cæteris gradatim brevioribus; *clava* ovalis, distincta. *Prothorax* subconicus, apice supra paulo productus. *Elytra* cordiformia, basi prothorace haud latiora. *Pedes* elongati; *femora* sublinearia, infra canaliculata, et dente parvo instructa; *tibiæ* rectæ, sulcatæ; *tarsi* articulo penultimo late transverso. *Rima* pectoralis inter coxas posticas evanescens. *Coxæ* utrinque approximatæ. *Processus* intercoxalis latissimus. *Abdomen* segmento secundo vix ampliato.

In this genus and the next the pectoral canal gradually disappears behind, the apex of the rostrum in repose lying beyond it. The tibiæ in this and nearly all the following genera are longitudinally grooved, the intervals between the grooves consisting of narrow elevated lines generally studded with small scales. These are small, very glossy, glabrous insects, frequently with a snowy-white line along the upper margin of the femora. The only species (*T. nitida*) is figured on Pl. XVI. fig. 8, and is from Aru and Dorey.

Telaugia.

Rostrum haud elongatum, vix tenuatum, apice depressum parum arcuatum; *scrobes* præmedianæ, obliquæ, ad partem inferiorem oculorum currentes. *Funiculus* articulis duabus basalibus longiusculis, cæteris brevibus; *clava* ovata, distincta. *Oculi* laterales, tenue granulati. *Prothorax* subconicus, lobis ocularibus fere obsoletis. *Elytra* subcordiformia. *Femora* modice elongata, linearia, infra subcanaliculata, mutica; *tibiæ* rectæ, sulcatæ; *tarsi* normales. *Rima* pectoralis mesosterno evanescens. *Abdomen* normale.

As in *Thyestetha*, the pectoral canal is not limited behind, the mesosternum being hollowed out in the middle, allowing the rostrum to pass between its two projecting sides; the rostrum, however, does not extend beyond the intermediate coxæ. The canal beneath the femora is not so well marked as in *Thyestetha*.

Telaugia coccosa.

T. breviter obovata, atra, nitida; capite haud squamoso; rostro vage punctulato, sulco laterali squamis albis repleto; antennis testaceis; prothorace vage subtiliter punctulato; elytris rufo-brunneis, nitidissimis, remote subtiliter seriatim punctulatis; corpore infra rufo-brunneo, nitido; pedibus nigris, sparse albo-squamosis; femoribus supra linea niveo-squamosa ornatis. Long. 2 lin.

Hab. Batchian.

IDOTASIA.

Rostrum haud elongatum, validum, arcuatum; *scrobes* medianæ, ad partem inferiorem oculorum currentes. *Oculi* laterales, antice haud approximantes. *Scapus* brevis, oculum vix attingens; *funiculus* 7-articulatus, articulis 1°, 2° longiusculis, cæteris brevioribus; *clava* ovata, adnata. *Prothorax* subconicus, supra valde convexus, lobis ocularibus distinctis. *Scutellum* nullum. *Elytra* breviuscula, valde convexa, subcordiformes, prothorace paulo latiora. *Pedes* elongati; *femora* incrassata, compressa, infra canaliculata; *tibiæ* rectæ, sulcatæ; *tarsi* æquales, articulo basali modice elongato, secundo angustiore, tertio late bilobo, quarto breviusculo; *unguiculi* approximati, basi connati? *Rima* pectoralis mesosterno terminata, apice margine elevato. *Metasternum* normale. *Processus* intercoxalis latissimus. *Abdomen* segmentis tertio quartoque brevissimis.

There is a very marked resemblance between the species of this genus, which are, notwithstanding, distinguished by very distinctive characters. The genus is also found in Northern Australia.

Idotasia nasuta. Pl. XVI. fig. 2.

I. nigra, nitida; rostro dimidio basali arcuato-gibboso, et niveo-squamoso; antennis pallide ferrugineis; oculis tenue granulatis; prothorace ampliato, transverso, subvage subtilissime punctulato; elytris seriatim remote subtilissime punctulatis; corpore infra nigro-brunneo; femoribus lineatim albo-squamosis, supra squamis dense vestitis, anticis valde ampliatis, subtus dente minuto instructis, cæteris muticis; tibiis posticis basi paulo arcuatis. Long. $1\frac{2}{3}$ lin.

Hab. Dorey, Morty, Waigiou.

Idotasia ebriosa.

I. præcedenti simillima; rostro minus elongato, fere toto arcuato-gibboso, squamis niveis basi vestito; antennis pallide ferrugineis; oculis tenue granulatis; prothorace subconico, vage subfortiter punctato; elytris seriatim subtiliter, sat minus remote punctulatis; corpore infra pedibusque piceis, his sparse niveo-squamulosis; femoribus vix incrassatis, haud dentatis, nec lineatis. Long. $1\frac{1}{4}$ lin.

Hab. Salwatty.

Idotasia inclusa.

I. nigra, nitida; rostro fere toto arcuato, subgibboso, basi niveo-squamoso; oculis grosse granulatis; prothorace medio carinulato, lineis confertis abbreviatis sublongitudinalibus insculpto, singulis pilis perpaucis minutis transversim obsitis; elytris sat fortiter striato-punctatis, interstitiis latis, uniseriatim remote punctatis, sutura, præsertim basi, subacute elevatis; pedibus vage niveo-squamosis; femoribus nec dentatis nec lineatis; tarsis piceis. Long. 1 lin.

Hab. Mysol.

Idotasia scaphioides.

I. nigra, nitida; capite inter oculos rostroque confertim oblongo-punctatis, interstitiis carinulatis, hoc toto arcuato; antennis ferrugineis; oculis grosse granulatis; prothorace minus transverso quam in *I. nasuta*, sat fortiter subvage punctato, in medio linea glabrata impunctata; elytris subtiliter striato-punctatis, punctis majusculis; femoribus haud lineatis, subtus omnibus dente minuto instructis; tibiis posticis basi valde arcuato-productis. Long. $1\frac{2}{3}$ lin.

Hab. Batchian, Saylee (Gilolo, var.?).

Idotasia elliptica.

I. nigra, nitida; capite inter oculos rostroque antice tricarinulatis, inter carinulas basi transversim subquadrato-insculptis, hoc toto arcuato-gibboso; antennis ferrugineis; oculis tenue granulatis; prothorace oblongo, haud ampliato, utrinque perparum rotundato, sat fortiter subvage punctato; elytris pone medium paulo longioribus, punctis ut in *I. scaphioide* simillimis; femoribus haud lineatis, subtus omnibus dente minuto instructis; tibiis posticis basi arcuato-productis. Long. $1\frac{1}{2}$ lin.

Hab. Ceram, Batchian.

The differentiation of these species will be the more readily contrasted by the following table:—

Eyes coarsely facetted.
  Rostrum gibbous.
    Prothorax normally punctured .... *ebriosa.*
    Prothorax with short impressed lines .... *inclusa.*
  Rostrum not gibbous .... *scaphioides.*
Eyes finely facetted.
    Prothorax minutely punctured .... *nasuta.*
    Prothorax rather strongly punctured .... *elliptica.*

SEMIATHE.

Idotasiæ subsimilis, sed *rostro* tenuato; *scutello* distincto, et *femori-*

bus infra haud canaliculatis. *Oculi* magni, tenue granulati. *Corpus* modice convexum.

The femora in this genus are only grooved at the apex in the ordinary way; the tibiæ, therefore, do not admit of being lodged in them as in those genera in which they are canaliculate or grooved in their whole extent.

Semiathe rufipennis.

S. late elliptica, supra nitida, nigra, elytris rufo-luteis; capite antice vix convexo, crebre punctato; rostro prothorace breviore, subtilissime punctato, basi lato; antennis testaceis; oculis antice vix approximatis, squamis albis marginatis; prothorace basi longitudine paulo latiore, leviter subvage punctato; scutello punctiformi; elytris prothorace duplo longioribus, pone basin latioribus, seriatim leviter punctatis, interstitiis latis, impunctatis, apicem versus nigricantibus et vitta albo-squamosa decoratis; corpore infra subluteo; pedibus piceis, vage squamosis; femoribus anticis dente valido instructis. Long. 2 lin.

Hab. Dorey.

Semiathe ophthalmica.

S. subelliptica, oblonga, nigra, nitida; capite parvo; rostro prothorace breviore, basi vix latiore, subtilissime punctulato; antennis subtestaceis; oculis subapproximatis; prothorace basi latitudine parum longiore, leviter subvage punctulato; scutello suborbiculari; elytris prothorace plus duplo longioribus, pone basin latioribus, seriatim leviter punctulatis, interstitiis latis, apicem versus vitta abbreviata albo-squamosa decoratis; pedibus piceo-nigris, vage squamosis; femoribus basi infra dense albo-squamosis, totis dente valido instructis. Long. $2\frac{1}{2}$ lin.

Hab. Mysol.

XYCHUSA.

Rostrum subtenuatum, depressum. *Clava* ovata, distincta. *Oculi* tenue granulati, approximantes. *Prothorax* utrinque valde rotundatus, basi paulo constrictus, sulcato-marginatus. *Elytra* ovata, prothorace vix latiora. *Femora* infra haud canaliculata, dente parvo instructa; *tibiæ* haud sulcatæ; *coxæ* intermediæ et posticæ utrinque fere contiguæ. *Metasternum* brevissimum. Cæteris ut in *Idotasia*.

In the form of the prothorax, narrower at the base than in the middle, and in its grooved margin, this genus differs from all the preceding; like *Idotasia* and *Semiathe*, it has also the upper edge of the femora covered with white scales.

Xychusa larvata.

X. subanguste ovalis, nigra, nitida, elytris piceo-luteis; capite supra convexo, subtilissime crebre punctulato, inter oculos squamis niveis dense tecto; rostro castaneo, basi subfortiter punctato; antennis piceo-testaceis; prothorace longiore quam latiore, apice haud tubulato, sat fortiter vage punctato; scutello inconspicuo; elytris obovatis, convexis, seriatim punctatis, punctis oblongis, interstitiis latis planatis, piceo-luteis, apicem versus nigricantibus et vitta abbreviata niveo-squamosa notatis; corpore infra pedibusque piceis, femoribus crebre punctatis, supra linea niveo-squamosa ornatis. Long. 2 lin.

Hab. Aru.

ELICHORA.

Rostrum longiusculum, tenuatum. *Scapus* oculum haud attingens. *Oculi* grosse granulati. *Pedes* longiusculi; *femora* linearia, mutica; *coxæ* intermediæ et posticæ utrinque fere contiguæ. *Rima* pectoralis coxarum intermediarum marginem posteriorem attingens. Cæteris ut in *Idotasia*.

This genus approaches *Xychusa* in the extreme shortness of the metasternum and the consequent approximation of the intermediate and posterior coxæ, but differs in the greater length of the rostrum and the corresponding extension of the pectoral canal. In habit it resembles *Thyestetha*, but, with *Xychusa*, it is more nearly allied to *Idotasia*.

Elichora coruscans.

E. elliptica, nigra, nitida; rostro basi rude lineatim punctato, apicem versus punctis sensim minoribus; antennis testaceis; prothorace oblongo-conico, vage subtiliter punctulato; elytris pone basin latioribus, remote subtilissime seriatim punctulatis; corpore infra nudo, nitido; pedibus disperse albo-squamosis; tarsis ferrugineis. Long. $2\frac{1}{2}$ lin.

Hab. Batchian.

NYPHÆBA.

Rostrum breviusculum, validum, arcuatum, apice depressum. *Funiculus* 7-articulatus, articulis duobus basalibus longioribus, cæteris transversis, ultimo clava ovata quasi incipiente. *Oculi* magni, antice subapproximantes, grosse granulati. *Prothorax* transversus. *Scutellum* distinctum, punctiforme. *Elytra* oblonga, modice convexa, prothorace parum latiora. *Femora* subcrassa, infra canaliculata et dentata; *tibiæ* breviusculæ, subarcuatæ, sulcatæ; *tarsi* normales. *Rima* pectoralis ut in *Idotasia*. *Metasternum* modice elongatum. *Processus* intercoxalis angustatus. *Abdomen* normale.

The narrowness of the intercoxal process, as compared with *Idotasia* and allied genera, is a marked departure from their structure in that respect. The type of this genus is nearly glabrous, except that it is spotted here and there with a few white scales collected together principally on the elytra, and resembles a small *Monomma* or, still nearer perhaps, a *Chelonarium.*

Nyphæba monommoides. Pl. XVI. fig. 7.

N. ovalis, nitida, nigro-picea, elytris rufo-piceis; capite fronte opaco, impunctato, inter oculos foveato; rostro basi rugoso-punctato; antennis testaceo-piceis; prothorace basi fere duplo latiore quam longiore, antice tubulato, utrinque valde rotundato, sat fortiter subvage punctato, basi maculis duabis albis notato; elytris duplo longioribus quam latioribus, utrinque modice rotundatis, fortiter sulcato-punctatis, punctis magnis subquadratis, interstitiis sub certa luce planatis et, basin versus, corrugatis, maculis albis irroratis e squamis albis formatis; corpore infra pedibusque piceis. Long. $2\frac{1}{2}$ lin.

Hab. Ceram.

EXPLANATION OF THE PLATES.

Plate XV.

Fig. 1. *Dædania mesoleuca*: *a*, head and part of the prothorax; *b*, antenna; *c*, fore tarsus.
Fig. 2. *Pempheres trilineata* (the fore tibiæ are not sufficiently curved): *a*, head.
Fig. 3. *Mecopus pulvereus.*
Fig. 4. *Talanthia phalangium*: *a*, head.
Fig. 5. *Heurippa amœna* (the body is much too broad): *a*, head; *b*, antenna.
Fig. 6. *Phylaitis* V-*alba*: *a*, head; *b*, antenna.
Fig. 7. *Ganyopis leucura*: *a*, head.
Fig. 8. *Mecopus spinicollis.*
Fig. 9. *Chirozetes nervosus*: *a*, front view of the head.
Fig. 10. Antenna of *Agametis festiva.*
Fig. 11. Head and part of the prothorax of *Mecopus bispinosus*, Web.
Fig. 12. Head and part of the prothorax of *Mecopus serrirostris.*
Fig. 13 *a*, antenna; *b*, head, of *Brimoda pagana.*
Fig. 14. Front view of the head of *Phylaitis cyclops.*

Plate XVI.

Fig. 1. *Emexaure gallinula* (the penultimate tarsal joints are much too broad): *a*, head; *b*, fore leg.
Fig. 2. *Idotasia nasuta*: *a*, head.
Fig. 3. *Nauphæus miliaris*: *a*, head.
Fig. 4. *Metialma nævia*: *a*, head; *b*, fore leg.
Fig. 5. *Odoacis grallarius*: *a*, head.
Fig. 6. *Osphilia undata.*
Fig. 7. *Nyphæba monommoides.*
Fig. 8. *Thyestetha nitida*: *a*, head and part of the prothorax.
Fig. 9. *Arachnopus phaleratus.*
Fig. 10. Head of *Idotasia ebriosa.*
Fig. 11. Head of *Idotasia scaphioides.*

Fig. 12. Part of hind femur and tibia of *Idotasia scaphioides.*
Fig. 13. Head of *Osphilia apicalis.*
Fig. 14. Right fore leg of *Xychusa larvata.*
Fig. 15. Front view of the head of *Semiathe ophthalmica.* The eyes are scarcely large enough, and not sufficiently approximate.

XXXIV.—*Note on* Prof. Cope's *Interpretation of the Ichthyosaurian Head.* By Harry G. Seeley, F.G.S., Assistant to Prof. Sedgwick in the Woodwardian Museum, University of Cambridge.

Professor Cope, in the 'American Naturalist' for October 1870, published an illustrated abstract of his recent memoir on the crania of the lower Vertebrata. By the aid of these figures many readers will become conversant with the curious new interpretations which are among the results of Prof. Cope's labours; and this consideration leads me to offer the following remarks upon the abstract of the memoir. As a briefer notice has already been reprinted in the 'Annals' (1871, vii. p. 67), it may be enough to state that from study of the skull-bones which are immediately connected with the quadrate bone, Prof. Cope finds that previous writers have not accurately determined the cranial elements in Ichthyosauria, Dicynodontia, and others of the Monocondylia. And the questions raised are questions of fact, concerning one or two of which it is necessary to ask, Do the alleged facts exist? and if they exist, are they truly interpreted in the figures? On one point, that of the new interpretation of Ichthyosauria, we have good materials in England for forming a judgment; and having had occasion in the last few years to study these specimens in detail, I will endeavour to make Prof. Cope's positions intelligible.

First he finds at the back of the external nostril in *Ichthyosaurus* two small bones which are named the nasal bones. There is no antecedent improbability in this determination; the nasal bones commonly have such a position in all the Vertebrata, and any deviation from such a plan may be regarded as exceptional. A consequence, however, of such an identification is that a bone which Prof. Cope regards as the principal frontal bone (nasal of authors) enters into the nostril also; and against this there is a *prima-facie* probability, because the frontal bone has no such relation in vertebrates. But the improbability is lessened when the nostril of *Ichthyosaurus* is seen to occupy the position usually held by the middle hole of the skull (seen in Ornithosaurs, Dinosaurs, Teleosaurs, &c.); and with that anteorbital perforation it may be supposed to be confluent. But even with this view there remains an improbability against the nostrils being mesially divided by the principal frontal bones, inasmuch as it is only among mammals, from which the prefrontal and postfrontal bones have disappeared as separate elements, that the frontal bone ever enters into the anteorbital vacuity. Prof. Cope, by what is probably an oversight in lettering the figure, makes the lachrymal bone enter the alveolar border and carry teeth, by which it is excluded from entering into the orbit. These relations are so entirely unparalleled, that I can only account for the determination on the supposition that, in printing, the letters intended for the maxillary and lachrymal bones became interchanged. On this view, the anterior narine would be surrounded by the premaxillary, frontal, nasal, and lachrymal bones—though, according to the lettering, for lachrymal we should read maxillary.

Now, do the European Ichthyosaurs support the interpretation which Prof. Cope makes from a head from the Lias of Barrow-upon-Soar? I do not find such a bone in any of the materials (drawings, photographs, and specimens) to which I have access; and these include species from several formations, both English and French. I do not wish to urge this negative evidence as proof that the bone does not exist, but only to show that, if it does exist in Prof. Cope's specimen, he possesses an animal which differs in remarkable generic characters from *Ichthyosaurus*. And this view might be regarded as supported by the figure; for we miss from its place, posterior to the postorbital bone, an osseous supraquadrate element which has hitherto been found to mark every Ichthyosaurian cranium. And Prof. Cope's other modifications all point in the same direction, and make an animal which mimics *Ichthyosaurus*, but differs from that type in all its most essential characters. Thus, in the new Barrow specimen, the squamosal bone takes upon itself the ordinary functions of the parietal, whereas in *Ichthyosaurus* the squamosal is much such a bone as it is in the Teleosauria; and in no Ichthyosaur known to me do the squamosal bones extend up the side of the cranium and meet mesially, as they are shown to do in one of Prof. Cope's figures. In consequence of this identification, all the superior cranial bones are moved a place backward, what were regarded as parietals now being squamosals; the frontals are parietals, and the nasals frontals, while the nasals are replaced by the new bones already discussed.

In view of the supposition that we have here a new genus, it is difficult to believe that a naturalist so acute and accomplished as my friend should have overlooked such a possibility if it existed; but it would be much more easy, if the squamosal suture with the parietal bone had become obliterated, and the specimens studied were few, to suppose that the difficulty could be so explained. The existence of that suture, which is usually well seen, would restore to all the bones of the upper part of the head their usual names; and in view of the large serpent-like development of the parietals in *Ichthyosaurus*, it is not easy to bring one's self to call them squamosals if any other explanation can be given. There would then (excepting also the loss of the supraquadrate bone) be nothing to distinguish the *Ichthyosaurus* under discussion from other Ichthyosaurs but the anomalous little bones at the back of the nostril, which could neither be nasal nor any named element of the skull. Than that a new bone should appear in such a place it would seem less improbable that the obscure element should be an accidental dismemberment of an adjacent bone—probably a part of the lachrymal, which usually extends over the area which the supposed new bone occupies. The lachrymal is often fractured, even in crania which have preserved their natural form.

Prof. Cope's nomenclature of the bones of the lower jaw does not accord with the structures of any Ichthyosaur known to me. The articular bone is not a long external splint element, as shown in his figure, but is shaped more like the hoof of an odd-hoofed mammal, and is usually so enclosed in the jaw as only to display its articular surface, and is never seen in a view of the external part of the jaw.

There are many points in the Ichthyosauria worthy of attention; and on the relation of the immature to the adult animal I trust soon to be able to offer some new evidence.

XXXV.—*On two undescribed Sponges and two* Esperiadæ *from the West Indies; also on the Nomenclature of the Calcisponge* Clathrina, *Gray.* By H. J. Carter, F.R.S. &c.

[Plate XVII.]

In Dr. Bowerbank's 'Monograph of the British Sponges,' published by the Ray Society in 1864, there are two illustrations of foreign sponges without names (viz. figs. 289 & 292, vol. i.), the former of which is stated to be "West Indian," and the locality of the other is not mentioned.

For these two sponges Dr. Gray, in his "Notes on the Arrangement of Sponges" generally, has proposed the names of *Ectyon sparsus* and *Acarnus innominatus* respectively (Proc. Zool. Soc. 1867, pp. 515 & 544).

There is, of course, little or no description of them amongst the British Spongiadæ, because they do not belong to the British Isles; but what little is stated of them is so contradictory, that it had better have been omitted altogether.

Thus, at p. 25, vol. i., the spicules of *Ectyon sparsus* are said to be "entirely" spined; at p. 125, "entirely and verticillately," and at p. 275, in the index to the figures, "verticillately," while in the figure itself (289) they agree only with the latter. Now all these are distinct terms for Dr. Bowerbank's different kinds of spined spicules, as may be seen in his "Terminology;" and had *Ectyon sparsus* any more than one form of spicule, the contradictions might have been of little consequence; but as there is only one form, they are most confusing and unsatisfactory.

Again, in *Acarnus innominatus* (fig. 292), there is only one kind of spicule recognizably figured, viz. the "recurvo-quaternate" form, and, but for the separate figures of this spicule given in figs. 73–76 inclusively, we should not know exactly what it was like; while there are no less than four others unfigured (equally distinct and beautiful forms) in this sponge, rendering it, above all others, the most exquisite little spicule-combination of any sponges with which I am acquainted.

Lastly, Dr. Bowerbank states of this sponge (fig. 292), in his "Terminology," that it is "a portion of the reticulated surface of the sponge," having called the preceding figure (fig. 291) *Hymeniacidon Cliftoni*. Thus "the sponge" would appear to mean *Hymeniacidon Cliftoni*; yet at p. 33, vol. i. it is stated to belong to his "Halichondroid tribe," which is much more intelligible, if not much more correct.

But Dr. Gray, who had nothing but Dr. Bowerbank's text and illustration for his guidance, evidently did not know all this, or he would not have placed this sponge, viz. *Acarnus innominatus*, amongst his Tethyadæ.

Under such circumstances I do not hesitate to give full illustrations and descriptions of both these sponges with Dr. Gray's names.

The former, which is a very large specimen (being nearly a foot long), is in the British Museum; and the latter, of comparatively insignificant size, had grown upon the fragment of calcareous débris (consisting of the remains of corals and the like) at its base. Hence, knowing that the former came from the West Indies (St. Vincent is suggested by Dr. Gray, who requested me to describe the specimen), we have also the locality of the latter, which Dr. Bowerbank has omitted, although, curiously enough, *Ectyon sparsus* and *Acarnus innominatus* are figured by the latter close together, as if the author had obtained his knowledge of them from the same source as myself.

Beside *Acarnus innominatus*, there are the remains of two other sponges of the same family, which have grown together with it upon the fragment of débris mentioned, viz. two Esperiadæ, of which the spicular complements respectively (taken from minute portions) are also and only figured, but are sufficient to establish the species, although all other remains of the entire sponges have disappeared.

Then we do not expect to find these sponges in large masses, for it is not their habit, but rather with meagre development, although with exquisite combinations of spicules, to creep together over the small crevices of marine objects in the more shallow seas; and hence probably the term "*macilenta*" given by Dr. Bowerbank to one of them, which is also a British species.

Ectyon sparsus, Gray. Pl. XVII. figs. 1–3.

Kerataceous, massive, erect, compressed, sessile, tawny yellow or sponge-colour. Surface even, undulating; edges obtuse, round; free throughout, except at the point of attachment, which is contracted and sessile. Oscules of two kinds, viz. large and small, scattered generally all over the sponge (Pl. XVII. fig. 2); large oscules (*a a*) separate and single, small oscules (*b b*) frequently arranged in a petaloid manner. Pores situated in the minutely reticulated surface generally. Internally cavernous, canaliferous; canals tortuous, branched. Structure fibrous; fibre horny, round, reticulated and anastomosing, bearing spicules on its outer side only (fig. 1, *a a a*). Spicule of one form only, viz. acuate, slightly curved, verticillately spined at regular intervals throughout, except toward the point or free end, which is smooth (fig. 3, *a*, *b*); obtuse end a little smaller than the following portion of the shaft, covered with spines and sunk into the outer side of the fibre, which appears, under the microscope, to be hollow and rough or micropunctate (fig. 1). Spicule about 1-183rd of an inch long and 1-3000th of an inch in maximum width. Size of entire specimen 10 inches long, 5 inches high, and about 2 inches wide.

Hab. Marine.

Loc. West Indies.

Obs. This appears to be the specimen represented by Dr. Bowerbank in his fig. 289, which is stated to be a "West-Indian sponge." By Schmidt's mounted specimens at the British Museum, I see that it is his *Chalinopsis clathrodes*, which comes from the coast of Caracas (Grundz. Spong. Faun. Atlant. Geb. 1870, p. 60); but no figured illustration of this is given. It is marked by Schmidt "*nova species*," yet appears to have been figured by Dr. Bowerbank in the 'Philosophical Transactions' of 1862 (pl. 30. fig. 7), and called *Ectyon sparsus* by Dr. Gray in 1867; so Schmidt's name of 1870 for this sponge is not wanted.

In Dr. Bowerbank's 'Monograph' it is given as a type specimen of his genus *Ophlitaspongia* (ὁπλίτης, *armed?*), wherein the spicules are confined to the external surface of the kerataceous fibre, "exterspiculate" (externo-spiculate?), in contradistinction to the foregoing genus *Chalina*, where the spicules are *entirely* "interspiculate" (introspiculate?), illustrated in the type specimen *Chalina oculata*, fig. 262.

Nothing can be more natural or more distinct than these two characters for these two kinds of sponges respectively; yet, immediately after making the distinction, Dr. Bowerbank calls one of the commonest opalitous sponges on this coast (*Halichondria seriata*, Johnston) "*Chalina seriata*" (fig. 287), thus upsetting the ocular demonstration by untrustworthy mental reflection.

Schmidt, too, because the tricurvate or bow-like spicule is present in this sponge, would place it among his Desmacidinæ (Atlant. Spong. Faun. p. 76, note, & p. 77), when it would come, together with Dr. Gray's Esperiadæ, in his second subsection, viz. Spiculospongiæ, perhaps near *Dictyocylindrus* (p. 519, *l. c.*); but Dr. Gray has more properly put it with his Ophistospongiæ (Ophlitaspongia, Bk.), in his first subsection under the second order of Keratospongiæ, or horny sponges, with the name of *Seriatula seriata* (p. 515, *l. c.*). I say "more properly," because it is much more horny than spiculous or siliceous, which is the opposite to the Desmacidinæ.

Perhaps the most useful primary division of the Spongiadæ may be based on the rigidity or supporting-power of the skeleton-structure, *i. e.* in short, on the skeleton, thus:—

1. The rigidity of the skeleton dependent on a predominance of the sarcodal over the siliceous element. Commencing with *Verongia*, Bk., in which there is nothing but horny fibre.

2. The rigidity of the skeleton dependent on a predominance of the siliceous over the sarcodal element. *Ex. gr.* *Dactylocalyx pumiceus*, Stutchbury, in which the horny fibre is silicified.

3. The rigidity of the skeleton dependent on a predominance of the spiculous over the sarcodal element. *Ex. gr.* *Acarnus innominatus*, in which the sarcodal element is re-

duced to its minimum: *Hyalonema* &c.; also the Calcispongiæ.

Thus *Chalina seriata*, Bk., would come into the first division, viz. that in which there is more sarcodal or horny than siliceous development; and Schmidt's Desmacidinæ into the third division, the reverse, viz. that in which there is more spiculous than sarcodal or horny development.

Make, however, the presence of the tricurvate or bow-like spicule (for that is one of the spicules of *Chalina seriata*) supreme, and the division based on the rigidity of the skeleton breaks down altogether.

Schmidt, in his 'Note to the Synonymy of Dr. Bowerbank's Sponges' (*l. c.*), takes the presence of the tricurvate or bow-like spicule in *Hymeniacidon Bucklandi*, Bk., to be as accidental as it is peculiar to the Desmacidinæ; but I have shown that its existence in this sponge is normal—or at all events in *Dercitus niger*, which is but a variety of it (Annals, Jan. 1871), =*Pachastrella*, Sdt.; and Schmidt himself places the latter under his *Ancorinidæ*, that is, among the Pachytragian sponges (*op. cit.*).

So much for the value of a division based more on the presence of certain forms of spicule than on the rigidity of the skeleton, *i. e.*, in this instance, on the tricurvate or bow-like one.

Now *Chalina seriata* and the Desmacidine *Microciona atrosanguinea* are closely allied in form, habitat, and spicular composition, but in the way that *Ectyon sparsus* is allied to *Acarnus innominatus*, where, as may be seen by the illustrations, the rigidity of the skeleton in the former (Pl. XVII. fig. 1) depends as much on the keratified state of the sarcode as it does in the latter (fig. 4) on the number and arrangement of the large acuate spicules. Thus *Microciona atrosanguinea* bears to *Chalina seriata* (better *Seriatula*, Gray, for it is not a *Chalina*, if the latter be only *intro*-spicular) the same relation as *Acarnus innominatus* to *Ectyon sparsus*.

The specimen of *Ectyon sparsus* in the British Museum was evidently found on some strand, where it might have been washed about for years before it was picked up for further preservation—a way in which many foreign sponges are obtained, as there is not much time for deliberate dredging on the survey of a perhaps distant and perilous shore; and few beside naturalists care much for sponges beyond their intrinsic value.

Hence it is not surprising that the surface of this sponge, after having been exposed, perhaps, for months or years on a dry hot strand under a tropical sun, should present a greyish or weather-worn white colour, while its interior still retains the tawny-yellow one which, in the living condition or fresh state, most probably pervaded it throughout.

Acarnus innominatus, Gray. Pl. XVII. figs. 4–6.

Spiculous, flat, spreading, sessile, penetrating and incrusting the interstices of bodies over which it grows, but not boring into them. Colour when fresh unknown, now light grey. Structure delicate. Surface even, isodictyal, presenting an irregularly hexagonal arrangement of the spicules (Pl. XVII. fig. 4). Oscules and pores not seen. Internal structure or skeleton polyhedral, subdivided, consisting of straight lines of spicules supported by delicate sarcode rendered more dense at the angles of union by the addition of the bulbous ends of capitate spicules &c., which project into the interstices (fig. 5). Spicules of five kinds, viz.:—(1) the largest, acuate smooth, slightly curved, and fusiform (fig. 6, *a*); (2) large capitate, shaft smooth, straight, provided with a globular inflation at the fixed end, and an inflated head at the free one, armed with four or five large recurved spines (*b*); (3) small capitate, the same, but much less in size, and the shaft sparsely armed also with recurved spines (*c*); (4) tricurvate, bow-like, robust, much arched (*d*); (5) equianchorate, three-fluked, minute (*e*, *f*). These spicules are respectively about 25-, 18-, 7-, 6- and 1-1800th of an inch long. The largest forms the meshes or skeleton of the polyhedral structure (figs. 4 & 5, *aaa*); and the rest are aggregated at the angles of union, whereby these points are rendered more dense and present a knotted appearance (figs. 4, *c c*, & 5). Size of largest specimen about an inch square, with variable thickness below 1-12th of an inch.

Hab. Marine.

Loc. West Indies.

Obs. This little sponge, apparently of an incrusting habit, humbly creeping over the débris of corals and the like (which, cemented together by calcareous material, appear, from the fragment still attached to *Ectyon sparsus*, to have formed the kind of rock on which the latter grew), presents, under the microscope, one of the most beautiful sponge-structures that I have ever seen. Each spicule has a most attractive form; and the whole produce a combination and arrangement (fig. 5) which, for exquisite beauty, individually as well as collectively, is, so far as my experience goes, unsurpassed, if not unequalled, among the Spongiadæ.

The hexagonal and isodictyal structure of the surface (fig. 4), which closely resembles that of the Esperiadæ, together with the absence of horny fibre, a minimum of sarcode, and predominance of spicules, including tricurvate and anchorate ones, altogether claim for it a place in Dr. Gray's second subsection of Spicular Sponges, viz. his "Spiculospongiæ;" for here, contrary to the character of *Ectyon sparsus*, we have the spicular element developed at the expense of the sarcodal one, that is, an increase in the number of spicules and a reduction of the kerataceous fibre to a delicate sarcodal film.

The term "Halichondriæ" for this section of sponges is not near so expressive or intelligible, and therefore not near so well-chosen, as that of "Spiculospongiæ."

Thus *Acarnus innominatus* would come into Dr. Gray's second family, viz. "Esperiadæ;" and here I should be inclined to place it next to the genus *Microciona*, p. 535 (*l. c*), whereabouts it would probably have been placed by Dr. Gray himself, instead of among his Tethyadæ, had Dr. Bowerbank's figure been more detailed.

The anchorate spicule is precisely like that of *Microciona atrosanguinea*, Bk.; but the bow-like or tricurvate one is stouter and more arched. Again, the larger spicules of both are acuate; and although there is no isodictyal structure in *M. atrosanguinea*, from its peculiar mode of growth, the bulbous ends of many spicules of the latter, which are also globular, are sunk into the sarcode precisely in the same manner as the fixed ends of the capitate spicules in *Acarnus innominatus*. There are also in both species a few long spicules of hair-like fineness; but whether they are the earlier stages of the larger ones, or permanent forms, I have not been able to determine.

Microciona atrosanguinea, which is also one of the commonest sponges on this coast, is set down by Schmidt, in his 'Synonymy of Dr. Bowerbank's Sponges,' as a "Desmacidine," and hence would come under his family "Desmacidinæ," which, according to his "Sponge Pedigree" (Atlant. Spong. Faun. p. 83), are among the latest developments of his Protospongiæ, while the Ventriculitidæ are among the most ancient. Now the bihamate spicule is as characteristic of Schmidt's Desmacidinæ as the little siliceous ball is of his Geodinidæ; and both of these abound together fossilized in the "Upper Greensand" of Haldon Hill, in Devonshire (Annals, Feb. 1871, p. 112 &c.), while the Ventriculites as yet appear to have been found only in the Chalk, which is a subsequent formation. How this discrepancy, which makes the Ventriculitidæ the ancestors of the Desmacidinæ and Geodinidæ, is to be reconciled is left for the evolutionist to explain.

I have stated that the acuate spicules form the lines of the isodictyal or polyhedral meshes of *Acarnus innominatus* (fig. 4, *a a a*), where from two to six are placed side by side and end to end for this purpose; and where they join, their ends are imbedded in a mass of sarcode densely charged with the minute anchorate spicules, amidst which are a considerable number of tricurvate or bow-like ones, all of which, united together, afford support to the bulbous ends of sometimes as many as twenty-four large capitate spicules, together with a few of the smaller capitate ones, which are not more than half the size of the former, and very sparsely scattered (fig. 5).

The capitate spicules are termed by Dr. Bowerbank "defensive," the anchorate "retentive," and the tricurvate or bow-like "tension spicula."

Among other offices, the former are supposed to be for catching "intruding worms" (p. 23), the anchorates for retaining the sarcode, and the latter to aid in expanding it.

How far such offices are imposed upon these spicules respectively in the present species the reader may conceive, where the capitate spicules are situated in cavities to which only the minutest particles are admitted, and the other spicules confined to the knots of the skeleton, where at least no tension whatever seems to be required; or how these purposes are fulfilled in sponges where there are no such spicules present, as in the Chalineæ, in which the spicules are *entirely* within the fibre, or in *Verongia*, where there are *no* spicules at all, he may also conjecture.

In short, it is only when the sponge is in a passive state, or dead or dried, that the ends of the spicules are uncovered by the sarcode. In the active living state, the sarcode invariably creeps up to the tops of them gradually, until the whole are concealed or thus invested. Hence the necessity of studying sponges generally in their active, living state, before attempting to assign uses to their different spicules, which under any circumstances are so self-evident in themselves, or so hidden altogether, or so indefinite, that to enter upon the subject savours more of weak twaddle than of useful description, and so perplexes the student, *usque ad nauseam*, that every moment he is inclined to throw away the book, exclaiming with the lawyers in court, "Give us your facts; we don't want your reasons."

The capitate spicules are present in all stages of development in *Acarnus innominatus*, as Dr. Bowerbank has well illustrated in his figures 73–76 inclusively.

From exposure and other causes, the specimens of this sponge had become more or less incrusted with calcareous material, which required to be dissolved off by an acid before it could be well examined, when, from a white aspect, it assumed the grey colour above mentioned. In one part it had spread itself over the concavity of a small oyster-shell, but had in no part acted upon it after the manner of a *Cliona.*

Esperiadæ.

Beside *Acarnus innominatus*, two Esperiadæ had grown together with it, as above stated, one of which is *Hymeniacidon macilenta*, Bk. = *Carmia macilenta*, Gray (*l. c.* p. 537) = *Desmacidon*, Sdt. (*l. c.* p. 76), and the other apparently a new species, *Esperia socialis*, mihi.

They all belong to the same family, and present the same hexagonal or isodictyal aspect on the surface more strongly than any other sponge of this section,—growing for the most part, when in shallow water, with a creeping habit, insinuating themselves among the roots of *Laminaria digitata* and the like crevices in marine objects generally, but seldom spreading extensively unless in sheltered positions—or growing erect and branching, except in the shrubby *Esperia* of the deep sea.

The spicules of the West-Indian *Carmia macilenta* are much the same as those of the same species which grows on the south coast of Devon, viz. :—(1) acuate, fusiform, with oval defined head as wide as the thickest part of the shaft (Pl. XVII. fig. 8, *a*) ; (2) bihamate, large, robust, contort, elliptico-elongate (*c*) ; (3) inequianchorate, large, three-fluked (*a'*, *b*) ; (4) tricurvate, thin (*d*),—measuring respectively 22-, 6-, 3½-, and 2–3-1800ths of an inch long.

Beside these, there are a number of long, delicate, thin, acuate spicules, which, accompanied by small bihamates and anchorates, appear to be the early, if not aborted, stages in development of the larger spicules of the same kind and form respectively.

But if spicules are developed in this way, viz. from small to great, how is it that the central canal in some full-sized spicules is so large as to reduce their shafts almost to the thinness of mere shells or cases?

The only portion of this sponge found not being larger than a pin's head, there is not sufficient for a description of it generally. Its colour might have been "bright scarlet," as noticed by the Rev. A. M. Norman (*ap.* Bk.), or tawny yellow ; for it occurs of both colours here ; and this again presents another question, viz. in what states are sponges when they present these colours respectively, or does the scarlet colour indicate a reproductive one?

The spicular combination of *Esperia socialis*, mihi, which was taken from a specimen equally small with the foregoing, consists of:—(1) acuate fusiform, with head less wide than the thickest part of the shaft (fig. 7, *a*); (2) bihamate contort, thin, almost semicircular (*c*); (3) inequianchorate, large, three-fluked (*a'*, *b*); (4) minute acuate in bundles (*d*); measuring respectively 35–40-, 3-, 4-, and 5–6-1800ths of an inch long.

The bihamates and minute acuate spicules in bundles occur together in masses in *Esperia socialis*. The latter, too (viz. the "bundles," which do not appear to be initiatory stages of the large spicules, but distinct developments, as I have only found them in three sponges), are not less characteristic of *Stelletta lactea* (Annals, Jan. 1871, pl. 4. fig. 22). I saw them also in the mounted specimen of *Esperia diaphana*, Sdt., from the Gulf of Florida, in the British Museum. Schmidt (*op. cit.* t. iv. fig. 13) gives the anchorate only, which is decidedly the largest on record, and in which he has been able to illustrate the course of the central canal.

Beside the spicules above mentioned, each specimen was pregnant with the usual rosettes found in the Esperiadæ, which, as those who have seen Dr. Bowerbank's excellent figure 297 (*l. c.*) already know, consist individually of an assemblage of the full-grown anchorates placed foot to foot in a radiating globular form. Here certainly the anchorates cannot be regarded as "retentive spicules," unless they are for carrying out bits of sarcode for reproductive purposes in the form of gemmules. We have yet to learn the office of these beautiful and ornamental little bodies.

With reference to the anchorates in detail, it will be observed that they have respectively three flukes or arms (figs. 7 & 8), that the two lateral ones are winged on to the shaft (*e e*), and that the central one is expanded into a petaloid form (*f*), supported inferiorly by a falcate web-like septum which connects the median line of the middle fluke with this end of the shaft (*g*). A similar condition exists in the foot (*h*); but here the alæ are united to the sides of the middle fluke, by which the space between the falcate septum and the alæ, on either side, is converted into holes like nostrils.

I allude to this more particularly, because, in the lateral view, it often appears as if the anchorate had but two flukes, whereby it has as often, under misconception, been termed "bidentate" (Bk. figs. 136 & 137, *l. c.*); indeed in these two figures there are, to me, evidently three flukes; and, further, I much question, if every kind of anchorate were minutely examined on all sides or in all directions, whether any would be found to be only "bidentate"—that is, whether in all more or less of a central fluke might not be detected.

It is worthy of remark, when looking at the illustrations of *Ectyon sparsus* and *Acarnus innominatus* in the plate, that, although belonging to different orders, both are armed sponges—that is, characterized by the projection of spicules from the outside of the skeleton into the interstices; while the skeleton of *Ectyon sparsus* is formed of horny fibre, and that of *Acarnus innominatus* of large spicules almost alone respectively, showing the value of the latter distinctions over the former similarity, in the matter of classification.

On the Nomenclature of Clathrina, Gray.

As regards the multiplication of synonyms, which is the bane of natural history, Dr. Bowerbank has chosen new names for nearly all Dr. Johnston's sponges, Dr. O. Schmidt new ones for almost all Dr. Bowerbank's, and my friend Dr. Gray new ones for the species of both.

Much of this has arisen from the want of adequate illustrations of the entire sponges, in the first place, combined with microscopical details—an omission which characterizes in part Dr. Johnston's work of 1842, where the absence of the latter is more excusable, because the value of the microscope in such inquiries had hardly become known when his book was under preparation, but certainly not in Dr. Bowerbank's 'Monograph' of 1864–66, wherein both illustrations and details are wanting—a deficiency which Dr. Bowerbank informs me he is about to supply; but, unfortunately, the time is past, the names are multiplied, and Dr. O. Schmidt's works on the Sponges of the Adriatic Sea, the coast of Algiers, and the Atlantic Ocean have deservedly become the chief sources of reference for those engaged in the study of the Spongiadæ.

There is a calcisponge which grows in flat spreading patches over the lower surfaces of the rocks here as plentifully as, if not more so than, any other kind or species. At first it looks like a delicate piece of fine white lace; but on nearer inspection, especially with a lens, it may be observed to consist of a dense reticulation of anastomosing tubular thread, which finds its vents on the summits of small papillary eminences of the same structure, from which the tubulation, a little increased in size at these points, branches off to the divisions of the sponge which the vents or oscules respectively drain.

For this sponge Montagu, in 1818 (Mem. Werner. Soc. vol. ii. p. 116), proposed the name of *Spongia coriacea*, with the following description:—"The fibres that constitute this sponge are composed of very fine spicula, and are intersected with numerous large pores and cavities, giving the appearance of singed leather or a piece of dark-coloured worm-eaten wood in a very decayed state. One side is rather smooth, with circular depressions or cavities. The only specimen that has occurred is depressed, four inches in length and above two in breadth." These are his words (*ap.* Johnston). "Depressed" cannot apply to Dr. Bowerbank's *Raphyrus Griffithsii*, as suggested by this author (p. 36, *l. c.*); for the latter, from its structure and mode of growth, must, when of the dimensions mentioned, be more or less thick or elevated; while the calcisponge must, from *its* structure and mode of growth, be equally more or less thin or depressed. Besides, we have only to turn to Johnston (p. 124) to see that *Raphyrus Griffithsii* is no new genus at all, but a free form of *Cliona* (*Halichondria*, Johnst.) *celata*, which Montagu seems to have had in view "when he drew up the description of his *Spongia fava*." Both the calcisponge and the *Cliona* (*Raphyrus Griffithsii*) occur here in great abundance, the former, as above stated, on the rocks, and the latter in masses larger than the fist, which, drifting about in the sea (perhaps after having destroyed the oyster-shells in which they commenced their existence), are cast ashore in great quantity during heavy gales of wind from the south. I am therefore able to state, from personal observation, that Montagu's *Spongia coriacea* was intended for the calcisponge, and not for the *Cliona*.

In 1842, Johnston gave a figure and description of this calcisponge under the name of *Grantia coriacea* (*op. cit.* p. 183); in 1864 it appears in Dr. Bowerbank's 'Monograph' (vol. ii. p. 34) with the name of *Leucosolenia coriacea*; in 1864 it is also figured and described by Schmidt (Supp. Adriat. Spong. p. 24, t. iii. fig. 3) under the name of *Grantia clathrus*; and, lastly, in 1867, Dr. Gray (Proc. Zool. Soc. p. 557) has called it *Clathrina sulphurea*, which, wisely and fortunately, has been adopted by Häckel in his "Prodromus" (Annals, March 1870, vol. v. p. 183). Dr. Gray very properly made it the type of a distinct genus, which Häckel has accepted.

A few specimens of this sponge were dredged up from about 20 fathoms by Schmidt, in the Adriatic Sea; but they were not good ones, as his figure and description testify. "Oscula in summitate ramusculorum brevium" does not exactly apply to this sponge as I have above described it; nor does the meagreness of Schmidt's figure of a dredged specimen, as might be expected, accord with the more or less expanded, circular, and circumscribed patches of continuous dense network in which this sponge presents itself in full and robust development on the under surfaces of rocks here which are left uncovered by the tide for several hours daily.

The central and oldest portion, too, very frequently becomes elongated, from its pendent position, into a mammiform process as large as the top of a man's thumb, which appears to be more or less effete (exhausted in the middle, like some spreading fungi), while the circumferential parts are the best developed for description, and are most likely to die with their vents or oscules open—a contingency which has led previous describers occasionally to pass them over unobserved.

From the papillary eminences where the oscules are situated the tubulation branches off in all directions, anastomosing with that which belongs to the neighbouring divisions, and thus forming a continuous network drained by the several oscules, just as the canal-system in the solid sponges.

Here, then, the only difference between the network of *Clathrina* and that of the solid sponges appears to be the absence of the interstitial matter which, uniting the branches of the canal-system together in the latter, gives them their solidity. Thus it would appear that the canal-system in both does not end in open mouths anywhere except at the oscules, and that whatever gets into it must naturally pass through the pores and be very minute, as their capillary extremities only end in anastomoses. In this way probably we may picture to ourselves the excretory canal-system of *all* sponges.

Of the colour, too, of this sponge there would appear to be a difference of opinion: thus Schmidt's specimens were sulphur-yellow, Lieberkühn's (*ap.* Sdt.) colourless, Mrs. Buckland's (*ap.* Bk.) crimson, Johnston's bluish grey or white changing to yellowish brown when dried or immersed in fresh water—which latter is a very good test for the species, as will presently be shown.

The specimens here are whitish or bluish grey, with occasionally sulphur-yellow, but with no structural difference that I can detect; so I conclude that both colours belong to the same species. I have never seen it of a crimson colour; but, as I have before stated respecting the bright scarlet colour of *Esperia macilenta*, it would be worth inquiring whether these bright colours occasionally assumed by sponges have not something to do with the reproductive process.

We must not forget, however, that in some instances the colour may be owing to the presence of a foreign organism or parasite.

Thus I have just observed, in a portion of *Halichondria incrustans* found here last September, growing on the rocks, that, although generally of its natural or yellowish sponge-colour, the tips of the surface are deep carmine-red; and this is owing to the presence of a parasitic cell, of a beautiful carmine colour, which, bound together in great numbers by a transparent envelope, pervades the whole of the sponge in little prothalloid masses, appearing here and there on the surface in minute botryoidal tubercles of a dark black-brown colour, formed of a congeries of radiating columns of brown cells placed one above the other in their tubular envelopes respectively, the carmine ones on one side in the sponge giving rise to the brown ones in the columns of the botryoidal tubercle on the other.

This looks very much like a *Hildenbrandtia* of the freshwater kind, which I described and figured in 1864 (Journal of Botany, No. xx. p. 225), and which, indeed, is no *Hildenbrandtia* at all, but the type of a new genus, if Kützing's diagnosis of the fructification of the latter is to be the criterion (Sp. Alg. p. 694); for the conceptacle contains neither tetraspores nor paraphyses.

But, without knowing the import of the botryoidal masses, or whether there is any further development of this organism, I am unable at present to do more than state what I have seen of it, for the guidance of others.

The cell, while in its prothalloid investments in the body of the sponge, is about 1-4000th of an inch in diameter, subcircular, capsular, filled with homogeneous plasma of a beautiful pink or carmine colour by transmitted light, growing granular toward the surface, where, from a total absence of definite arrangement in the prothalloid carmine mass, it developes a defined column of cells filled with plasma of a yellowish-brown colour by transmitted light, which, placed together collectively in a radiating form, produces the dark botryoidal tubercles on the surface, varying in diameter below the 1-48th of an inch.

Undoubtedly this is a true Algal (?) parasite of *Halichondria incrustans*, which, perhaps, may account for the colour of the specimen sent to Dr. Bowerbank by Mrs. Griffith, and marked as having been "scarlet, but not fœtid" (Brit. Spong. vol. ii. p. 251). Be this as it may, it seems to be the first instance on record, and as yet only seen in *Halichondria incrustans*.

There is one phenomenon about *Clathrina* which is very characteristic of the species, and has been alluded to by Dr. Johnston, as just quoted, in such a way that it shows that he must have studied the sponge in its living state, unless informed of the fact by others,—viz. that when it dies or is put into fresh water, the white colour immediately changes (that is, *here*) to ferruginous or brick-red, which, when the specimen is dried, turns again to yellowish brown. And this is the more striking when it has grown together with *Grantia nivea*, which retains its white colour throughout.

So much for the nomenclature and history of this beautiful calcisponge, finally, I hope, and most appropriately, called "*Clathrina*." May its synonyms rest here; for so evidently self-strangling must this course, if continued, be in the end to natural history, that, on naming an object, one may be pardoned for recalling to mind the following lines in Shakspeare's epitaph:—

> "Blest be the man that spares these stones,
> And cursed be he that moves my bones."

Then, again, we are not all Shakspeares.

EXPLANATION OF PLATE XVII.

Fig. 1. *Ectyon sparsus*, Gray: fragment much magnified, to show:—*a a a a*, horny fibre; *a′ a′ a′*, portion of the same, deeper; *b*, spicules situated on the outside of the fibre; *c*, fixed ends of the spicules from which the rest of the shaft has been broken off. Scale 1-12th to 1-1800th of an inch.

Fig. 2. The same, portion of surface, to show the two kinds of oscules, viz. large and small: *a*, large oscules; *b*, smaller oscules arranged more or less in a petaloid manner. Natural size.

Fig. 3. The same: *a*, spicule much magnified; *b*, section of the same, near its base. Scale 1-12th to 1-6000th of an inch.

Fig. 4. *Acarnus innominatus*, Gray; diagram of fragment of surface, to show its irregular hexagonal structure: *a a a*, straight lines indicating the bundles of acuate spicules which form the polyhedral structure of the skeleton; *a′*, central heptagon, from actual measurement; *b b b*, capitate spicules projecting into the interstices; *c c*, knots or angles of union of the acuate spicules thickened by the presence of sarcode densely charged with the anchorate and other spicules figured hereafter. Scale 1-48th to 1-1800th of an inch.

Fig. 5. The same, knot or angle of union of the acuate spicules, more magnified: *a a a a*, acuate or skeleton-spicules forming the heptahedral structure; *b b b b*, large capitate spicules projecting into the interstices; *c c c*, small spined ones, also projecting into the interstices; *d d d*, tricurvate or bow-like spicules confined to the sarcode of the knots; *e e e*, equianchorate spicules, with which the sarcode of the knots is densely charged. Scale 1-12th to 1-1800th of an inch.

Fig. 6. The same, specimen of each of the spicules, still more magnified: *a*, acuate or skeleton-spicule, smooth, slightly curved; *b*, large capitate spicule, smooth, straight shaft, with head 4-spined, recurved, sometimes 5-spined (see fig. 5, *f f*); *c*, small capitate spicule, shaft straight, sparsely spined, spines recurved; *d*, tricurvate or bow-like spicule; *e*, equianchorate spicule, anterior view; *f*, lateral view. Scale 1-12th to 1-6000th of an inch.

Fig. 7. *Esperia socialis*, mihi: *a*, inflated end of acuate or large skeleton-spicule; *a′*, front view of anchorate spicule; *b*, lateral view of the same; *c*, bihamate spicule; *d*, bundle of minute acuate spicules (the two latter occurring in masses together); *e e*, lateral flukes; *f*, middle fluke; *g*, falcate septum; *h*, foot. Scale 1-12th to 1-6000th of an inch.

Fig. 8. *Carmia macilenta*, Gray: *a*, inflated end of acuate or large skeleton-spicule; *b*, front view of anchorate spicule; *a′*, lateral view of the same; *c*, bihamate spicule; *d*, tricurvate spicule; *e e*, lateral flukes; *f*, middle fluke; *g*, falcate septum; *h*, foot. Scale 1-12th to 1-6000th of an inch.

XXXVI.—*On the Claspers of Male Lizards* (Sauri). By Dr. J. E. Gray, F.R.S. &c.

My attention has been drawn to this subject by the following circumstance:—

Mr. F. Moore, of the India Museum, has sent me a specimen to ask me if I can give him a clue to what it really is; it was sent, with some *botanical* products, from Bombay, where he believes it is used as an article of food; and "it has hitherto been supposed to be the root of a plant (*Cyclamen*), which of course it is not." Others have determined it to be a *Holothuria* or something of the kind, or a particular form of barnacle.

When it was soaked in hot water, so as to expand it, there was no doubt about its being part of an animal; and I was inclined to regard it as the penis of a lizard, from what I recollected of the form of that organ; and I was sure that it was part of a reptile, on account of the group of scales with which the base was covered.

But when I cut it open, I found that it was quite solid, and without any opening in any part of its surface for the emission of any secretion, and consisted of a pair of parallel cartilages covered with a skinny sheath, covered externally with horny plates, and having at the end a pair of exposed horny processes, which are divided at the end into several acute prominences, very unlike the structure of a penis.

On my showing the specimen to Dr. Günther and Mr. Edward Gerrard, they both determined that it was the penis of a lizard; and, at my request, Dr. Günther confirmed this determination by showing me the retracted penis of a Monitor preserved in spirits; and Mr. Gerrard showed me a stuffed specimen of *Varanus heraldicus* in the Museum, in which the penes were exserted; and there could be no doubt that we had rightly determined the true nature of the bodies which Mr. Moore had submitted to my inspection.

At the same time it was clear, from the structure that I had observed in examining the specimen, that the organs which have usually been regarded as the penes of lizards were not so in reality, and were merely claspers, by which the male kept the parts in position during coitus.

Cuvier, for example, in the 'Règne Animal,' in the character of lizards (*Sauri*), says the males "ont une double verge" (edition 2, vol. ii. p. 26). M. de Blainville, in his 'Tableaux du Règne Animal,' published in the Bulletin of the Philomathic Society, 1816, p. 119, and in his 'Organization of Animals,' makes a group for the lizards and snakes, which he calls "*Reptiles bipéniens.*" And I find even in Prof. Rolleston's 'Forms of Animal Life,' just published, that he says the copulative organs of the Squamata "consist of two protrusible or hollow conical bodies, which open into that cavity from behind" (p. lxi); and when describing a female snake, he says "it has two conic-shaped sacs, which correspond with the two intromittent organs of the male" (p. 82).

The claspers of the lizards, unlike those of the cartilaginous fishes, which are always external and exposed, are in the male retractile into a special cavity for their protection, in the sides of the under part of the tail of the animal, and are received into a couple of proper receptacles in the body of the female when the animals are *in coitu*. These organs appear to have been very little studied; for when I sent one of the specimens I received from Bombay to the College of Surgeons, Mr. Flower said that he was glad to retain it, as there was no preparation of the kind in their museum. Perhaps this explains why I could not find any figure or description of the penis of these lizards in Prof. Owen's work on the 'Anatomy of Vertebrates.'

M. Martin St. Ange, in his 'Études de l'Appareil reproducteur,' 1854, figures the organs of the green lizard and collared snake (t. 9 & 10); but he represents the "double penes" in their contracted, retracted state, giving no idea of the claspers when in use.

From the corrugated horny plates on the surface, they must offer considerable resistance against being withdrawn from the cavity in which they are enclosed when in copulation; but the lower end being first withdrawn after the connexion, the outer skin is reversed, and the horny part placed on the inner side, so that the drawing out of the claspers is performed without any inconvenience to the female.

The form of the claspers evidently differs in the species of the same natural family. In both the specimen received from Bombay and the specimen of *Varanus heraldicus* from

India in the British Museum, they are formed of two similar parts placed side by side, and united into one body, and provided with two terminal horny processes, which are of different shape in the two species. In both species they are large, subcylindrical, truncated at the end, and the flat termination is divided into several acute conical lobes. In the one from Bombay they are bent down on the body of the clasper, and in *V. heraldicus* they are much shorter and erect.

In a specimen in the Museum, also called *Varanus heraldicus*, which Dr. Günther showed to me, the clasper is subcylindrical, and terminates in only a single horny process divided and lobed at the end. I am not certain whether this is an individual malformation or a peculiarity of a distinct species; but I leave this for future research.

I have thought it well to figure (after they have been soaked in warm water to recover their natural appearance and size)

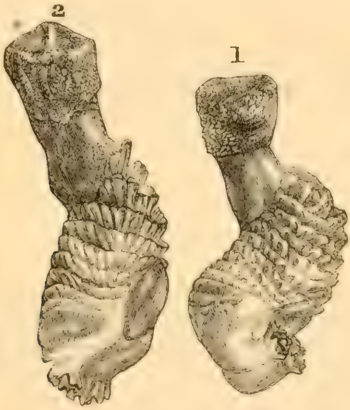


Fig. 1. Clasper from Bombay, nat. size.
Fig. 2. Clasper of *Varanus heraldicus*, nat. size.

the clasper of *Varanus heraldicus* and also that of the animal sold in the bazars of Bombay, I suspect as an aphrodisiac, of which the orientals are so fond.

Mr. Ford also informed me that he was once making a drawing of a chameleon at the Cape, for Sir Andrew Smith, when another specimen, which happened to be a female, was brought into the room; and the one that was sitting for his portrait, from being quite placid and slow, as is the manner of chameleons, suddenly (before he could have seen the female, but must have discovered her by scent) became excited, exceedingly rapid in his motions, rushing in search of the female, and they were soon connected, and the claspers were inserted to the base.

The claspers of the snakes are covered with a number of slender spines on all sides, and they may often be seen protruding at the sides of the vents in specimens in spirits; and specimens with them so protruding are figured by Seba and other iconographers. Mr. Ford informed me that in the puff-adder the claspers are dark brilliant reddish purple, covered with abundant white recurved spines.

XXXVII.—*Sketch of a Natural Arrangement of the Order* Docoglossa. By W. H. Dall*.

The following is a preliminary sketch of a more natural arrangement of the Mollusca contained in the orders Cervicobranchiata and Cyclobranchiata of Gray, taken from the results of investigations now in preparation for publication in a more extended form. These investigations having shown that no line can be drawn between the two orders of Gray above mentioned, it follows that they must be consolidated; and for the group in question the order Docoglossa, Troschel (minus the *Polyplacophora* and *Solenoconchæ*), has been restricted and adopted. As the denominations previously applied all imply an erroneous idea of the structure of the animals, this course has been determined upon in preference to using prior, but incorrect, ordinal names.

The order, as here restricted, was first recognized by me in "A Revision of the Mollusca of Massachusetts" (Proc. Boston Soc. Nat. Hist. xiii. p. 245, March 1870), at which time only the characters of the suborder *Abranchiata* had been fully worked out. Since that time I have investigated the characters of the suborder *Proteobranchiata*, as here restricted; and in a paper read before the American Association for the Advancement of Science, at Troy, September 1870, of which a synopsis was published in the 'American Naturalist' (November 1870, p. 561), I restricted the order Docoglossa within its present limits, from the researches above mentioned. Among the fruits of these investigations was the definite exclusion of the *Gadiniidæ* from the order (see Am. Journ. Conch. 1870, vi. p. 8). It is proper to state that Prof. Theodore Gill had, upon general considerations, adopted the same limits for the order in his unpublished manuscript, although the conclusions to which I have been led were the result of independent ana-

* From the 'Proceedings of the Boston Society of Natural History,' Feb. 7, 1871. Communicated in advance by the Author.

tomical investigations upon my part, which, so far as I am aware, are the only ones, including the whole order, which have been made. I am indebted to Prof. Gill for suggesting the very appropriate names by which I have designated the suborders as restricted.

Class *GASTEROPODA.*

Order DOCOGLOSSA, Dall ex Trosch. 1870.

Suborder **ABRANCHIATA** (Gill), Dall, 1870.

Radula furnished with a rhachidian tooth and two uncini. Animal destitute of eyes, branchiæ, and lateral teeth on the area.

Family **Lepetidæ** (Gray), Dall, 1869.

Shell patelliform; apex erect or anteriorly directed. Muzzle of the animal with an entire edge; furnished with a tentacular appendage below on each side.

Formula of the radula, $\frac{1}{2\,(0\,.\,0)\,2}$.

Genus Lepeta, Dall ex Gray, 1869.

A. *Lepeta*, Dall.

Rhachidian tooth tricuspid, concave in front; central cusp simple, much the largest; lateral cusps small, emarginate, base very broad; uncini with simple cusps.

Type *Lepeta cæca* (Gray), Dall, Am. Journ. Conch. 1869, v. p. 141.

B. *Cryptobranchia*, Dall ex Midd. 1869.

Rhachidian tooth with three short cusps, equal and parallel before and behind, not pointed; base moderately broad, more or less ornate behind; uncini with simple cusps.

Type *Cryptobranchia concentrica* (Midd.), Dall, Am. Journ. Conch. 1869, v. p. 143.

C. *Pilidium*, Dall ex Forbes, 1869.

Rhachidian tooth tricuspid, central cusp much the largest, convex in front; lateral cusps simply pointed; base narrow; uncini with cusps obliquely twisted.

Type *Pilidium fulvum* (Forbes), Dall, Am. Journ. Conch. 1869, v. p. 146.

Suborder **PROTEOBRANCHIATA**, Dall, 1870.

Animal provided with three lateral teeth, with eyes, and with external branchiæ. Rhachidian tooth usually wanting. Uncini present or absent.

Family **Acmæidæ**, Carpenter.

Shell patelliform. Animal provided with a free cervical branchia issuing from the left side of the body, above the head; muzzle surrounded with a frill of integument. Radula without a rhachidian tooth, and with three lateral teeth on each side; with or without accessory uncini.

A. Destitute of a branchial cordon. *Acmæa.*

1. *Acmæa*, Eschscholtz, 1828. (Syn. *Tecture*, Cuvier, 1830; *Tectura*, Gray, 1847.)

Teeth subequal, parallel in both axes; uncini absent; muzzle-frill produced into two lappets.

Formula, $\frac{0}{0\,(1-1-1\,.\,1-1-1)\,0}$.

Type *A. mitra*, Esch. Zool. Atlas, 1833, v. p. 18. no. 1; Philippi, Zeit. f. Mal. 1846, p. 106.

2. *Collisella*, Dall, n. subgen.

a. Third lateral smaller than, and opposed to, the second; first laterals anterior; muzzle-frill without lappets; a single minute uncinus on the pleura.

Formula, $\frac{0}{1\,(2-1\,.\,1-2)\,1}$.

Type *Acmæa pelta*, Esch. *l. c.* 1833, no. 5.

b. Provided with two minute uncini on the pleura. (? *Collisellina*).

Formula, $\frac{0}{2\,(2-1\,.\,1-2)\,2}$.

Type *Patella saccharina*, Linn., Gmel. S. N. 1792, p. 3695. no. 19.

B. Cordon present, interrupted in front. *Lottia.*

1. *Lottia* (Gray), Cpr. 1863. Without muzzle-lappets; teeth as in *Collisella* (*a*).

Formula, $\frac{0}{1\,(2-1\,.\,1-2)\,1}$.

Type *L. gigantea* (Gray), Cpr. Am. Journ. Conch. 1866, ii. p. 342.

C. Cordon present, complete, uninterrupted. *Scurria.*

1. *Scurria*, Gray, 1847. No muzzle-lappets; teet has in the last.

Formula, $\frac{0}{1\,(2-1\,.\,1-2)\,1}$.

Types: *S. scurra* (Lesson), Gray, P. Z. S. 1847, p. 158; *S. mesoleuca* (Mke.), Cpr. Maz. Cat. 1857, p. 208. no. 263 (as *Acmæa*).

Family **Patellidæ**, H. & A. Adams.

Animal without a cervical gill or muzzle-frill. Rhachidian tooth rarely present; uncini three in number. A more or less complete cordon of branchiæ between the mantle-edge and foot.

A. Branchial cordon complete.

a. Provided with a rhachidian tooth. *Ancistromesus.*

1. *Ancistromesus*, Dall, n. g. Two inner laterals on each side, anterior to the third, which is larger and denticulate; branchial lamellæ produced, arborescent; sides of foot smooth.

Formula, $\frac{1}{3\,(1-2\,.\,2-1)\,3}$.

Type *Ancistromesus mexicanus*, Dall ex Brod. & Sby. (as *Patella*) Zool. Journ. iv. p. 369; Rve. Conch. Icon. 1855, *Patella*, pl. 1. no. 1.

b. Without a rhachidian tooth. *Patella.*

1. *Patella*, Linn. 1757. Lateral teeth and foot essentially as in the last; branchial lamellæ linguiform, short, subequal all around.

Formula, $\frac{0}{3\,(1-2\,.\,2-1)\,3}$.

Type *Patella vulgata*, Linn. Syst. Nat. ed. 12. 1767, p. 1258. no. 758.

2. *Patinella*, Dall, n. subg. First inner lateral on each side anterior to the other two; second laterals largest, denticulate; foot with a scalloped frill, interrupted only in front; branchiæ as in *Patella*.

Formula, $\frac{0}{3\,(2-1\,.\,1-2)\,3}$.

Type *Patinella magellanica*, Gmel. (as *Patella*) Syst. Nat. 1792, i. p. 3703. no. 52.

3. *Nacella*, Schum. 1817. Shell thin, pellucid, apex anterior; foot frilled, as in *Patinella*; teeth bidentate, arranged as in the last; branchial lamellæ very small in front, but not interrupted.

Formula, $\frac{0}{3\,(\frac{2}{2}-\frac{1}{2}\,.\,\frac{1}{2}-\frac{2}{2})\,3}$.

Type *Nacella mytilina*, Gmel. Syst. Nat. 1792, vol. i. p. 3698. no. 28 (as *Patella*) = *Nacella mytiloides*, Schum. 1817, and *Patella cymbularia*, Lam. 1819.

B. Branchial cordon interrupted in front. *Helcion.*

1. *Helcion*, Montf. 1810. Shell solid, capuloid, with pectinated ribs; teeth?

Type *Helcion pectinatus* (as *Patella pectinata*), Linn., Gmel. Syst. Nat. 1792, p. 3710. no. 93.

2. *Helcioniscus*, Dall, n. subg. prov. Shell depressed, solid, with a subcentral apex; teeth arranged as in *Patinella*; sides of foot smooth.

Formula, $\frac{0}{3\,(2-1\,.\,1-2)\,3}$.

Type *Helcioniscus rota* (Chemn.), Rve. (as *Patella*) Conch. Icon. pl. 17. fig. 39, *a*, *b*, *c*.

3. *Patina* (Leach), Gray, 1840. Shell very thin, pellucid; sides of foot smooth; third pair of laterals posterior, largest, denticulated.

Formula, $\frac{0}{3\,(1-2\,.\,2-1)\,3}$.

Type *Patina pellucida*, Linn. Syst. Nat. ed. 12, 1767, p. 1260. no. 770 (as *Patella*).

* * * * * *

Soft parts?

1. *Metoptoma*, Phillips, 1836. Shell ovate, triangular, apex subcentral, posterior end truncated, or deeply, broadly emarginated.

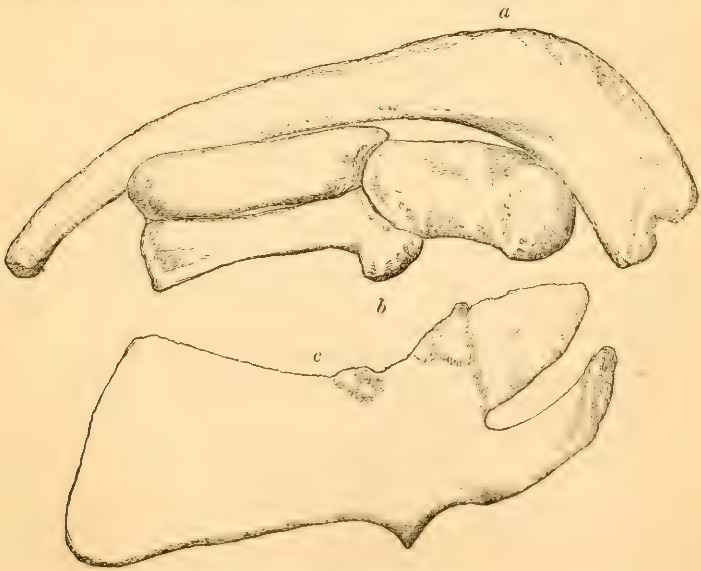
Type *Metoptoma pileus*, Phil. Geol. Yorkshire, vol. ii. p. 223 (1836). Fossil in the Carboniferous formation of Great Britain. Many of the species referred to this genus by Billings and other palæontologists clearly do not belong to it.

The above sections, with the exception of *Helcion*, are well-defined, and will probably include the greater portion of the known species, though some may prove distinct from any yet examined. Extensive study of the soft parts has shown, beyond dispute, that generic distinctions founded on the shells alone are wholly valueless, as the latter cannot be depended upon for diagnostic characters; and many so-called genera and subgenera founded upon the shells will fall as synonyms, or retain their places solely as the result of accident. *Scutellina*, as far as known, is equivalent to *Acmæa*. *Olana*, *Scutellastra*, *Cellana*, &c. are founded upon characters of hardly specific value. The results of extended researches on this order are now in the press, which will include a thorough revision of the synonymy in full, with a definite reference of many species to their proper position, as determined by the sum of all their characters.

XXXVIII.—*Additional Notes on the Skeleton of* Dioplodon sechellensis. By Dr. J. E. Gray, F.R.S. &c.

Mr. Krefft has kindly sent me additional photographs of the skeleton of this animal in the Australian Museum, the skeleton of the body of which was figured in the 'Annals and Magazine of Natural History,' 1870, vol. vi. p. 343. It was obtained from near Lord Howe's Island.

Mr. Krefft complains that the figure taken from his photograph does not quite correctly represent the form of the tooth. The fact is, he fears that what is intended for shadow may be taken for the form, so that the tooth may be believed to be not so much exserted as it is in nature, and impressed with a longitudinal groove, as if it had two fangs. This is certainly not the case; and I do not think that any one would be deceived; and the photograph, representing the tooth of a larger size, gives the same shadows; and you cannot represent in woodcuts all the details of the photograph. Mr. Krefft has sent me photographs of some of the dorsal vertebræ, of a caudal vertebra with the chevron bone attached, and the second rib, which is broad at the upper end and gradually narrowed towards the thoracic end; he observes that the first rib is very small. The imperfect scapula, which has lost its upper front edge, is very



a. The second rib. *b*. The upper and forearm bones.
c. The scapula (imperfect).

peculiar for having very large coracoid and acromion processes, the latter being broad, compressed, and lanceolate; and the body of the scapula is small in comparison with these processes.

The upper arm-bone is subcylindrical and slightly curved, nearly as long as the ulna and radius, which are compressed and parallel, having only a linear suture between them.

He says the carpal bones were nearly all lost, and only one or two of the digital bones were obtained; but, in a letter written three or four days afterwards, he states that he is going to send me a photograph of the scapula and paddle restored as well as the materials will allow.

BIBLIOGRAPHICAL NOTICES.

Recherches anatomiques et physiologiques sur les Champignons. Par J. B. Carnoy. (Bulletin de la Société Royale de Botanique de Belgique, tome ix. p. 157.)

It would seem, from some remarks at the close of the paper of which the title is given above, that it is intended to form one of a series. Although nominally embracing Fungi in general, it relates only to the *Mucorineæ*, and for the most part to a single species, supposed to be new, and which is called *Mucor romanus**. The author's remarks upon the polymorphism of this *Mucor* (that is, the number of phases which it assumes at different periods) are curious, and, if confirmed, will be of considerable importance. The paper is of great length; and in what follows an attempt has been made to give a concise summary of the author's views of the polymorphism of the species, without entering into the minutiæ of its anatomical and physiological details.

It would, M. Carnoy says, be a great mistake to suppose that the life of the *Mucorineæ* is confined within the narrow circle of a mycelium and a mucorinean fructification. Under certain conditions the *Mucorineæ* assume all the characters of the *Mucedineæ*; or, in other words, they have two lives or phases, a *mucorinean* and a *mucedinous.* The *mucorinean* phase has also its primary and secondary forms, of which the primary one is the normal well-known form of *Mucor.* The secondary forms are very numerous, but may be divided into two great groups:—1, sporangial forms, in which the sporangia are abnormal but the spores of which reproduce the normal form of *Mucor*; 2, acrogenous forms, or those in which, instead of sporangia, macroconidia are produced.

These macroconidia are of rare occurrence, and often will not germinate; but in experiments made with the spores of *Mucor romanus* it was found that when sown upon the heads of fish which

* The plant was discovered in a dark cave at Rome.

had been cooked, they produced a delicate and weakly mycelium, the vitality of which not being sufficient to reproduce the primary form, the preservation of the species was provided for by the condensation of its protoplasm into a secondary formation; that is, the mycelium became covered with terminal and interstitial macroconidia. These macroconidia produced a mycelium identical with that from a spore; in short, they reproduced directly the fundamental form of the species, from which M. Carnoy concludes that spores and macroconidia are physiologically identical.

In its mucedinous phase (*vie mucedinéenne*) *Mucor romanus* becomes under many circumstances completely metamorphosed. It assumes an appearance altogether new, and so different from the first that it would be impossible to recognize it without following out its change of form. This species (*M. romanus*) is far from being as polymorphic as many others of the same genus; but nevertheless it presents five sorts of fructification, corresponding to as many different forms:—1, the ferment-form (*forme levure*); 2, the *Penicillium*-form (*forme penicillienne*); 3, the *Botrytis*-form; 4, the *Torula*-form; 5, the Ascomycetous (?) form.

I. *The Ferment-form.*—The spores of *Mucor romanus* and of the Mucors in general, when cultivated on dry or unsuitable soil, develope solid internal nodules. If placed upon the pulp of an orange, the nodules disappear and the spores germinate normally. When the spores do not germinate normally, the nodules become granular at the centre, and the spore usually bursts and discharges the nodules, which become enlarged, exhibit a central cavity, and begin to bud. The same phenomenon may be seen in *Mucor vulgaris*, *M. caninus*, and in *Rhizopus*; and the several products (*levures*) are not distinguishable; they are of the nature of the organisms called by Hallier *Cryptococcus*. Other forms, such as *Protococcus* and *Arthrococcus*, would certainly be obtained by cultivating the spores in different media. The nodules are morbid growths arising from the spore not being able, from want of nourishment, to develope itself normally; it therefore organizes its protoplasm in a manner appropriate to the medium in which it finds itself, and extracts from the protoplasm germs destined to produce an inferior form which requires less sustenance to develope itself.

The *Ferment-form* of *Mucor romanus* developes rapidly, and forms a thick crust of a rosy-grey colour. If the *Ferment* be sown on dry orange-peel, it produces *Penicillium glaucum*; and the author has observed the same result to arise from the cultivation of ferments derived from different Fungi. He alleges that he has sufficient data to state positively that all Fungi cultivated under certain conditions are transformed into *Penicillium glaucum*, and that this is the reason why the latter fungus is so universally present. The *Ferment* always produces the mycelium of a *Penicilhium*, never of a *Mucor*; and the spores of *Penicillium* again produce *Ferment*. Thus there is a passage from *Mucor* to *Ferment*, from *Ferment* to *Penicillium*, and from *Penicillium* there is a return to *Ferment*; but there is no direct return from *Ferment* to *Mucor*.

II. *Penicillium-form.*—Under defective nourishment, the spores of *Mucor*, instead of producing the mycelium of *Mucor*, produce that of *Penicillium.* The author has observed this fact five times in *Rhizopus* and several times in *M. vulgaris.* The same result follows if the spores are too old, as was observed in *M. caninus*, *M. romanus*, and *M. vulgaris.* Moreover a normal mucorean mycelium may be transformed into a mucedinous mycelium, in which case the septa (which are few in *Mucor*) multiply until the filaments are quite septate, as in true mucedinous filaments; at the same time the protoplasm becomes oily, and exhibits very regular and numerous cavities. The formation of septa and the change in the protoplasm are the certain signs of the change of a mucorean into a mucedinous filament, whatever may be the nature of the mucedinous fructification which it may ultimately bear. In a species of *Mucor* the author has observed the fructification of *Penicillium* proceeding from the base of the cell which supports the sporangium; but the *Mucor*-mycelium may become metamorphosed in the same way before normal fructification, and yield only mucedinous fruit. When *Mucor*-spores are sown on the pulp of an orange, the mycelium sometimes penetrates the pulp and appears on the sides transformed into *Penicillium.* It is not an exception or an anomaly, but a general rule, that the *Mucorineæ* can pass into the form of *Penicillium.* The cause of this transformation is defect of nourishment. The Mucors require considerable quantities of nitrogenous matters, whilst certain *Mucedineæ*, especially *Penicillium*, can live on an exhausted soil. It is doubtful whether *Penicillium* can reproduce *Mucor* directly, although perhaps such reproduction may take place through the macroconidia.

III. *Botrytis-form.*—If *Mucor romanus* is cultivated on cats' dung, it forms a strong mycelium; but after the second day the mycelium becomes septate, and on the third day it becomes altogether mucedinous. The transformed filaments grow and form a dense fleshy mass, which may be cut with a knife like the flesh of the large fungi. The mass is ultimately of a deep golden-yellow colour. Under the microscope, it is seen to consist of interlaced filaments crowned with a bunch of spores. This new mucedinous fungus is like one found by the author in Belgium and at Rome upon excrement, especially of cats. Without regard to physiology, the two forms might be united. The yellow colour of the mass is attributable to the spores, which, although evidently mucedinous, have entirely the nature of the spores or macroconidia of *Mucor romanus.* These spores, if sown on an orange, germinate immediately and produce a vigorous *Mucor*-mycelium. The mycelium at the end of the second day produced the sporangiferous cells of *Mucor romanus.* The allied form above alluded to behaves in the same way, but does not produce *Mucor romanus*; it gives rise to quite a different *Mucor*, very near *Mucor romanus.* The author knows two other analogous forms of *Mucedineæ* which produce in germination a mucorean mycelium without any intermediate mucedinous form.

From the above data two important laws may be deduced:—1, there are mucedinous spores which have the nature of primary mucorinean spores; 2, some mucedinous spores and forms which are identical anatomically and morphologically, have an entirely different physiological nature, since they produce primary mucorinean forms which are quite distinct. If the white tufts of mycelium which grow upon excrement, and which, if left alone, would form the yellow masses of *Botrytis*, are transferred into hollows scooped out of an orange, such tufts become transformed into a *Penicillium*-mycelium, upon which the fruit of *P. glaucum* may be observed. The *Penicillium*-spores from the transplanted tufts, or from the transformed mucorinean mycelium, produce the yellow masses of *Botrytis* when sown on cats' dung. They produce a *Penicillium*-mycelium, but the ramifications of the latter enlarge, and assume the form of white tufts identical with those which proceed from a sporangial spore or a *Botrytis*-spore. They become covered with *Botrytis*, the spores of which, sown on fruit, reproduce immediately the primary mucorean form. It is clear, therefore, that the appearance of the different mucedinous forms of *Mucor romanus* is caused by soil. The *Botrytis* is a rich form, requiring more nitrogenized matter than *Penicillium*, which is a lower form, growing in any place where life can be maintained.

IV. *Torula-form.*—Many of the filaments of the septate mycelium of *Mucor romanus*, when growing on animal dejections, break into cylindrical cellules of various sizes, rounded at each end. These are sometimes the cellules of the mycelium; but more commonly they are little spore-cellules growing at the summit of the filaments, seven or eight in a row. The filaments usually run horizontally, and the formation of them resembles that of the mycelial macroconidia of the Mucors or of the spores of a *Torula*. These cellules in germination reproduce a *Penicillium*-mycelium, which either reproduces the same cellules, or which grows normally and yields the fruit of *P. glaucum*. This *Torula*-form never appears on a true mucorinean mycelium; it must be transformed into a mucedinous mycelium. This is so in many other Mucors, especially *M. vulgaris* and *caninus* and in *Rhizopus*. This *Torula*-form is probably caused by vibrionic fermentation; at least vibrios seem always present with this form.

V. *Ascomycetous form.*—Multicellular, spherical, or slightly elongated yellow bodies appear on the mucedinous mycelium of *Mucor romanus*. They are large enough to be seen with the naked eye. They are always found upon that part of the large mycelium of the primary or *Botrytis*-spores which radiates from the white tufts and extends horizontally over the soil. They are only found on very nitrogenized matter or on dejections. The author has not been able to make them germinate. They certainly belong to *Mucor romanus*, because macroconidia occur on the same filaments, and these macroconidia reproduce the primary mucorean form. The author thinks these bodies may be the rudiments of some Ascomycetous or Hymenomycetous fungus. In upwards of fifty *Ascomycetes* which the author has examined, all develope in their early stage multicellular masses like those of *Mucor romanus*.

The *Botrytis*-form of *Mucor romanus*, and two analogous forms which the author has succeeded in producing from two other Mucors, also have similar bodies or their equivalents. One of these produces a quantity of black sclerotium almost as big as ergot. Many other Mucedines are states of thecasporous fungi. May not the *Botrytis*-Mucors be in the same case?

Perhaps the yellow bodies may produce an Hymenomycete. Two sorts of *Coprinus* have been seen by the author to commence by enrolment and segmentation of a mycelium-thread.

M. Carnoy concludes that possibly these facts may lead to the uniting in one group of the *Mucedines*, the *Mucorineæ*, the *Ascomycetes*, and the *Hymenomycetes*. These four general forms, of which as many classes have been made, are, in the author's opinion, only phases of existence destined to be passed through by one and the same mycological species, in order to complete and bring to a close the entire cycle of its development.

General Outline of the Organization of the Animal Kingdom, and Manual of Comparative Anatomy. By THOMAS RYMER JONES, F.R.S. &c. 4th edition. 8vo. London: Van Voorst, 1871.

The short time that has elapsed between the publication of the third and fourth editions of Professor Rymer Jones's 'Animal Kingdom' shows that its reputation is so well established and its usefulness so generally recognized that for us to express any opinion upon its merits would be almost a work of supererogation. With all its defects (and we must confess that the author's intense conservatism makes these more numerous than they would otherwise be), Professor Jones's volume is actually the only work in our language to which we can refer the student as to a storehouse of sound zoological and anatomical details systematically arranged; and if the author would only add to his other qualifications a rather clearer idea of morphological matters, it would really leave little to be desired.

In the present publication Professor Jones has carried a step further the reform in his classification which was inaugurated in his third edition, and has accepted the group *Cœlenterata* as a zoological subkingdom. Nevertheless, by some strange confusion, he has failed to get the benefit from this step which he might have done; indeed it is questionable whether, as regards the value of his teaching, he would not have done better to leave matters as they were. From his expressions at page 4, and from the general arrangement of his chapters, he appears to consider that the Cuvierian Radiata have been divided into the two groups of Protozoa and Cœlenterata, than which nothing can be more erroneous; and this error is carried out by the arrangement of the Helminthozoa (including Turbellaria) and Echinodermata under the subkingdom Cœlenterata! Such a mistake is incomprehensible, and certainly much to be regretted.

The Cirripedia, which were regarded by Professor Jones as Mollusca long after every body else had recognized their Annulose nature, are now placed by him in the Articulate series; but he still retains such statements as that "the Cirripedia present a strange combination of articulated limbs with many of the external characters of a mollusk," which would seem to intimate that he feels by no means sure of their true position. And yet one would think that the mode of development of these creatures could leave no doubt as to their being not only Articulata, but Crustacea. But Professor Jones gives but a scanty notice of the interesting metamorphoses of the Cirripeds, and does not seem at all to appreciate their importance. From a similar unappreciation, his classification of the Crustacea is in a very backward state.

But we will carry no further the ungrateful task of fault-finding. The defects that we have indicated, and especially that relating to the Cœlenterata, are, however, of a nature to prevent any thing like a high or philosophical view being taken of the lower divisions of the animal kingdom; and we can only hope that a fifth edition of the work may speedily be called for, and that its author will not allow his conservative feelings again to lead him astray.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

January 19, 1871.—General Sir Edward Sabine, K.C.B., President, in the Chair.

"On the Structure and Development of the Skull of the Common Frog (*Rana temporaria*)." By W. Kitchen Parker, F.R.S.

At the close of my last paper "On the Skull of the Common Fowl," I spoke of bringing before the Royal Society another, treating of that of the osseous fish I was working at the early conditions of the salmon's skull at the time.

I was, however, led to devote my attention to another and more instructive type early in the following year; for it was then (January 1869) that Professor Huxley was engaged in preparing his very important paper "On the Representation of the Malleus and the Incus of the Mammalia in the other Vertebrata" (see Zool. Proc. May 27, 1869).

In repeating some of his observations for my own instruction, it occurred to me to renew some researches I had been making from time to time on the frog and toad. The results were so interesting to us both, that it was agreed for me to work exhaustively at the development of the frog's skull before finishing the paper on that of the salmon. On this account Professor Huxley mentions in his paper (*op. cit.* p. 406) that he leaves the Amphibia out of his demonstration, and that they are to be worked out by me. The amount of metamorphosis demonstrable in the chick whilst enclosed in the egg suggested a much more definite series of changes in a low, slow-growing Amphibian type. I think that this has been fully borne out by what is shown in the present paper.

The first of the ten stages into which I have artificially divided my subject is the unhatched embryo, whilst its head and tail project only moderately beyond the yelk-mass. Another stage is obtained by taking young tadpoles on about the third day after they have escaped from their glairy envelope; a few days elapse between the second and third stages, but a much longer time between the third and fourth; for the fourth stage is the perfect tadpole, before the limbs appear and whilst it is essentially a fish with mixed *Chimæroid* and *Myxinoid* characters. Then the metamorphosing tadpole is followed until it is a complete and nimble frog, two stages of which are examined; and then old individuals are worked out, which give the culminating characters of the highest type of Amphibian.

The early stages were worked out principally from specimens hardened in a solution of chromic acid; and the rich umber-brown colour of these preparations made them especially fit for examination by reflected light.

Without going further into detail as to the mode of working my subject out, and without any lengthened account of the results obtained, I may state that the following conclusions have been arrived at—namely, that the skull of the adult is highly compound, being composed of:—

1st. Its own proper membranous sac;

2nd. Of a posterior part which is a continuation, in an unsegmented form, of the vertebral column;

3rd. Of laminæ which grow upwards from the first pair of facial arches, and which enclose the fore part of the membranous sac, just as the "investing mass" of the cranial part of the notochord invests the hinder part.

4th. The ear-sacs and the olfactory labyrinth become inextricably combined with the outer case of the brain. And

5th. The subcutaneous tissue of the scalp becomes ossified in certain definite patches; these are the cranial roof-bones. Around the mouth there are cartilages like those of the Lamprey and the *Chimæra*; but these yield in interest to the proper facial bars, which are as follows, namely:—

First pair, the "trabeculæ."

Second pair, the mandibular arch.

Third pair, the hyoid arch.

And fourth to seventh pairs: these are the branchials.

These are all originally separate pairs of cartilaginous rods; and from these are developed all the complex structures of the mouth, palate, face, and throat. The pterygo-palatine arcade is merely a secondary connecting bar developed, after some time, between the first and second arches.

Meckel's cartilage arises as a segmentary bud from the lower part of the second, and the "stylo-cerato-hyal" as a similar secondary segment from the third arch.

By far the greater part of the cranium (its anterior two-thirds) is developed by out-growing laminæ from the trabeculæ, which after a time become fused with the posterior or vertebral part of the skull.

When the tadpole is becoming a frog, the hyoid arch undergoes a truly wonderful amount of metamorphosis.

The upper part, answering to the hyomandibular of the fish (not to the whole of it, but to its upper half), becomes the "incus;" and a detached segment becomes the "orbiculare," which wedges itself between the incus and the "stapes." The stapes is a "bung" cut out of the "ear-sac." The stylo-cerato-hyal is set free, rises higher and higher, and then articulates with the "opisthotic" region of the ear-sac; in the toad it coalesces therewith, as in the mammal. The lower part of the hyomandibular coalesces with the back of the pair of the mandibular arch; and the "symplectic" of the osseous fish appears whilst the tadpole is acquiring its limbs and its lungs, and then melts back again into the arch in front; it is represented, however, in the bull-frog, but not in the common species, by a distinct bone.

This very rough and imperfect abstract must serve at present to indicate what has been seen and worked out in this most instructive vertebrate.

January 26, 1871.—General Sir Edward Sabine, K.C.B., President, in the Chair.

"On the Organization of the *Calamites* of the Coal-measures." By W. C. Williamson, F.R.S., Professor of Natural History in Owens College, Manchester.

Ever since M. Brongniart established his genus *Calamodendron*, there has prevailed widely a belief that two classes of objects had previously been included under the name of *Calamites*—the one a thin-walled Equisetaceous plant, the *Calamites* proper, and the other a hard-wooded Gymnospermous Exogen, known as *Calamodendron*. This distinction the author rejects as having no existence, the thick- and thin-walled examples having precisely the same typical structure. This consists of a central pith, surrounded by a woody zone, containing a circle of woody wedges, and enclosed within a bark of cellular parenchyma.

The Pith has been solid in the first instance, but very soon became fistular, except at the nodes, at each one of which a thin diaphragm of parenchyma extended right across the medullary cavity. Eventually the pith underwent a complete absorption, thus enlarging the fistular interior until it became coextensive with the inner surface of the ligneous zone.

The Woody Zone.—This commenced in very young states by the formation of a circle of canals stretching longitudinally from one node to the adjoining one. Externally to, but in contact with, these canals a few barred or reticulated vessels were found; successive additions to these were made in lines radiating from within outwards; hence each wedge consisted of a series of radiating laminæ, separated by medullary rays, having a peculiar mural structure. At their commencement these wedges were separated by wide cellular areas, running continuously from node to node; as the woody tissues increased exogenously, these cellular tracts also extended outwards. Radial longitudinal sections exhibited in these the same mural tissue that occurs in the woody wedges. Hence the author gives to the former the name of primary medullary rays, and to the latter that of secondary ones. The structure of the medullary and ligneous zones is compared with that of the stem of a true Exogen of the first year, of which transitional form *Calamites* may be regarded as a permanent representative. Tangential sections of this woody zone exhibit parallel bands of alternating vascular and cellular tissue, running from node to node. At the latter points each vascular band dichotomizes, its divergent halves meeting corresponding ones from contiguous wedges, and each two unite to form one of the corresponding bands or wedges of the next adjoining internode.

The Bark, hitherto undescribed, consists of a thick layer of cellular parenchyma, undivided into separate laminæ, and not exhibiting any special differentiation of parts. This structure exhibits no signs of external ridges or furrows, being apparently smooth. The stem was enlarged at each node, but the swelling was less due to any increased thickness of the bark at these points, than to an expansion of the woody layer at these points, both externally and internally. This was the result of the intercalation of numerous short vessels, which arched across each node, their concavities being directed inwards, and which constituted the portion of the woody zone that encroached upon the constricted pith at these nodes. Several modifications of the above type have been met with, most of which may have had a specific value. In one form no canals exist at the inner angles of the woody wedges; in another, laminæ, like those of the woody wedges, are developed in the more external portions of the primary medullary rays, those occupying the centre of each ray being the most external and latest formed. The primary ray is thus transformed into a series of secondary ones.

In another type the vascular laminæ of each woody wedge are few in number, and the component vessels are the same; but the latter are remarkable for their large size. In a fourth variety, the exterior of the woody zone has been almost smooth, instead of exhibiting the usual ridges and furrows: this variety is also remarkable for the large size of its medullary cells, compared with that of the cells and vessels of the woody zone.

But the most curious modification is seen in a plant previously described by the author under the name of *Calamopitus*, in which round or oblong canals are given off from the medullary cavity, and pass horizontally through each primary medullary ray of the woody zone to the bark. These, being arranged in regular verticils below each node, are designated the infranodal canals. The verticils of small round or oblong scars, seen at one extremity of the internodes of some *Calamites*, are the results of this peculiar organization. In one species of this *Calamopitus*, instead of the longitudinal canals of the woody wedges terminating at the nodes, they bifurcate, like the wedges with which they are associated, and are continuously prolonged from internode to internode.

The ordinary structureless fossils found in shales and sandstones receive a definite interpretation from the specimens described. The fistular medullary cavities, due in the first instance, *not* to decay of the tissues, but to the rapid growth of the stem, became further enlarged by the entire absorption of the true pith, which commenced after the latter had fulfilled its purpose in the origination of the woody wedges. This process terminated at an undulating line of arrested absorption, the convexities of which projected outwards, opposite the primary medullary rays, and inwards, opposite the woody wedges; and the inorganic cast of the cavity thus formed by a physiological action constitutes the *Calamites* commonly seen in collections. Hence they are not, like the Sternbergiæ, casts of a cavity within a true pith, but their form represents that of the exterior of the medullary tissue. The ridges and furrows of these *internal* casts are not identical in position with the similar undulations of the *exterior* of the woody zone, but alternate with them; so that the ligneous cylinder projects both externally and internally where the woody wedges are located, and contracts, in like manner, at the intermediate points opposite to the primary medullary rays. The thin carbonaceous film which frequently invests these casts is the residue of the altered elements of the woody zone, and possibly also of the bark, which latter has been very liable to become detached from the former. The surface-markings of this carbonaceous film have usually no structural significance, being merely occasioned by the impression of the hardened casts which they invest.

Two kinds of branches are given off by *Calamites*—the one subterranean, springing from peculiarly formed rhizomes, and the other aërial, attached to the upright unbranched stems. The former of these are of comparatively large size, the nodes from which they have been detached being marked by large concave lenticular scars as phragmata. These branches appear to have been given off from central rhizomes in accordance with a regular phyllotaxis, but which varied in different species. The aërial branches, on the other hand, were merely slender appendages to a virtually unbranched stem; they were arranged in verticils round the nodes, in variable numbers. Each branch sprang from the interior of one of the woody wedges, the two halves of which were forced asunder to admit the base of the appendage, and from which its constituent vessels were derived. The branch, deprived of its bark, never appears to have had a diameter equal that of two of the woody wedges; and the rarity of their occurrence attached to the stem seems to indicate that they were deciduous. The bark investing them is not yet known, and the exact nature of the foliage which they bore is also uncertain, owing to discordant testimony respecting it; but there appears no reason for doubting that some of the verticillate Asterophyllites or Annulariæ represent it, though there is uncertainty respecting the actual forms to be identified with *Calamites*. The roots were given off from the lower part of each internode, but above the node, and were apparently epidermal.

There is also considerable doubt respecting the fructification of *Calamites*. Some of the Volkmanniæ have evidently belonged to this group; but only one example retaining its minute organization has yet been found in which the structure of the central axes corresponded with that of the *Calamites*. The relationship to *Calamites* of the fruits figured by Binney under the name of *Calamodendron commune*, which are identical wth the *Volkmannia Binneyi* of Carruthers, is more than doubtful, because of the anomalous structure of their central axes.

After a careful comparison of the organization of *Calamites* with that of the recent Equisetaceæ, the author prefers constituting the former an independent order, distinct from, though allied to, the Equisetums, under the name of *Calamitaceæ*, and characterized by cryptogamic fructification and verticillate foliage, associated with an exogenous axis. The latter feature probably involved the existence of something resembling a cambium layer, furnishing the material for the new tissues.

It is further proposed to divide these plants into two generic groups, viz. *Calamites* and *Calamopitus*—the former to comprehend those unprovided with infranodal canals, and the latter those which possess them. The existing specific distinctions appear to have little or no scientific value.

MISCELLANEOUS.

On a new Species of Three-toed Sloth from Costa Rica. By Dr. J. E. Gray, F.R.S. &c.

Arctopithecus griseus.

Fur very long, greyish white; under-fur very abundant, brown; forehead and cheeks white; crown and temples black; chin and throat brown. *Male* with a yellow patch of soft hair between the shoulders, with a central black streak. *Female* with a puff of very soft white hair on each side of the back.

Hab. Costa Rica (Salvin). Brit. Mus.

On a new Form of Sponge. By Prof. Ehlers.

Aulorhipis elegans, n. g. et sp.

The stratified tissue of this sponge, which encloses many foreign bodies, lines the inner surface of a worm-tube, from the superior opening of which it projects in the form of a little stalk, which forks into two branches bending downwards in the same plane, and gives off from each branch several (eight to ten) twigs directed upwards, standing at regular distances apart, one or two of which give off lateral branchlets, springing at an acute angle in the same plane, also directed upwards and terminating in a capillary form. Pores and oscula and the internal canal-system are deficient. Length of a lined worm-tube 78 millims.; breadth of the freely projecting portion of the sponge 11 millims.; height of the longest upright branch 15 millims.

Locality. Viti Islands (Dr. Gräffe), Narcon Island (Capt. Ross).

Of this peculiar sponge, five specimens from the Godeffroy Museum in Hamburg, sent by Dr. Gräffe from the Viti Islands, were investigated. In external habit the regular fan-like ramification of the free part is remarkable, whilst the basal part lines the inner surface of the tube of a Chætophorous Annelide. It is not improbable that the form of the sponge may vary with a change in its point of attachment; as a settler in the worm-tube or as the commensal of a worm, however, the form may probably be constant.

In all parts of the fan-like portion the sponge-tissue encloses very numerous foreign bodies, but only a few in the portion lining the tube. Beside very numerous Diatoms imbedded between the layers of the tissue, the foreign bodies are elongated structures, many plant-cells, probably from the hairs of plants, usually with calcified or silicified cell-membranes, more rarely spicula of corals, fine *Echinus*-spines, Annelid-bristles, and a great many sponge-spicules, of which most, if not all, do not belong to this sponge. All these substances are completely and closely embraced by the sponge-substance. The sponge would thus be a horny sponge or a Chalinean.

As neither oscula nor pores are detected on the surfaces of the sponge, nor any cavities in the interior of its substance, and therefore, beside an "*Aporia*" and an "*Astomia*" (Osc. Schmidt), an "*Acœlia*" exists in it, the sponge acquires great significance in the settlement of the question whether the Sponges are to be referred to the Cœlenterata. For unless we regard the lumen of the worm-tube as the body-cavity of the sponge, and the whole structure, therefore, as a monozoic creature, the want of other cavities in the body would prevent the sponge from taking its place in the group of the Cœlenterata as usually conceived, but would much rather make it appear to be a Protistan, so far as we can form a judgment from the materials at present available.

It may be remarked further that the whole structure has been described and figured by Baird as *Terebella flabellum* ("On new Tubicolous Annelides in the Collection of the British Museum," Part. 2, Journ. Linn. Soc. Zool. 1865, vol. viii. p. 157, pl. 5. fig. 1). Two specimens in the collection of the British Museum were brought from Narcon Island by the Antarctic Expedition under Sir James Clarke Ross.—*Sitzungsber. phys.-med. Societät zu Erlangen,* Feb. 20, 1871.

On the Rotatoria *of the Neighbourhood of Tübingen.* By Samuel Bartsch.

The author notices the species of Rotatoria obtained by him in the neighbourhood of Tübingen, mentioning any peculiarities observed by him, and discussing the views of previous authors. He commences with a sketch of the bibliography of the subject, in which the principal authorities are mentioned, and then gives a general account of the structure of the animals belonging to this class, which forms a useful summary of our present knowledge. With regard to the systematic position of the Rotatoria, the author adopts Häckel's notion, according to which they belong to the great Articulate stem, forming a small branch from the same point whence the two great branches of the Vermes and Arthropoda diverge.

As the author establishes three new families and one new genus, we here give an abstract of his classification.

(Order) I. ENTERODELA.

With a stomach, intestine, and anus.

Fam. 1. **Floscularinæ**, Bartsch.

(= *Tubicolarina*, Carus, =*Monotrocha* and *Schizotrocha*, Ehrenb.)

Form clavate; foot long, annulated; ciliary organ like the corolla of a flower; usually sedentary animals, placed in a sheath. There appears to be no reason for giving a new name to this group.

The author notices species of *Floscularia* and *Melicerta*. Of the former he states that the rotary organ is always five-lobed, and that the cilia move during the unfolding of the lobes or when a living organism approaches them. The habits of *Melicerta ringens* are described at considerable length.

Fam. 2. **Hydatinæa**, Ehr. (s. str.).

Body-envelope saccular, soft, varying in form from cylindrical to conical; foot and its terminal styles short, in part not retractile. Genera noticed: *Hydatina, Pleurotrocha, Synchæta, Notommata*, and *Diglena*.

In *Hydatina senta* the author finds attached to the brain, at the points where the nerves running to the two cervical palpi are given off, *two pedunculate vesicles*, consisting of a very thin envelope enclosing finely granular contents, in which about half a dozen orange-red globules are suspended. During the movements of the animal, these vesicles oscillate to and fro; and the author suggests that they may be auditory vesicles. The cilia on the interior of the rotary organ extend down to the gizzard. *Eosphora* (Ehr.) is combined with *Notommata*, as by Leydig.

Fam. 3. **Longisetæ**, Bartsch.

Skin soft or firm; body varying in form from cylindrical to oval; foot very much reduced; terminal styles one or two, long, setiform.

including the genera *Distemma*, *Rattulus*, *Furcularia*, and *Monocerca*, and a new genus,

Monommata, with a cylindrical body, a partially hardened skin, two long caudal points, and one cervical eye. Species *Notommata tigris* and *longiseta*, Ehr.

Fam. 4. **Scaridina**, Carus.

Foot long-jointed, frequently with long spines and points, not retractile; skin soft or hardened. Genera *Scaridium* and *Dinocharis*.

Fam. 5. **Philodinæa**, Ehr.

Body fusiform; foot retractile like a telescope, forked at the end; one cervical movable palpus. Genera: *Callidina*, *Philodina*, *Rotifer*, and *Actinurus*.

Fam. 6. **Loricata**, Bartsch.

(=*Brachionea*, Carus, =*Euchlanidota* and *Brachionæa*, Ehr.—*Dinocharis*.)

With a hard carapace sharply separated from the head and foot; soft parts retractile. Genera observed: *Euchlanis*, *Lepadella*, *Metopidia*, *Brachionus*, *Monostyla*, *Pterodina*, *Anuræa*, *Salpina*, and *Colurus*.

(Order) II. GASTERODELA.

Fam. 7. **Ascomorpha**, Perty.

Body short, cylindrical, truncated in front, rounded off behind; no intestine or anus; one cervical eye.

Under the genus *Ascomorpha* (Perty) the author describes a new species, which he calls *A. saltans*.—*Württemb. naturw. Jahreshefte*, xxvi. pp. 307–364.

On the Blood and Blood-corpuscles of Insects and some other Invertebrata. By Dr. V. Graber.

The blood-corpuscles of Insects and many other Arthropoda (*Epeira*, *Phalangium*, *Oniscus*, *Julus*, *Lithobius*) present extraordinary differences, especially with respect to their relative number, size, and form, even in one and the same individual. As regards form, they show all possible transitions, from a slender sigmoid or horseshoe-shaped spindle to biconvex or sometimes perfectly flat, thin, circular disks. Proteiform corpuscles also appear, although only exceptionally. Their size, or, more properly, the measurement of their longest diameter, is equally variable. It is usually from 0·008 to 0·02 millim., but also may be less (as in *Cossus ligniperda*), or it may attain the gigantic dimensions of 0·04 millim., or even more (in species of *Asilus*).

Many phenomena (for example, on the addition of water), however, indicate that the majority of the blood-corpuscles observed in the same specimen possess nearly the same volume, and that the various forms in which they appear are for the most part caused by the very narrow courses through which they have to pass in some places, where, as is shown by observations on living Dipterous larvæ and other Arthropoda (*Oniscus*, *Epeira*), spontaneous obstructions sometimes occur in the movement of the corpuscles, and sometimes they stretch themselves to almost three times their ordinary length, and may also break up into fragments.

As regards the nature of the corpuscles in other respects, their behaviour with various fluids and also when frozen, heated, and electrified, it may be asserted with great probability that they cannot be perfectly identified with the well-known colourless formative constituents of the blood of the Vertebrata (with which they certainly have much in common), and still less with its coloured constituents. As a rule, no differentiation of their substance into a central structure (a nucleus) and a (cortical) layer surrounding it can be observed in the fresh blood-corpuscles; but the capability of such a differentiation must be ascribed to them on both chemical and purely physiological grounds. But the author could not detect any true cell-membrane (in Schwann's sense of the word), such as is almost universally ascribed to the blood-corpuscles of insects (as by Landois, Weissmann, and Gerstäcker) and other Invertebrata (as by Dr. Häckel in the crayfish).

It is especially characteristic of the blood-corpuscles of Insects, and probably of most Arthropoda (Crustacea according to E. Häckel), that a very variable number of small, frequently dust-like drops of an oleaginous fat are detected upon them. These appear of a more or less intense yellow, but sometimes (pupa of *Sphinx ligustri*) almost of a hyacinthine red colour, and appear to indicate a close relation between the blood-corpuscles and the *corpus adiposum* of these animals. The amount of fat in the blood, and especially in the formative constituents suspended therein, may in general determine the colour of the body-fluid to which the name of "blood" is given, and which in most cases is whitish, pale yellowish, or yellowish green. The last-named colour appears especially in decidedly phytophagous insects (Acridiidæ, many caterpillars, &c.). Sometimes, however, pigments in the serum, which may also be attached to the corpuscles in the form of little points, are to be regarded as the chief cause of the coloration of the blood of insects. Blood agreeing with that of the Vertebrata, both in its red colour and in the cause of the latter (Rollet), only occurs as an extraordinary rarity (larvæ of *Chironomus* &c.).

Beside fat, the substance of the blood seems principally to contain globuline (precipitable by CO^2). Both substances not unfrequently separate in the form of numerous fine acicular crystals, which are usually arranged radially around the central point of the corpuscle. It is less probable, on the contrary, that the contents of a blood-corpuscle become converted into a single crystal. The author found such simple crystals (8-, 4-, and 6-sided tables) similar in composition to snow-crystals.

The division of the blood-corpuscles, starting from the nucleus, observed by Landois in the larva of *Agrotis segetum*, and ascribed by him to the blood-corpuscles of insects in general, was not seen with certainty by the author, although he made observations for hours together upon numerous insects.

Beside globuline, fibrine, and another proteine body, the author detected CaO, MgO, PO^5, and NaCl as inorganic constituents of the serum.

The author did not succeed in accurately ascertaining the chemical constitution of many crystals which occur in the evaporated serum; but he convinced himself that these are not, as affirmed by Landois, all of organic nature.

Those crystals which are undoubtedly of organic nature (many of them become carbonized when strongly heated) show on the whole so great an agreement, both crystallographically and in their solubility, that they must be referred, with great probability, to one and the same essential constituent of the blood. They cannot, however, be placed upon the same stage as the hæmoglobine crystals of the Vertebrata, not only on account of their colour, but also because they are for the most part either insoluble or difficultly soluble in aqueous ammonia.—*Anzeiger der K. K. Akad. der Wiss. in Wien*, Jan. 5, 1871, pp. 2–5.

On the Structure of the Renillæ. By A. Kölliker.

1. The *stem* of the *Renillæ* contains two canals, separated by a partition—a dorsal one and a ventral one, which coalesce into a single cavity at the free end of the stem, the partition ceasing with a sharp margin before the end of the stem.

2. The continuation of the stem into the disk (frond) or the *keel* contains in some species nothing but the dilated ends of the peduncular canals; but in other species there is, in addition, a central sinus-like space, which may even be imperfectly divided into two cavities by a vertical septum. This median sinus is completely closed; that is to say, it is destitute of large apertures of communication. On the other hand, such apertures occur in the dorsal and ventral sinuses of the keel (the continuations of the two peduncular canals), which, although they terminate cæcally, open into the neighbouring polyp-cells by a larger or smaller number of apertures.

3. The *stem* and *keel* are furnished with longitudinal and annular muscles, and possess wider nutritive canals than the other Pennatulidæ; from these, finer nutritive vessels, ultimately becoming very fine, are given off, and are particularly numerous in the cutis.

4. The *frond* or *disk* of *Renilla* consists of nothing but polyp-cells, to which the dorsal and ventral laminæ of the frond serve as roof and floor; they are separated in the interior by septa, which unite the two laminæ above mentioned. All these parts consist of connective tissue, with an abundance of fine and capillary nutritive vessels and more or less numerous calcareous corpuscles.

5. The *polyp-cells* are lozenge-shaped or fusiform in the direction of the radii of the frond, and are of the height of the distance between the dorsal and ventral laminæ of the frond. Nevertheless

each cell possesses in the direction of the stem two canaliform prolongations, one of which runs along the dorsal and the other along the ventral lamina, diverticula the length of which is equal to or even exceeds that of the polyp-cell. Both the polyp-cells and their diverticula are connected with each other by numerous apertures in the lateral walls bounding them, so that the nutritive fluid contained in them has free communication throughout the whole stock.

6. The *polyps* are seated in the marginal parts of the polyp-cells, and exhibit the typical structure of those of the Alcyonaria. Of the compartments surrounding the stomach, one is dorsally, a second ventrally, and the other six laterally situated: I designate them the dorsal, the lateral dorsal, the lateral median, the lateral ventral, and the ventral compartments. The polyps usually possess no calcareous spicules; but these may occur at the lower extremity of the protrusible part, and even on the tentacles.

7. At the apertures of the polyp-cells the dorsal lamina of the disk generally rises to form a cup or *calyx*, the margin of which projects in three, five, or seven teeth. If there are three teeth, these are seated above the dorsal and the two lateral ventral compartments. With five teeth, the fourth and fifth correspond to the lateral dorsal compartments; and with seven teeth, these projections are also situated over the lateral median compartments; so that there is only the ventral compartment to which no tooth corresponds, although in rare cases a rudimentary one is present. The polyp-cells in course of development at the margin of the disk have only two teeth, which correspond to the lateral ventral compartments.

8. In many, perhaps in all, *Renillæ*, these calycine teeth contain hollow, simple diverticula of the compartments surrounding the stomach, which lie outside the plumose tentacles, and remind one of similar structures described by me in the genus *Funiculina*. But in the *Renillæ* these *calycine tentacles*, as I call them, very frequently project freely beyond the apices of the calycine spines, and to a certain extent represent a second deeper-seated circlet of tentacles, so as to produce conditions which remind one of those of the Polyactiniæ.

9. As in other Pennatulidæ, the *septa* surrounding the stomach contain *musculi protractores* and *retractores*. With regard to these muscles I have recently ascertained, in the *Renillæ*, *Veretillidæ*, and *Virgulariæ*, that they are bilaterally symmetrical, and not arranged in accordance with the radiate type. If a straight line be drawn through the middle of the dorsal and ventral compartments in the transverse section of a polype, each pair of protractors in one compartment are turned towards the straight line, and in the other turned from it; whilst the retractors present exactly the reverse. This arrangement proves, better than any thing hitherto known, that the Alcyonaria are by no means regularly radiate creatures.

10. The *mesenteric filaments* of the *Renillæ* are as in the Pennatulidæ. The two long slender filaments are seated on the dorsal septula, and run out into the dorsal diverticula of the body-cavity. The four lateral septula have short and thick filaments, and lie in

the principal segment of the polyp-cell. Lastly, the ventral septula have still shorter and thick filaments, and the septula are continued as far as the extremity of the ventral diverticula of the body-cavity.

11. The *sexual organs* are seated only on the four lateral septula, occur only in fully developed polyps, and in other respects are as in the other Pennatulidæ.

12. The *rudimentary polyps* or *zooids* are seated upon the dorsal surface of the disk, in groups of from five to thirty or forty together. Each group possesses in its interior a common cavity, and on the surface as many small cavities as there are zooids; and in each of these there are eight very small septa without mesenteric filaments. The common cavity of each group opens by a round aperture into the main cell of a polyp or into its dorsal diverticulum.

13. Around the groups of zooids a variable number of spines are often seated. It is a matter of more interest that in certain species one zooid regularly possesses simple tentacles on two compartments, which serve to represent the lateral ventrals; these represent the calycine tentacles of the sexually mature polypes, and are generally supported by two spines. The zooid bearing these two tentacles is also usually larger than the rest.

14. The aquiferous pore described by Fritz Müller in the middle of the frond of the *Renillæ* is the orifice of an isolated large zooid possessing a stomach and eight septa, but no plumose tentacles, filaments, or sexual organs, and somewhat resembling, in size and the spines surrounding it, the sexually mature animal. The body-cavity of this "chief zooid" opens into the end of the dorsal sinus of the keel.

15. The polyp-cells are lined with epithelium, muscles, and connective tissue; and these muscles produce the extraordinarily strong extensions and contractions of which the frond of *Renilla* is capable.

16. The *spicules* of the *Renillæ* are all essentially of the same form (see my 'Icones histiol.'), and, after the extraction of the calcareous salt by acids, leave a coloured organic residue of exactly the form of the previous structure.—*Proc. of the Phys.-med. Gesellschaft in Würzburg*, Feb. 4, 1871.

Observations on Urnatella, *a Genus of Ciliated Polyps of the Family* Pedicellinidæ. By Prof. Leidy.

This polyp is found abundantly below the dam at Fairmount, in the Schuylkill River, adhering to stones and rocks, on the sides and underpart not in contact with the ground. Occasionally it is observed attached to the shell of the living *Unio complanatus* and *Melania virginica*, and less frequently to the stem of *Schollera graminea* and the leaves of *Vallisneria spiralis*. In the locality named, on the rocks, there may be observed, in association with *Urnatella*, the following animals:—*Spongilla fragilis*, *Limnias ceratophylli* (usually abundant and in compound bunches), *Cothurnia pusilla* (parasitic on *Urnatella* and *Limnias*), *Hydra carnea*, Ag., *Paludicella* *elongata*, *Plumatella vesicularis*, and the worm *Manayunkia speciosa*, &c.

Unlike the marine genera of Pedicellinidæ, the polyp-stocks of *Urnatella* are erect or semierect, and not prostrate or creeping attached along the surface of bodies. *Urnatella* starts by a thin membranous disk or expansion tightly adherent to the point of support. Usually two stems or stocks (occasionally three or only one) start from the same disk, and diverge from each other in a gentle curve. The stems may be seen from a simple pedicle without division to a series of eleven divisions or segments, exclusive of the polyp-head. A colony of *Urnatella* recalls to mind a miniature patch of plants in a flower-garden. The smallest polyps are translucent whitish or nearly colourless; the largest are less than two lines long, and alternately white and blackish or brownish. When disturbed, the polyps retract their arms, hang their heads, and bend downward, so that the heads touch the basis of support, or the stems even become somewhat involute. Voluntarily the polyps are often observed abruptly to move from one side to the other in the most singular manner, as if wearied of remaining too long in the same position. In these movements the stems bend the entire length, but there is no contraction or shortening. In attempting to detach a polyp, the heads suddenly bend downward in such a manner as if the violence elicited a feeling of pain in the animal.

The terminal two or three segments of the parent stems usually give off a branch on each side; and this branch sometimes gives off a second. The branches always consist of a pedicel or single joint supporting a polyp-head.

In a polyp-stock of more than two divisions, independent of the polyp-head, the additional segments are urn-shaped. The penultimate segment is barrel-shaped; the last one cylindrical or clavate.

The polyp-heads are provided with from a dozen to sixteen ciliated arms. The internal structure of the polyps, including that of the stems, bears a resemblance to that of *Pedicellina*, and will be more particularly described in a memoir preparing on the animal.

The youngest independent polyp-stems of *Urnatella* consist of a simple cylindrical pedicel starting from the disk of attachment to the rock, and supporting a single polyp-head. The pedicel elongates and divides into two segments. The ultimate segment grows in length, and again divides; and in this manner all the segments are produced. After the production of three segments, the antepenultimate segment assumes the urn-form. Budding commences from the second and third segments after their production, and from the succeeding segments, but not usually from the first segment. The buds originate from opposite sides of the base of the segments, and form branches of a single segment with a polyp-head. The pedicel of these branches also frequently gives off a bud, which forms a secondary branch of the same kind as the primary ones.

In the longer *Urnatella*-stocks branches are usually observed only from the one, two, or three terminal segments. In the posterior urn-shaped segments, in the position in which branches emanate in the terminal segments, cup-shaped processes are observed. These were formerly mistaken for buds, but evidently result from the dehiscence or separation of branches which leave the parent stock to establish colonies elsewhere. Though I have not observed this separation take place in *Urnatella*, yet all the points of structure appear to indicate that it actually takes place in the manner intimated.

It thus appears that the first step towards the multiplication of *Urnatella* is the segmentation of its stem. The segments put forth buds which develope polyps, and these then separate from the parent stock to settle elsewhere and become the source of other series of polyps.

The ultimate history of the segmented polyp-stock of *Urnatella* I have not ascertained. The stocks which I have preserved in an aquarium for several months finally lose their terminal polyps. Late in the season, also, all the polyp-stocks which I could obtain on the river-shore within the reach of my arm, at low tide, were deprived of their terminal polyps. The destruction of these, however, I have suspected to have been due to their having been uncovered in lower tides earlier in the season. I hope yet to be able to determine this question in the course of the next few weeks.

It has occurred to me that the segmented stems of *Urnatella*, after the decay of the polyps, remained through the winter with little obvious change, and that in the following season the segments served as reproductive bodies, in the same manner as the statoblasts in Plumatellidæ and their allies. This view, however, is not confirmed by specimens retained in the aquarium and those collected on the edge of the river which had lost their polyps.

In relation to the production of ova, or the reproduction of *Urnatella* through sexual agency, I have yet learned nothing.

Among the animals mentioned as found in association with *Urnatella* is the singular Annelide *Manayunkia speciosa*, discovered by me some years ago (Proc. Acad. Nat. Sc. 1858, p. 90). The worm is closely allied to the marine genus *Fabricia*, and, like it, lives in tubes constructed of mud. It is abundant in the locality indicated. Individuals about two lines in length are usually seen in a state of division near the middle into two. The anterior division of the body consists of five bristle-bearing annuli in addition to the head. The posterior division consists of six bristle-bearing annuli in addition to the partially developed head. The anterior head is provided with about thirty-six ciliated tentacula supported on four lobes. It is also furnished with a pair of eyes; besides which the tentacle-bearing lobes exhibit a number of pigmentary spots, apparently of the nature of eyes. No eyes exist in the tail of *Manayunkia* as they do in *Fabricia*. The blood is green, and is pumped intermittently into a large vessel occupying one tentacle on each side of the middle of the head.

I have studied the development of *Manayunkia*, which will be fully described in a future memoir on the animal. Curiously enough, the development of the young takes place within the tube of the parent, and the young remain in this position for a considerable time after their development. Thus I have obtained the young from the tube of the parent after it was one third of a line in length, and consisted of ten annuli, including the head, from which projected ten tentacles.—*Proc. Acad. Nat. Sc. Philad.* Sept. 20, 1870.

Note on transversely striated Muscular Fibre among the Gasteropoda. By W. H. Dall.

In studying the radula of a species of *Acmæa* (probably *A. borneensis*, Rve.) obtained by Prof. A. S. Bickmore at Amboyna, I noticed, on placing the structure under a power of 100 diameters, that certain of the muscular fibres which adhered to it, when torn from the buccal mass, had a different appearance from the others. On increasing the power to some 800 diameters, it was at once evident that the different aspect of these fasciculi was caused by fine, but clearly defined, transverse striation. Suspecting that it was an optical delusion, caused by a very regular arrangement of the nuclei of the fibres, I subjected the muscle to various tests and to still higher magnifying-powers. I also introduced under the same glass some of the voluntary dorsal muscles of a small crustacean, for comparison. The structure of the ultimate fibres in both appeared to be similar. These seemed to be composed of a homogeneous tube or cylindrical band of translucent matter, with nuclei interspersed at irregular intervals. In neither was there any appearance of separation into transverse disks, as is seen in the striated muscles of vertebrates. That the striated appearance was not due to contraction and folding of the muscle was evident upon taking a side view of one of the fibres, when the striæ on each side, as well as the intervening elevations, were seen to correspond exactly to each other.

The only perceptible differences between the muscles of the crustacean and the striated muscles of the mollusk appeared to be that the latter were much more finely striate, the striæ being six to eight times as numerous as in the former, in the same space. No difference between the striated and non-striated muscles of the *Acmæa* could be observed, except in the fact of the striation. In both the nuclei were irregularly distributed. The appearance of the striated fibre reminded one of a string of rhombic beads, which bore no relation to the position of the true nuclei. The striated fibres appeared, after a careful dissection of the parts in a number of specimens, to be the retractors of the radula; they were longer and in narrower bands than the non-striated fibres, and comparatively much fewer in number. The striation was most evident toward the middle of the fibres, and became evanescent toward their extremities.

Lebert and Robin (Müller's Arch. f. Anat. und Phys. 1846, p. 126) state that the primitive muscular fasciculi of invertebrates often have the nuclei and intervening clear spaces "arranged in such regular order that they might, at the first glance, be mistaken for transversely striated muscular fibres. The latter, however, are actually found in one acephalous mollusk, *Pecten* (and probably in *Lima* also), and some annelids," and are constantly present in the voluntary muscles of Crustacea and Insecta. In the further researches of M. Lebert (Annales Sci. Nat. 1850, t. xiii. p. 161) he observes that there is nothing extraordinary in the discovery of transversely striated muscular fibre in Polyzoa (*Eschâra*) by Milne-Edwards, and in *Actinia* by Erdl, since "the further we have pursued the study of the comparative histology of muscular fibre, the more convinced we have become that transversely striated muscular fibre is to be found in a large number of animals of very inferior organization, without regard to their more or less advanced position in the animal kingdom."

Striated muscular fibre has lately been shown to exist in the "tail" or appendix of *Appendicularia* by Moss (Trans. Linn. Soc. vol. xxvii. p. 300). It was already known to exist in *Salpa* (Eschricht, Ov. Salperne), in the articulated Brachiopoda (Hancock, Trans. Roy. Soc. 1857, p. 805), and in *Pecten* (Lebert, Annales Sci. Nat. 1850, sér. 3. t. xiii. p. 166; and Wagner, Lehrb. d. vergleich. Anat. 1847, t. ii. p. 470), as well as in *Eschara* (Milne-Edwards, Annales Sci. Nat. sér. 2. t. iv. p. 3). I believe, however, that this is the first instance in which it has been shown to exist in the class Gasteropoda; and this, as well as the rarity of such cases among the lower invertebrates, is a sufficient apology for bringing forward such an isolated fact. Other duties have not yet permitted me to determine whether this phenomenon is constant throughout the genus, or whether it does or does not occur among allied genera.—*Silliman's American Journal*, Feb. 1871.

On Bud-formation in Gymnocladus *and other Plants.* By Thomas Meehan.

The author said that last year he had called the attention of the Academy to the fact that *Gymnocladus* and some other plants had a series of buds, not in the usual order of *phyllotaxis*, accordant with the leaves, as we have believed axillary buds ought to be, but in a direct line one above another, and that in these cases the upper bud, the one the furthest removed from the axil, was the strongest bud. He had overlooked the fact, long known to botanists, until pointed out by Dr. Engelmann, that *Lonicera* had this longitudinal string of buds; but in this case the largest bud was the one nearest the axil. He had since noted that these buds all followed the same law in this, that it was the large buds which had a flower-producing character, while the small ones were those which continued the axial growth.

By the help of this last observation, he was now able to explain some facts in Solanaceous plants which he believed had not hitherto been understood. It was well known that many of these had a habit of producing their flower-scapes at varying positions between the nodes, and not at the nodes, as is usual with most flowering plants. He exhibited specimens of the common cherry tomato, in which a few of the flower-clusters sprang apparently opposite to a node, but the majority were at least one-fourth of the way down to the node below,—also other species of the genus, in which the flower-peduncle pushed out almost down to the lower axil. This was especially the case in some egg-plants, wherein the leaf-axil, the axillary bud, and the bud producing the flower-peduncle were close together in a direct line, as in *Gymnocladus*, before noted. The point to which he wished the particular attention of the members was that this internodular flower-bud really belonged to the system of buds apparently originating at the node below.

He then showed that the flowering character of *Solanum* had a numerical law of its own. Every third node produced a flower-spike or cluster. The node next following the flower had barely the rudiment of an axillary bud; the second one had a stronger bud; the third had a bud which in the tomato and egg-plant pushed again into axillary growth, and had the extra bud beyond, before noted, the flowering one. Other solanaceous plants had similar characters, which, unless we remembered what we had learned in these common Solanums, we might not understand. For instance, in *Nycterium violaceum* the two nodes between the flowering one approached very close together, so as to appear nearly opposite, but still one axillary bud stronger than the other. In *Datura* all three nodes approached and formed a sort of fascicle with the flower proceeding from the irregular centre of the mass.

He now exhibited some specimens of the common poke-weed (*Phytolacca decandra*), and showed that the inflorescence was exactly on the same law. The flower-raceme only appeared at every third node, and sometimes was as much as a quarter of an inch above the node. It was directly in a line with the lower bud, as in the cases of *Gymnocladus*, *Lonicera*, *Solanum*, &c.; and there was no difficulty in assuming that the flower-spike had really belonged to the lower system, just as in the other cases. The ratio of vigour in the axillary buds was just the same. The leaf opposite to or near by the raceme had scarcely any axillary bud, the next stronger, the next strong enough to push into a secondary axillary growth, and then the flower above this. In this we saw *Phytolacca* to have the same characters as Solanaceous plants. The seeds of *Phytolacca* were of very similar structure to *Solanum*; and it had many other characters in common. He was not prepared to speak positively without further investigation, but thought it quite likely, in spite of the hypogynous flower, *Phytolacca* would be found more nearly related to Solanaceæ than to Chenopodiaceæ, near which it was now placed.

He then exhibited some shoots of grape-vine, and said that Dr. Engelmann had pointed out, when at the Academy last year, that there was some numerical order in the tendrils of grape-vines. In the specimen he exhibited every third node had no tendril; but he had seen some grape-vines in which as many as eight nodes with tendrils had followed one another. In the mature wood, however, those without tendrils perfected the strongest buds. But he had found in the allied genus *Ampelopsis* a nearly regular system of buds and tendrils. In *A. hederacea*, the common Virginia or five-fingered creeper, the strong shoots running up a wall or tree had at every third node a strong axillary bud, *without any tendril*, while the two intervening nodes had tendrils *without axillary buds*. Occasionally, but very rarely, two successive nodes would have axillary buds, in which case the lower one would be smaller, and have also a small tendril on the opposite side. *Ampelopsis Veitchii* had the same character. He had attempted to propagate this by using nodes from which the tendrils pushed as single bud-cuttings, but failed to get any development from the axils. He believed they had not a trace of a bud in even the most rudimentary state. It had been said, in Darwin's paper on motion in tendrils, that the gland on the end of the tendril did not develope itself until it approached the object it was to cling to. In *Ampelopsis Veitchii* they developed before this, in the shape of small globes, looking like rudiments of the same flower which ultimately appeared. In fact, tendrils here were incipient flower-branches, as any one could see by tracing the common *Ampelopsis hederacea* up to its final flowering condition, when, the axial growth ending in a terminal bud, instead of the usual lateral tendril, it seemed to erect itself and bear flowers. It would seem as if it were only the elongation of the axis, demanding and drawing to itself nutriment which would otherwise go into the tendril, which made it a tendril, and not a flower-shoot.

He did not, however, intend at this time to attempt any explanation of these series of observations. He thought there was nothing in any known law of phyllotaxis which would explain them, and that by following them up matters of much interest to botany might be evolved. But, as he might have more to say about it some day, and winter was approaching, he thought to call the attention of the Academy to the facts, so that those interested might examine them for themselves before the frost destroyed the specimens.—*Proc. Acad. Nat. Sc. Philad.* Sept. 20, 1870.

On the Flowers of Aralia spinosa, *L.*, *and* Hedera helix, *L.* By Thomas Meehan.

The study of *Aralia spinosa*, L., affords some interesting facts which do not seem to have attracted the attention of other observers.

In Dr. Gray's indispensable 'Manual of Botany,' it is said to be "more or less polygamous." I have had many specimens under my daily observation this season, from the earliest opening till the last blossom appeared, and find that it is much more nearly monœcious than the above quotation would imply.

There are three different sets of flowers, corresponding to the thrice-compounded branchlets of the large panicle. When the flower-scape elongates, it seems suddenly arrested at a given point, and a very strong umbel of *female* flowers appears at the apex. A great number of secondary branches appear along this main one, and they also suddenly terminate each with an umbel of female flowers. From these secondary branches a third series appear; and these flowers are well filled with anthers that are abundantly polliniferous. The female organs of these flowers of the third class, however, are defective, as only a few bear capsules, and in these a large portion of the seeds have no embryos. The polygamous character is confined to this third series of flowers, the first two having purely pistillate blossoms. In these there do not seem to be the rudiments of stamens.

The most remarkable part of this process of development is that the whole of this first series of female flowers should open so long before the male ones come that they fall unfertilized. Most part of the second series also fall, and the crop of seeds is mainly made up of a few of the last opening ones of the section, and the comparatively few hermaphrodite ones which are found in those of the third class. It is a matter for curious speculation what special benefit it can be to the plant to spend so much force on the production of female flowers too early to mature, and then producing such an immense mass of pollen to go utterly to waste.

It may not be amiss to note that in the common carrot the earlier strong umbels have often a male flower in the centre, and that, while the usual flowers are of a pure white, this one is of a crimson colour. In the central umbels of *Aralia spinosa*, and at times on spurs along the branchlets of the panicle, are similar-coloured processes, so small that their form cannot be made out by a common pocket lens. Our fellow member, Dr. J. Gibbons Hunt, makes them out, under the dissecting-microscope, to be vase-like forms with five minute reflexed segments, and with a small solid disk in the centre. It is interesting as evidently being a successful attempt of an abortive flower to simulate in some respects a real one of another character.

Examining also the flowers of the allied European evergreen ivy (*Hedera helix*, L.), I find similar laws of distribution of the sexes as in *Aralia spinosa*, with the addition of a somewhat different structure in the male from the female flowers.

In Europe the plant is described as often having a single umbel as a flower-spike. It is quite likely in these cases the flowers are hermaphrodite. In all the cases I have met with here, the inflorescence is a compound of several umbels—a terminal one female, and the lateral ones male, as in *Aralia*. But there are rudiments of stamens in the flower; and in occasional instances I find a filament developed, but never, so far, with any polliniferous anthers. The flowers of the central female umbel have rather longer and stronger pedicels than the lateral male ones. The calyx is united with the ovarium for one half its length, and the latter much developed in the unopened flower. In the male the segments of the calyx are two-thirds free, and the petals are much longer than in the female flowers.

As in *Aralia spinosa*, the male flowers do not open until some time after the female ones, and not before some of the latter, impatient of delay, have fallen unfertilized.

I have so often and in so many varied ways demonstrated to the Academy that in plants the male element is a later and inferior creation, that it seems almost supererogatory to point out that these plants illustrate the same principle; but it is part of the record of what I believe to be unobserved facts in relation to these species; therefore I briefly allude to them.—*Proc. Acad. Nat. Sc. Philad.* Sept. 27, 1870.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 41. MAY 1871.

XXXIX.—*On a Specimen of* Diplograpsus pristis *with Reproductive Capsules.* By JOHN HOPKINSON, F.G.S., F.R.M.S.

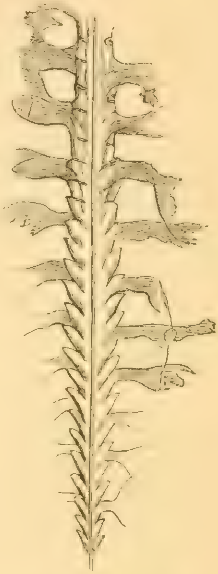
IN looking over a few Graptolites which had recently been received by Mr. Etheridge at the Geological Museum, I detected a specimen which appeared to be a *Diplograpsus* bearing reproductive capsules. About half of the graptolite as it is now seen was visible; and this portion showed the reproductive organs, but no hydrothecæ, the proximal end being imbedded in the shale. On clearing away the shale, the specimen, which Mr. Etheridge kindly lent me for examination, proved to be a tolerably well-preserved impression of *Diplograpsus pristis*.

The graptolite appears as a silvery pyritous impression on the surface of the shale. The proximal termination is indistinct. A slender radicular process, continuous with the solid axis, can just be made out. At the distal end the shale is broken right across the polypary, which here shows no signs of coming to a termination. One inch only is exposed.

The solid axis is clearly seen throughout. The hydrothecæ, towards the proximal end, are very distinct; the apertures of those on the left-hand side are clearly seen, extending partly over the periderm, while those on the right-hand side are partially hidden. There are twenty-four in the space of an inch. Towards the distal end the apertures only of a few of the hydrothecæ are seen; they appear as "scalariform impressions" on the surface of the polypary.

The reproductive organs, which I consider to represent the gonothecæ of the recent Sertularian zoophyte, are developed almost immediately opposite each other from each side of the periderm and throughout its whole length. Though at equal intervals from each other, they are in no even numerical relation to the hydrothecæ, there being ten to the inch. They appear to have budded from the periderm at right angles to the hydrothecæ, and thus have caused the polypary to be unevenly compressed. The most perfect are pear-shaped in form, 1-6th of an inch long, and at their narrow end, by which they are attached, about 1-30th of an inch wide. They have apparently been bounded by a single marginal fibre, which is slightly thickened at its edges, and, where the pyrites is removed, has impressed a fine double groove on the surface of the shale. If the fibres were slender tubes, this appearance would naturally be presented; for their outer margins would offer the greatest resistance to compression. The so-called solid axis of the graptolite frequently presents a similar appearance. At the proximal end of the polypary these fibres only are preserved, the oldest or first-formed gonothecæ having fulfilled their function and perished. The distal extremity of even the most perfect is not clearly defined, the impression of the capsule in most cases becoming gradually less perceptible from the proximal to the distal end. Sometimes the capsules are irregularly ruptured, their torn jagged edges being distinctly seen, while one has split along its marginal limit, along the line of the marginal fibre, which appears to have parted abruptly near the distal end of the capsule at one side, and split acutely for some distance along the other side. This would appear to indicate that the capsule may be composed of two membranes joined together at their edges, through which the fibre, if it be not merely a tube formed by a kind of double marginal seam, has run. In no case can a distinct unruptured distal orifice be traced.

Fig. 1.



Diplograpsus pristis with reproductive capsules. Magn. 3 diameters.

The gonothecæ present other peculiar appearances. Towards their proximal end they are sometimes longitudinally corrugated or crumpled, or traversed by fibres which extend for some distance into the body of the polypary. Some are much twisted and bent about, occasionally overlapping each other. Between two which thus overlap, or perhaps only come into contact with each other, just at the point of contact and apparently within one of the capsules, are two minute young graptolites, one lying across the other. Each consists of a thin membrane, probably forming the first partially developed pair of hydrothecæ, a minute radicle, and a slender solid axis which is prolonged beyond the membrane. They are similar in form and proportions; but one is a little larger than the other. Its length, from the extreme point of the radicle to the distal end of the axis, is 1-20th of an inch. The membrane itself is about half this length, and 1-60th of an inch wide, tapering towards the proximal end. The smaller specimen is 1-30th of an inch in entire length, and 1-80th wide. If these young forms had not been in connexion with a mature graptolite, they would have been considered to belong to the genus *Diplograpsus*, but it would have been impossible to refer them to any species. In their present position I think we may without hesitation infer that they are the young of the graptolite with which they are associated. That they have not yet entered upon independent existence we cannot conclude; for they are in different stages of growth, and young graptolites are frequently met with in a less advanced state than either; indeed on the same piece of shale there are several young graptolites referable to the same species, and no more developed, some even less so.

Fig. 2.

Young graptolites. Magn. 6 diams.

This is the only graptolite with undoubted reproductive organs yet known to have been found in Britain. In America, however, Professor James Hall has detected diprionidian graptolites with what he describes as "reproductive sacs" or "ovarian vesicles." These are figured and described in his 'Graptolites of the Quebec Group.' In Britain Dr. Nicholson has described and figured, in the 'Geological Magazine,' monoprionidian graptolites with what he has termed "grapto-gonophores." If these should prove to be, as Dr. Nicholson believes, the reproductive *buds* of graptolites, the monoprionidian graptolite is reproduced in a totally different manner to the diprionidian; but I think we have as yet had no sufficient evidence brought forward to prove that these problematical bodies have even any connexion with graptolites. The discovery of this specimen throws no light upon this mode of reproduction. It affords, on the other hand, a decided confirmation of Hall's observations; and as his views have not been generally accepted, the specimen is perhaps of more value than if it were unique. The reproductive sacs figured by Hall are essentially similar to the gonothecæ I have here described; upon the surface of the shale on which they occur there are numerous young graptolites in various stages of growth; and in one specimen figured, "in connexion with one of the sacs there are two minute germs, one of them lying beneath the sac, and the other just beyond its outer margin and barely separated from its fibres"*.

The presence of these reproductive capsules throws some light upon the affinities of graptolites. It confirms the evidence which their internal structure has already furnished, of their near alliance with the Hydroida. The reproductive organs of the Actinozoa and of the Polyzoa being internal, graptolites cannot, as some think, belong to either of these classes. In the Hydrozoa they are external; and in some of the Hydroida (the only subclass of the Hydrozoa with which graptolites, having a chitinous polypary, can be compared) there are reproductive capsules essentially similar to those of the graptolite, although in no single instance entirely agreeing with them. We have no single recent Hydroid with reproductive organs enclosed in chitinous capsules which are destitute of any distinct orifice, are bounded by a marginal fibre, or composed of two membranes united at their edges, and at the same time bud from the periderm without interfering with the continuity of the hydrothecæ; but these appearances are all presented by one or other of the Hydroid zoophytes. In *Sertularia*, *Diphasia*, &c., the gonothecæ bud from the periderm in the same manner as in the graptolite; in several genera they are ribbed or thickened at their edges, and in one genus, if not in more, they have no definite distal orifice. In *Aglaophenia*, I have been kindly informed by the Rev. Thomas Hincks, the gonotheca "is oval in form, without orifice, and bounded by a very thin and delicate chitinous wall."

I need only add that graptolites, having, as is here shown, true gonothecæ as well as hydrothecæ, are most nearly and intimately allied to that order of the Hydroid Cœlenterata known as the Thecaphora or Sertularina.

The specimen which has formed the subject of these remarks was collected by the Geological Survey of Scotland, at Leadhills, Lanarkshire, along with a series of fossils which parallel the rocks of this locality with those of Moffat, Dumfriesshire, or with the Llandeilo Flags of Wales.

* Grapt. Quebec Group, expl. pl. B. fig. 8.

XL.—*On Spore-cases in Coals.* By J. W. Dawson, LL.D., F.R.S.*

When I was in London last spring, Prof. Huxley was kind enough to show me some remarkably beautiful slices of coal mounted by his assistant, Mr. Newton, and showing with great distinctness multitudes of spore-cases and spores, some of them very well preserved. He further stated to me his belief that such material had been largely or mainly instrumental in the production of coal. At the time I declined to accept this conclusion, on the ground that the specimens probably represented layers of coal exceptionally rich in spore-cases, and that even in these specimens a large quantity of matter was present which long experience in the examination of coals enabled me to recognize as cortical or epidermal matter, which I had previously shown, by my examination of the coals of Nova Scotia, to be the principal ingredient in ordinary coal. I promised, however, on my return to Canada, to look over my series of preparations of coal, with a view to the occurrence of spore-cases, and also to make trial of the somewhat improved method of preparation employed by Mr. Newton. On my return I gave the results of my examination to Prof. Huxley in a letter quoted by him in the brilliant exposition of his observations and conclusions in the 'Contemporary Review' for November†, which will probably give a tone to the representations of popular writers on this subject for some time. While, however, admitting the great interest and importance of Prof. Huxley's observations, and prepared to contribute some additional illustrations of the occurrence of spore-cases in coal, I think it well to direct attention anew to the actual composition of the substance, as proved by its mode of occurrence, and illustrated by my own extensive series of observations on the coals of Nova Scotia and Cape Breton, including the series of eighty-one seams exposed at the South Joggins, the whole of which I have examined *in situ* and under the microscope.

The occurrence of bodies supposed to be spore-cases in coal is, as Prof. Huxley states, no new discovery, but in reality these may be said to be the first organisms recognized by any microscopic observer of coal—that is, if all the clear spots and annular bodies seen in slices of coal are really spore-cases. They were noticed by Morris as early as 1836, and they had been observed and described long before by Fleming in Scot-

* From 'Silliman's American Journal,' April 1871.

† In the quotation the word "cubical" has been substituted for "cortical."

land. Goeppert mentioned and figured them in his 'Treatise on Coal' in 1848. Balfour described them in 1859 as occurring in Scottish coals; and Quekett figured them in his account of the Torbane-Hill mineral in the same year. In 1855, the latter microscopist showed me in London slices exhibiting round bodies of this kind, very similar to those now described by Huxley; but at that time I regarded them as concretionary, though Prof. Quekett was disposed to consider them organic. Mr. Carruthers has summed up most of these facts in his account of his genus *Flemingites* in the 'Geological Magazine' for October 1865. The subject has also attracted the attention of microscopists in connexion with the Tasmanite or "white coal" of Tasmania, which is composed in great part of the spore-cases of ferns.

I suppose that the oldest spore-cases known are those described by Hooker from the Ludlow formation of the Upper Silurian; but these, if really spore-cases, are different in structure from those ordinarily found in the coal-formation, more especially in the great thickness of their walls, and I am not aware that they have anywhere been found in considerable quantities.

The oldest bed of spore-cases known to me is that at Kettle Point, Lake Huron. It is a bed of brown bituminous shale, burning with much flame, and, under a lens, is seen to be studded with flattened disk-like bodies, scarcely more than a hundredth of an inch in diameter, which under the microscope are found to be spore-cases, slightly papillate externally, and with a point of attachment on one side and a slit more or less elongated and gaping on the other (figs. 1, 2, 3). I have proposed

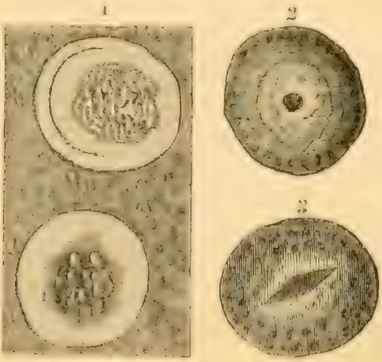


Fig. 1. Part of a slice of shale from Kettle Point, showing two spore-cases and remains of spores. Magn. 70 diams.
Figs. 2 & 3. Spore-cases from the same, as opaque objects. 70 diams.

for these bodies the name of *Sporangites huronensis*. When slices of the rock are made, its substance is seen to be filled with these bodies, which, viewed as transparent objects, appear yellow like amber, and show little structure, except that the walls can in some cases be distinguished from the internal cavity, and the latter may be seen to enclose patches of flocculent or granular matter. In the shale containing them there are also vast numbers of rounded translucent granules, which may be the escaped spores.

The bed at Kettle Point is stated in the Report of the Geological Survey to be from 12 to 14 feet in thickness; but to what degree either in its thickness or horizontal extent it retains the characters above described, I do not know. It belongs to the Upper Devonian, being supposed to be a representative of the Gennesee slates of New York. It contains stems of *Calamites inornatus* and of a *Lepidodendron*, obscurely preserved, but apparently of the type of *L. Veltheimianum*, and possibly the same with *L. primævum* of Rogers. The spore-cases are not improbably those of this plant, or of the species *L. gaspianum*, which belongs to the same horizon, though not found at this locality. The occurrence of this bed is a remarkable evidence of the abundance of Lycopodiaceous trees, whose spores must have drifted in immense quantities in the winds, to form such a bed. It is to be observed, however, that this is not a bed of coal, but a bituminous shale, of brown colour, and with pale streak, no doubt accumulated in water, and even marine, since it contains *Spirophyton** and shells of *Lingula*. In this it agrees with the Australian Tasmanite, which, though composed in great part of spore-cases of ferns, is, as I am informed by Mr. Selwyn, an aqueous deposit, containing marine shells.

There is, however, one bed of true coal known in the Devonian of Eastern America, that of Tar Point, Gaspé; and it is curious to observe that this is not composed of spore-cases, but of successive thin layers of rhizomata and stems of *Psilophyton*, with occasional fragments of *Lepidodendron* and *Cyclostigma*. Rounded disks, which may be spore-cases, occur in it, but very rarely. In the bituminous shales associated with this coal the microscope shows amber-coloured flakes of irregular form; but these are easily ascertained to be portions of the epidermis of *Psilophyton*, or of the chitinous crusts of crustaceans which abound in these beds.

Ascending to the Lower Carboniferous (sub-Carboniferous), there are great quantities of rounded spore-cases of the size of

* The well-known *Cauda-galli* fucoid.

mustard-seeds (*Sporangites glabra* of my papers) in the rocks of Horton Bluff and Lower Horton, Nova Scotia. They are sometimes globular, and filled with pyrites of a granular texture, which perhaps represents the original cellular structure or the microspores; in other cases they are flattened, and constitute thin carbonaceous layers. They are, almost without doubt, the spore-cases of *Lepidodendron corrugatum*, which abounds in the same beds, and constitutes in one place a forest of erect stumps. I described them in a paper on the Lower Carboniferous of Nova Scotia, in the 'Proceedings of the Geological Society of London' for 1858, though not then aware of their true nature, which, however, was recognized by Dr. Hooker in some specimens which I had sent to London.

In my paper on the conditions of accumulation of Coal (Proc. Geol. Soc. London, May 1866), I proposed the name of *Sporangites* for these bodies, in consequence of the difficulty of referring them certainly to any generic forms. Carruthers had, in Oct. 1865, described a cone containing rounded spore-cases of not dissimilar type, under the name of *Flemingites*. In the paper above referred to, I stated that, out of eighty-one coals of the South-Joggins section examined by me, I recognized these bodies and other fruits or sporangia in only sixteen; and of these only four had the rounded Lycopodiaceous spore-cases similar to those of *Flemingites*. These are the following:—

1. Coal-group 12, of Division IV., has a bed of coal 1 foot thick, of which some layers are almost wholly composed of *Sporangites papillata*.

2. Coal-group 13, Div. IV., has in some layers great quantities of *Sporangites glabra*, especially in the shaly part of the coal.

3. In Coal-group 14, Div. IV., a shaly parting contains great numbers of similar sporangites.

4. In coal-group 15 *a*, Div. IV., the shaly roof abounds in sporangites, but I did not observe them in the coal itself.

In addition to these cases, all of which, curiously enough, occur in one part of the section, and among the smaller coals, I have noted the occurrence of clear amber spots in several of the compact coals; but I did not regard these as certainly organic, suspecting them to be rather concretionary or segregative structures.

The great coal-beds of Pictou are, so far as my observation has extended, remarkably free from indications of spore-cases, and consist principally of cortical and ligneous tissues, with layers of finely comminuted vegetable matter. A layer of cannel, however, from a bed near New Glasgow, has numerous flattened amber-coloured disks, which may be of this character. In those of Cape Breton, the yellow spore-case-like spots are much more abundant; but these coals I have less extensively examined than those of the mainland of Nova Scotia. Of American coals, the richest in spore-cases that I have seen is a specimen from Ohio, which contains many large spore-cases and vast numbers of more minute globular bodies, apparently macrospores. It quite equals in this respect some of the English coals referred to by Huxley (fig. 4). I have also a specimen of anthracite, from Pennsylvania, full of spore-cases, some of them retaining their round form, and filled with granular matter, which may represent the spores.

Fig. 4.

Part of a slice of Ohio coal, showing at one side a part of a large spore-case and numerous spores. Magn. 70 diams.

It is not improbable that sporangites, or bodies resembling them, may be found in most coals; but the facts above stated indicate that their occurrence is accidental rather than essential to coal-accumulation, and that they are more likely to have been abundant in shales and cannel coals deposited in ponds or in shallow waters in the vicinity of Lycopodiaceous forests than in the swampy or peaty deposits which constitute the ordinary coals. It is to be observed, however, that the conspicuous appearance which these bodies, and also the strips and fragments of epidermal tissue which resemble them in texture, present in slices of coal, may incline an observer not having large experience in the examination of coals to overrate their importance; and this, I think, has been done by most microscopists, especially those who have confined their attention to slices prepared by the lapidary. One must also bear in mind the danger arising from mistaking concretionary accumulations of bituminous matter for sporangia. In sections of the bituminous shales accompanying the Devonian coal above mentioned there are many rounded yellow spots, which, on examination, prove to be the spaces in the epidermis of *Psilophyton* through which the vessels passing to the leaves were emitted. To these considerations I would add the following, condensed from my paper above referred to, in which the whole question of the origin of coal is fully discussed* :—

* See also 'Acadian Geology,' 2nd edit. pp. 138, 461, 493.

1. The mineral charcoal, or "mother coal," is obviously woody tissue and fibres of bark, the structure of the varieties of which and the plants to which it probably belongs I have discussed in the paper above mentioned.

2. The coarser layers of coal show under the microscope a confused mass of fragments of vegetable matter belonging to various descriptions of plants, and including, but not usually largely, sporangites.

3. The more brilliant layers of the coal are seen, when separated by thin laminæ of clay, to have on their surfaces the markings of *Sigillariæ* and other trees, of which they evidently represent flattened specimens, or, rather, the bark of such specimens. Under the microscope, when their structures are preserved, these layers show cortical tissues more abundantly than any others.

4. Some thin layers of coal consist mainly of flattened layers of leaves of *Cordaites* or *Pycnophyllum.*

5. The *Stigmaria*-underclays and the stumps of *Sigillaria* in the coal-roofs equally testify to the accumulation of coal by the growth of successive forests, more especially of *Sigillariæ.* There is, on the other hand, no necessary connexion of sporangite-beds with Stigmarian soils. Such beds are more likely to be accumulated in water, and consequently to constitute bituminous shales and cannels.

6. *Lepidodendron* and its allies, to which the spore-cases in question appear to belong, are evidently much less important to coal-accumulation than *Sigillaria*, which cannot be affirmed to have produced spore-cases similar to those in question, even if the observation of Goldenberg as to their fruit can be relied on—the accuracy of which, however, I am inclined to doubt.

On the whole, then, while giving due credit to Prof. Huxley and those who have preceded him in this matter, for directing attention to this curious and, no doubt, important constituent of mineral fuel, and admitting that I may possibly have given too little attention to it, I must maintain that sporangite-beds are exceptional among coals, and that cortical and woody matters are the most abundant ingredients in all the ordinary kinds; and to this I cannot think that the coals of England constitute an exception.

It is to be observed, in conclusion, that the spore-cases of plants, in their indestructibility and richly carbonaceous character, only partake of qualities common to most suberous and epidermal matters, as I have explained in the publications already referred to. Such epidermal and cortical substances are extremely rich in carbon and hydrogen, in this resembling bituminous coal. They are also very little liable to decay, and they resist more than other vegetable matters aqueous infiltration—properties which have caused them to remain unchanged and to resist the penetration of mineral substances more than other vegetable tissues. These qualities are well seen in the bark of our American white birch. It is no wonder that materials of this kind should constitute considerable portions of such vegetable accumulations as the beds of coal, and that, when present in large proportion, they should afford richly bituminous beds. All this agrees with the fact, apparent on examination of the common coal, that the greater number of its purest layers consist of the flattened bark of *Sigillariæ* and similar trees, just as any single flattened trunk imbedded in shale becomes a layer of pure coal. It also agrees with the fact that other layers of coal, and also the cannels and earthy bitumens, appear, under the microscope, to consist of finely comminuted particles, principally of epidermal tissues, not only from the fruits and spore-cases of plants, but also from their leaves and stems. The same considerations impress us, just as much as the abundance of spore-cases, with the immense amount of the vegetable matter which has perished, during the accumulation of coal, in comparison with that which has been preserved.

I am indebted to Dr. T. Sterry Hunt for the following very valuable information, which at once places in a clear and precise light the chemical relations of epidermal tissue and spores with coal. Dr. Hunt says:—

"The outer bark of the cork-tree and the cuticle of many, if not all, other plants consists of a highly carbonaceous matter, to which the name of *suberin* has been given. The spores of *Lycopodium* also approach to this substance in composition, as will be seen by the following, one of two analyses by Duconi*, along with which I give the theoretical composition of pure cellulose or woody fibre, according to Payen and Mitscherlich, and an analysis of the suberin of cork, from *Quercus suber*, from which the ash and 2·5 per cent. of cellulose have been deducted†.

	Cellulose.	Cork.	Lycopodium.
Carbon	44·44	65·73	64·80
Hydrogen	6·17	8·33	8·73
Nitrogen	....	1·50	6·18
Oxygen	49·39	24·44	20·29
	100·00	100·00	100·00

"This difference is not less striking when we reduce the above centesimal analyses to correspond with the formula of

* Liebig & Kopp, Jahrbuch, 1847–48. † Gmelin, Handb. xv. 145.

cellulose ($C_{24}H_{20}O_{20}$), and represent cork and *Lycopodium* as containing 24 equivalents of carbon. For comparison, I give the composition of specimens of peat, brown coal, lignite, and bituminous coal*.

Cellulose	$C_{24}H_{20}O_{20}$
Cork	$C_{24}H_{18\frac{2}{10}}O_{6\frac{7}{10}}$
Lycopodium	$C_{24}H_{19\frac{4}{10}}NO_{5\frac{6}{10}}$
Peat (Vaux)	$C_{24}H_{14\frac{4}{10}}O_{10}$
Brown coal (Schrötter)	$C_{24}H_{14\frac{3}{10}}O_{10\frac{6}{10}}$
Lignite (Vaux)	$C_{24}H_{11\frac{3}{10}}O_{6\frac{4}{10}}$
Bituminous coal (Regnault)	$C_{24}H_{10}O_{3\frac{3}{10}}$

"It will be seen from this comparison that, in ultimate composition, cork and *Lycopodium* are nearer to lignite than to woody fibre, and may be converted into coal with far less loss of carbon and hydrogen than the latter. They, in fact, approach closer in composition to resins and fats than to wood, and, moreover, like those substances, repel water, with which they are not easily moistened, and thus are able to resist those atmospheric influences which effect the decay of woody tissue."

I would add to this only one further consideration. The nitrogen present in the *Lycopodium*-spores, no doubt, belongs to the protoplasm contained in them, a substance which would soon perish by decay; and, subtracting this, the cell-walls of the spores and the walls of the spore-cases would be most suitable material for the production of bituminous coal. But this suitableness they share with the epidermal tissue of the scales of strobiles, and of the stems and leaves of ferns and Lycopods, and, above all, with the thick corky envelope of the stems of *Sigillariæ* and similar trees, which, as I have elsewhere shown†, from its condition in the prostrate and erect trunks contained in the beds associated with coal, must have been highly carbonaceous and extremely enduring and impermeable to water. In short, if, instead of "spore-cases," we read "epidermal tissues in general, including spore-cases," all that Huxley has affirmed will be strictly and literally true, and in accordance with the chemical composition, microscopical characters, and mode of occurrence of coal. It will also be in accordance with the following statement, which I may be pardoned for quoting from my paper on the "Structures in Coal," published in 1859:—

"A single trunk of *Sigillaria* in an erect forest presents an

* Canadian Naturalist, vi. 253.

† "Vegetable Structures in Coal," Journ. Geol. Soc. xv. 626; "Conditions of Accumulation of Coal," *ib.* xxii. 95; Acadian Geology, 197, 464.

epitome of a coal-seam: its roots represent the *Stigmaria*-underclay; its bark the compact coal; its woody axis the mineral charcoal; its fallen leaves (and fruits), with remains of herbaceous plants growing in its shade, mixed with a little earthy matter, the layers of coarse coal. The condition of the durable outer bark of erect trees concurs with the chemical theory of coal, in showing the especial suitableness of this kind of tissue for the production of the purer compact coals. It is also probable that the comparative impermeability of the bark to mineral infiltration is of importance in this respect, enabling this material to remain unaffected by causes which have filled those layers consisting of herbaceous materials and decayed wood with pyrites and other mineral substances."

XLI.—*On the Limits and Classification of the Ganoids.* By Dr. C. Lütken*.

In my memoir on the limits and classification of the Ganoïdei (Om Ganoidernes Begrændsning og Indeling, Copenhagen, 1869) my only object was to summarize and expound the results at which science has arrived with regard to the important question above indicated; and its importance, whatever this may be, is due solely to the necessarily restricted number of those who have had the time, patience, and leisure to become thoroughly acquainted with these results by their own investigations. Certainly the history of palæichthyology shows very plainly that hitherto this question has not been perfectly clear, in part because several of the most eminent authors have, unfortunately, been unable to obtain an exact knowledge of the works of their predecessors. Hence, at least in part, arises the uncertainty as to the definition and limits of the Ganoïdei, the rank which they should occupy in the zoological scale, the mode of subdividing them, &c. Have we not seen Andreas Wagner, whose memoirs on the fishes of the Lithographic Limestone constitute one of the greatest triumphs of palæichthyology, contenting himself with a definition applicable only to a particular formation? and Rodolph Kner, the learned describer of the fishes of ancient and recent times, expressing the opinion that, at bottom, there are no Ganoids at all, and that the forms united under this name are nothing but the prototypes of the different existing ichthyological families, having nothing in common but a character of antiquity? England and southern Germany have been the prin-

* Translated by W. S. Dallas, F.L.S., from the 'Bibliothèque Universelle,' March 15, 1871, Arch. des Sci. pp. 283–296.

cipal modern centres of palæichthyological investigations; but (speaking, however, of a time which already belongs to the past), unfortunately, the English authors have generally had but little knowledge of the works of their colleagues on the shores of the Danube, and *vice versâ*. Thus the important and excellent memoir of Prof. Huxley on the classification of the fishes of the Devonian system, a work truly marking an epoch in palæichthyology, has remained almost unknown on the Continent.

The first portion of my work is exclusively of an historical and critical character, and will only be mentioned here very briefly, although it serves as the basis of the following part. Passing in review the more or less important writings* of Agassiz, Johannes Müller, Stannius, Gegenbaur, Williamson, Kölliker, Heckel, Wagner, Huxley, Kner, &c., I have shown that no one has ever been able to give an exact definition of what is a Ganoid, neither the external or so-called zoographic characters, nor those borrowed from anatomy and histology (*i. e.* the microscopic examination of the scales) having been capable of remedying this defect. The restricted space which you will devote to this summary will, however, prevent me from expressing my opinion upon all the points of the external and internal structure of these animals, to which more or less importance has been ascribed, with more or less justice, in connexion with their classification. I shall abide by the testimony of the late Dr. Kner, who said with so much reason that it will be impossible to give any definition of the order Ganoidei if we desire to maintain the limits which are generally assigned to it; and I also take my place on his side when he proposes subsidiarily to restrict its limits and to reduce it from the rank of a subclass or order to a lower place in the systematic scale. But I am far from being able to approve of his principal proposition of striking this tribe completely out of the zoological system—a proposition which is not supported by any indication as to the eventual distribution of this great group of diverse types among the other suborders of the class of fishes, and which, as we shall soon show, would be quite contrary to nature.

The theoretical or constructive method, that of zoographic or zootomical characters, having therefore failed, it will be necessary to apply to this question the *synthetical* or comparative method, a work of labour and patience, it is true, but always leading with certainty to the goal,—that is to say, the method which consists in ranging the known types in accord-

* At the end of my memoir there is a list of the principal publications upon this division of ichthyology, from 1841 to 1869.

ance with their affinities and the totality of their characters, species by species and genus by genus, until the families are formed; and then, by bringing together the families in the same manner, without any preconceived idea, we shall succeed by degrees in establishing groups of a higher order, and finally see rise before us the true natural system, the subdivisions of which will rest upon the solid basis of experience and the totality of the facts. We must therefore, provisionally at least, limit the name of Ganoids to the indubitable existing types (that is to say, the *Lepidostei* and *Polypteri*), and to the fossil types which will naturally group themselves around these, by giving proofs of their affinity rendered incontestable by the absolute concordance of important characters; whilst we must in the same way eliminate, at least provisionally, all the forms between which and the preceding our comparative synthetic method shall prove incapable of establishing any bond of relationship. The picture which the suborder Ganoidei will present to us after a scrupulous investigation of this kind will be nearly as follows:—

I. First series.—The *Lepidosteidæ* or *Euganoïdei* will include the fishes with bony, enamelled, rhomboidal, and articulated scales, related to the existing *Lepidostei*, and possessing neither the dermal ribs of the *Lepidopleuridæ*, nor the fringed or oar-like paired fins of the *Polypteridæ*, nor the gular plates which take the place of the branchiostegal rays in the latter*. Although apparently forming a very natural group, there is no positive peculiarity which characterizes these in an absolute and exclusive manner. As regards the scales of the body, they possess characters common to a portion of the *Polypteridæ*; the so-called *fulcral* scales of the margins of the fins, which occur at least in the majority of the fossil *Lepidosteidæ*, occur also in the ancient *Lepidopleuridæ*, and even in some true *Teleostei* of the Jurassic period; leaving out of consideration the living *Lepidostei*, the fossil *Lepidosteidæ* appear to have had a common character in the delicate and numerous rays of the fins and branchiostegal membrane; lastly, the forward position of the ventral fins upon the middle of the belly will also distinguish them from the *Polypteridæ* with similar scales.

Although this series embraces a very great number of genera, the greater part of which will be found mentioned in my memoir, it seems to me to be impossible to subdivide it naturally into tribes or families. We might perhaps distin-

* With the sole exception of *Cheirolepis*, the only Devonian type of the whole series which indicates by its gular plates a certain relationship to the contemporaneous Polypteridæ.

guish between the genera with large and those with small scales, and between the heterocercal and subhomocercal types; and in this way we should obtain a quaternary division such as this:—

1. Lepidosteidæ heterocercæ microlepidotæ...... *Cheirolepis.*
2. „ homocercæ „ „ ...... *Sauropsis.*
3. „ heterocercæ macrolepidotæ .... *Palæoniscus.*
4. „ homocercæ „ „ ...... *Lepidotus.*

But it appears to me to be impossible to mark out fixed limits between these groups, which are artificial rather than natural. It has also been proposed to divide the *Euganoïdei* into "monostichi" and "distichi," according to the single or double arrangement of the scales bordering the fins; but we are still destitute of sufficient information to enable us to adopt this classification, even if it has an actual foundation in nature.

Every one knows that there is a difference of epoch between the *Euganoïdei* called "heterocercal" and those called "homocercal," or, better, "simorrhachal;" but the line of demarcation is not so clearly drawn as has been supposed. As early as the Permian system there are species (referred to the genus *Palæoniscus*) which are only semiheterocercal, whilst in the Lias we may still find absolutely heterocercal genera (*Oxygnathus*, *Cosmolepis*). In general, however, an evident progress from the heterocercal to the so-called homocercal or fan-like tail may be observed running parallel to the progress of geological epochs. A similar progress is marked also, although perhaps less distinctly, in the structure of the vertebral column. No Lepidosteid presents true biconcave vertebral bodies: except in the living *Lepidostei*, we find either a *naked notochord* without any trace of vertebral bodies, the apophyses of the vertebræ, the interapophysial bones, the scapular arch, the fin-rays, &c. being at the same time well developed and ossified; or *semivertebræ*, that is to say, superficial plates, derived from the neurapophyses and hæmapophyses, covering the notochord completely or partially, and frequently, by touching or covering each other, simulating false vertebræ; or, lastly, these plates becoming amalgamated, so-called *annular vertebræ*, differing, however, from the true vertebræ of fishes by their smooth surface and their bony interior enclosing the notochord, almost completely developed. The reader who may wish to have more ample information upon this subject I recommend to consult especially the works of MM. Heckel and Wagner.

II. Second series.—The *Lepidopleuridæ* or *Pycnodontes* are especially characterized by peculiar dermal ribs* which protected their sides, at least on the anterior part of the body, and which held suspended the scales, which are sometimes very delicate, and are rhomboidal, and not articulated, but interlocking in a very peculiar manner. Generally there is also something very characteristic in the form of the body, which enables us at once to distinguish this well-marked and very remarkable *extinct* type. If we knew only its most recent representatives, we might doubt as to their true position in the system, so widely do they depart from the Euganoid type; but there is an uninterrupted series, leading directly from the Eocene Pycnodonts to the Palæozoic *Platysomi*, which no one has ever thought of excluding from the Ganoïdei, and showing evidently the filiation of all these creatures. It is a peculiar branch which separated during the Carboniferous period from the common trunk of the Ganoids, and continued in the course of time to depart more and more from its starting-point, to become developed in a more and more perfect manner, and to spread out into a multitude of well-marked genera, until it reached the term of its existence during the Eocene period. The classification of the *Lepidopleuridæ* will reproduce before us the image of this zoological progress:—

a. The Palæozoic *Lepidopleuridæ* or *Platysomii*, with the scaling of the body and the dermal ribs completely developed, with fulcral scales bordering the fins, with a naked notochord, and semivertebræ but slightly or not at all developed, &c. *Platysomus* and allied genera belong to the Carboniferous and Permian formations.

b. The Liassic *Pleurolepididæ* differ from the *Stylodont Platysomii* only by their well-marked homocercity.

c. The *true Pycnodontes* of the Jurassic, Cretaceous, and Tertiary periods are also homocercal, but the fulcral scales are wanting; the semivertebræ are more or less perfectly developed. Their very characteristic and diversified dentition furnishes excellent generic characters.

α. The *Mesozoic Pycnodonts* had the notochord partly naked, the development of the semivertebræ being less perfect. The dermal ribs in some formed a trelliswork all over the body as in the preceding, in the others only on the anterior part, as in the following.

* I have here followed the opinions of M. Heckel with regard to this part of their organization. According to Sir P. Egerton, these dermal ribs are only the anterior and thickened portion of the scales. In the question of classification, with which we are here occupied, this difference is of little importance; the character is persistent, even if the mode in which it has been expressed should prove to be false.

β. The *Neozoic* (Eocene*) *Pycnodonts* had the semivertebræ developed, and consequently covering the notochord entirely; the dermal ribs, which are sometimes delicate and complicated, never occupied more than the thoracic portion of the body.

III. Third series.—The *Ganoïdei Crossopteri* or *Polypteridæ*, represented in the present day by the genera *Polypterus* and *Calamoichthys*. The principal characters common to these and their ancient representatives of the Devonian system are the following:—1, the absence of rays in the branchiostegal membrane, which are represented here only by two gular plates; 2, the very characteristic structure of the paired fins, which are formed of a scaly stem, often of great length, and bordered on each side with rays like a fringe; 3, the very backward position of the ventral fins; 4, the absence of the so-called fulcral scales; 5, the diphyocercal or approximately heterocercal form of the tail, which is never fan-like.

The true *Polypteridæ* of the existing period are the direct representatives of the Palæozoic *Rhombodipteri* (Devonian and Carboniferous) with ossified, rhomboidal, and articulated scales like those of the *Lepidostei* and *Polypteri*, with a diphyocercal or slightly heterocercal tail, with a double dorsal fin thrown far back, with the base of the vertical fins scaly, &c. The principal character which separates them from the *Polypteridæ* therefore consists in the double dorsal placed far back. These are the genera *Osteolepis*, *Diplopterus*, *Megalichthys* (with smooth scales), *Glyptolæmus* and *Glyptopomus* (with the scales and bones of the head sculptured).

The contemporaneous *Cyclodipteridæ* present exactly the same assemblage of characters, with one single exception—that of the scales: these are ossified and enamelled, indeed, and sometimes even thick and smooth or sculptured, as in the preceding; but in place of the form, relative position, and articulation common to the *Euganoïdei*, *Rhombodipteridæ*, and *Polypteridæ*, we find here the rounded *cycloid* form and the imbricated superposition of the ordinary *Teleostei*. As among the *Rhombodipteridæ*, there are among the *Cyclodipteridæ* a smooth division (*Ctenodus*, *Dipterus*), and another with the cranium and scales sculptured (*Glyptolepis*, *Holoptychius*, *Gyroptychius*, &c.).

In a certain number, at least, of these *Dipteridæ*, whether rhomboidal or cycloid, if not in all, the vertebral column already possessed apparently a degree of development little, if at all, inferior to that of the *Polypteri* of the present day; in

* A single species of this tribe is obtained from the Cretaceous formation of Lebanon. For further details concerning the true Pycnodonts, their structure and classification, the reader will consult especially the celebrated works of the late M. Heckel.

other allied genera, such as *Phaneropleuron*, a Devonian genus differing from the *Cyclodipteri* by its undivided dorsal fin occupying the posterior half of the hack, a naked notochord is combined with ossified ribs, apophyses, and rays, as in the ancient *Lepidosteidæ* and *Lepidopleuridæ*.

The great extent of time which separates the Palæozoic *Dipteridæ* from the living *Polypteridæ* is filled up in part by the remarkable group of the *Cœlacanthi*, presenting a very peculiar combination of unique zoological and anatomical characters (for example, the structure of the tail, the peculiar interspinals of the anal fin and of the two dorsals, the ossified swimming-bladder, &c.), with less anomalous features borrowed from the other *Ganoïdei Crossopteri* (such as the gular plates, the fringe-like paired fins, the scaly base of the vertical fins, the duplicity of the dorsal, &c.). This group originated in the Carboniferous period, and maintained itself with rare persistence of type throughout all geological periods down to the Cretaceous, when it became extinct. But as I can refer the reader to the admirable works of Prof. Huxley, to whom belongs the inestimable merit of having so perfectly seized and so admirably developed the relations of the different types belonging to the great polymorphic series of the *Ganoïdei Crossopteri*, I shall abstain from speaking of them at greater length, so as to abridge this summary as much as possible.

Here concludes the representation of the *true Ganoids*, as to the nature of which there is no doubt, thanks to our method of synthesis. But what is to be done with all the other types which have been referred to the Ganoids by a greater or less number of authors? I will not speak here of the *Siluroïdei*, which are true Physostome Teleosteans, nor of the *Lophobranchii* and *Plectognathi*, belonging to the suborder of Aphysostome Teleosteans, nor of the *Dercetiformes* or *Hoplopleuridæ*, a very remarkable tribe characteristic of the Cretaceous period, if we omit the Triassic genera *Belonorhynchus* and *Ichthyorhynchus*, the place of which in the system is uncertain (perhaps they ought to be arranged among the *Aphysostomi*), but which have no relationship to the *Ganoïdei*. But I must express a more decided opinion upon the other types generally regarded as Ganoids—namely, the *Lepidosirens*, the *Sturgeons*, the *Amiidæ*, the Jurassic *Teleostei*, the *Acanthodei*, and the so-called *cuirassed Ganoids*—types to which I have not *yet* been able to assign a place in the picture of the Ganoids, seeing that the synthetic method has not yet proved those intimate bonds, those relations of structure, those intermediate forms—in one word, that filiation which alone would allow us to place them there. Nevertheless we must not deny the possibility that future discoveries may some day demonstrate to us these still unknown bonds*; nor must we forget that it is not many years since naturalists did not hesitate to refuse a place among the Ganoids to the *Aspidorhynchi*, the *Cœlacanthi*, and the *Pycnodontes*, which we now arrange without hesitation among the undoubted Ganoids.

a. In the first place, the *Lepidosirens* or *Protopteri*, classed by some writers of incontestable authority with the Ganoids, but most frequently regarded as forming a peculiar subclass (*Dipnoi*), will form, in my opinion, only an aberrant tribe or a suborder of the Physostome Teleosteans, to be placed in the immediate vicinity of the Ganoids and particularly of the *Crossopteri* (*Phaneropleuron*, for example).

b. Then the *Sturgeons* are also Physostome Teleosteans, which should be arranged as near as possible to the *Chondrostei*, between the latter and the *Ganoïdei*, with which, however, they must not be united†.

c. The *Amiæ* approach the Ganoids and Chondrosteans by a number of remarkable anatomical peculiarities; but we should not be more justified in classing *Amia* with the Ganoids than in arranging the Sturgeons among the Selachia. It is a special type, belonging to the true Physostome Teleosteans, leading towards the Ganoids, but not attaching itself to them. Moreover the removal of this group from the suborder Ganoïdei will but slightly modify the palæichthyological system, as it includes only a small number of forms (*Notæus*, *Cyclurus*, *Amiopsis*), which perhaps ought to be united with *Amia* itself.

d. There is also no positive reason for arranging the *Jurassic Teleostei* (*Leptolepides*, *Megaluri*, and *Caturi*) either with the Amiidæ or with the Ganoïdei. If we consult the synthetic method, it will lead us rather towards the *Halecoïdes*—that is to say, the Salmons, Herrings, and *Clupesoces*. They are consequently true Physostome Teleosteans, and, with the exception of the *Belonorhynchus* &c. of the Trias, the most ancient representatives of this suborder. Moreover it will be impossible to separate the three families above named from each other; those who, with the modern palæichthyologists, Heckel, Wagner, and Pictet, place the *Leptolepides* among the true Teleostei, will be obliged likewise to place there the *Megaluri* and *Caturi*, notwithstanding the fulcral scales bordering their fins; the filiation of the species, the crossing of

* At this moment the journals inform us of the discovery in Australia of a new genus of freshwater fish, intermediate between the *Lepidosirens* and the Palæozoic *Dipteri*! [See papers by Dr. Günther and Messrs. Hancock & Atthey in the March Number of this Journal.—Ed. *Ann. Nat. Hist.*]

† The affinities of the fossil genus *Chondrosteus* are perhaps still doubtful.

characters will leave them no choice. The *Leptolepides* and *Megaluri* have the true biconcave vertebræ of the Teleostei; but there is nothing astonishing in the fact that there was among the most ancient Teleostei a type (the *Caturi*) with a more embryonic spinal column—that is to say, with "annular vertebræ" or "semivertebræ."

e. If the *Acanthodei* should be classed with the Ganoids, they will undoubtedly form a separate division; but I am rather of the opinion of those authors who regard them as a special type among the *Chondrostei.* The reader will consult with advantage the excellent exposition of this question given by Prof. Huxley in 1861. Lastly, whether we regard this remarkable family as the group of Ganoids most nearly approaching the Selachia, or as the Selachian type nearest to the Ganoids, is not of much consequence in reality.

f. Finally, with regard to the *Placodermi*, I must in the first place declare that I do not understand why so much stress has lately been laid upon the profound diversity of type between the *Cephalaspides* on the one hand, and the *Coccostei* (with *Pterichthys*) on the other. Prof. Huxley regards the latter as true Teleostei, and places the *Cephalaspides* provisionally with the Sturgeons, at the same time indicating their analogy with the *Siluroïdei.* In my opinion, these are all animals of uncertain position, "*incertæ sedis*," the true affinities of which still remain to be discovered. If we are still to persist in regarding them as "*cuirassed Ganoids*," it will be necessary to establish for them a special division (fourth or third) in the suborder of Ganoids.

What, then, is a Ganoid? If it is absolutely necessary to give a definition, it must be formulated nearly as follows:—*Every fish* (abdominal, malacopterygian, physostome) *with osseous scales, articulated* (as in the *Lepidostei*) *or interlocked* (in the manner of the Pycnodonts), *or with gular plates in place of the branchiostegal rays, and with the paired fins fringed and scaly* (as in the *Polypteri*), *or which combine several of these characters, will be classed among the Ganoids**. And with regard to the position and rank which the Ganoids should occupy in the system, it will be necessary to form with them a suborder of the Physostome Teleostei, touching upon the Chondrostei, but separated from these by the Sturgeons, and surrounded by the Jurassic Teleostei, the Amiidæ, and the

* Even if we should prefer to suppress the suborder Ganoïdei altogether, and to place the three families *Lepidosteidæ*, *Lepidopleuridæ*, and *Polypteridæ* after the *Siluri*, *Characini*, *Cyprini*, *Salmones*, and the other physostome families, the term "Ganoid" must still be regarded as a general denomination for these three families, which are so intimately connected.

Protopteri. The table of that portion of the ichthyological system with which we are here occupied will then present nearly the following aspect:—

Subclass I. *Teleostei Eleutherobranchii.*

(*Osseous Fishes with free branchiæ.*)

Order I. *Physoclistes* or *Acanthopteri* (including the *Acanthopteri*, *Anacanthini*, and *Pharyngognathi* of Johannes Müller, groups which cannot be maintained; and, besides these, the *Lophobranchii* and *Plectognathi*, which must be reduced to the rank of simple families).

Order II. *Physostomi* or *Malacopteri.*

- Suborder I. The typical *Physostomi* (corresponding to the *Physostomi* of Johannes Müller, with the addition of the *Amiidæ* and the *Leptolepides*, the *Megaluri*, and the *Caturi* of the Jurassic period).
- Suborder II. The *Ganoïdei.*
  - Series 1. The *Lepidosteidæ* or *Euganoïdei.*
  - Series 2. The *Lepidopleuridæ* or *Pycnodontes.*
    - Fam. 1. The *Platysomii.*
    - Fam. 2. The *Pleurolepides.*
    - Fam. 3. The true *Pycnodontes.*
  - Series 3. The *Crossopteri* or *Polypteri.*
    - Subseries 1. The *Crossopteri Rhombiferi.*
      - Fam. 1. The *Polypteri.*
      - Fam. 2. The *Rhombodipteri.*
    - Subseries 2. The *Crossopteri Cycloïdei.*
      - Fam. 1. The *Cyclodipteri.*
      - Fam. 2. The *Phaneropleuri.*
      - Fam. 3. The *Cœlacanthi.*
- Suborder III. The *Lepidosirens* or *Protopteri.*
- Suborder IV. The *Sturgeons* or *Acipenseridæ.*

Subclass II. *Chondrostei Desmobranchii.*

(*Cartilaginous Fishes with fixed branchiæ*).

Order III. *Selachii.*

- Suborder 1. The *Acanthodei.*
- Suborder 2. The *Pleuracanthii.*
- Suborder 3. The *Chimærii.*
- Suborder 4. The *Sharks.*
- Suborder 5. The *Rays.*

Order IV. The *Cyclostomi.*

Order V. The *Branchiostomi.*

Incertæ sedis.

Order VI. The *Placodermi* (*Cephalaspis* &c.).

In concluding this abridgment, which is certainly too short to enable the reader to judge as to the justice of my opinions, but may perhaps suffice to give an idea of them, I will add one or two words—namely, that my memoir is illustrated with fourteen woodcuts representing the figures, in part restored, of the principal types of the palæichthyological system, and also that the ichthyological table annexed to it, when compared with that in the great work of Prof. Agassiz, will furnish the means of seizing at a glance the principal progress made in palæichthyology from 1843 to 1869.

XLII.—*On a new Species of Lemur from Madagascar, and on the Changes of* Lemur macaco, *Linn.* By Dr. J. E. Gray, F.R.S. &c.

Prosimia rufipes, n. sp.

Fur woolly, thick, dark rufous brown, with a golden gloss from the tips of the hairs; the sides of the head and cheeks, the hand and arm, and the feet and the sides to the under part of the body bright bay. Tail nearly black, rather longer than the head and body. Male with the middle of the throat greyish; face with short blackish hair. Female similar above, but with the chin, throat, and front half of the under part of the body reddish grey; the face and edge of the under jaw covered with blackish hairs.

Hab. Madagascar (Mr. Crossley). B.M.

With these two Lemurs were received a series of *Varecia varia* and *V. rubra*, showing that they are one species, extremely variable in colour; but, as far as I have observed, the head, the underside of the body, limbs, the feet, and tail are black, the back of the neck and the base of the tail are always white, while the colour of the back varies from dark red-brown through all gradations to pure white. In most specimens the shoulders, the sides of the chest, and the outside of the thighs, are the same colour as the back; but in one specimen these parts are deep black like the underside of the body. I might have been inclined to consider this variety to be a distinct species, as I believe it has been considered (*Lemur macaco*, Linn.); but one of the nearly white specimens has the base of the white hair of these parts black and partly showing through the white fur, and the white hairs of all parts of the body have a black base.

This series shows that *Lemur macaco* and *Lemur ruber* and *niger* of Geoffroy are one species.

Lemur macaco presents three distinct varieties, which gradually pass into each other. 1. *Lemur macaco*, Linn. White, with the shoulders and front of the thighs black; the size of the black patches varies in different individuals: when they cover the greater part of the body, it is *L. subcinctus* of A. Smith; and when they unite together, abolishing the white, they are *Lemur niger*. 2. White, yellow, or red; the shoulders and front of the thighs like the rest of the back. The red variety is called *L. rufus* by Geoffroy. The 3rd variety is described as pure white; but this we have not got.

I believe the variously coloured specimens are all males, showing a great mutability in that sex. On the other hand, all the females that I have hitherto seen are of one colour, brown, with white whiskers—*Lemur leucomystax*, Bartlett.

XLIII.—*Description of a new Species of the Family* Pittidæ. By John Gould, F.R.S. &c.

Pitta (Phœnicocichla) arquata, Gould.

Forehead, lores, and throat reddish buff; crown, nape, and breast rich rusty red; over (but posterior to) the eye a lovely stripe of blue, as in *Pitta granatina*; a broken tooth-like bar of the same beautiful hue across the breast, separating the rich rusty red of the chest from the deep scarlet of the abdomen; upper surface of the body and scapularies brownish olive-green; primaries and secondaries brown, tinged with green; the secondaries are also tipped with splendid blue, but not so conspicuously as in *P. granatina*; tail blue, tinged with olive; legs and bill black.

Total length 6 inches; bill 1, wing $3\frac{1}{4}$, tail $1\frac{1}{4}$, tarsi $1\frac{1}{2}$.

Hab. Borneo.

Remark. This new species is somewhat allied to the *Pitta granatina* of Temminck and the *Pitta concinna* of Eyton. If there be any difference in size, it is perhaps a trifle smaller than either of those species, but is at once distinguished from both by its very remarkable colouring, which in some respects resembles that of the *Pitta erythrogastra* of Temminck. The specimen above described is supposed, with some probability, to be a female; if so, the male, when discovered, will prove to be a still more lovely bird.

XLIV.—*On some points in the Myology of the Chimpanzee and others of the Primates.* By ALEXANDER MACALISTER, Professor of Zoology and Director of the Museum, University of Dublin.

A YOUNG female Chimpanzee was purchased by the Rev. Dr. Haughton for the Dublin Zoological Gardens during the past year; she was in feeble health, and after a short time died; and a very careful dissection of her body was made by Dr. Haughton and myself. As this species has been frequently dissected, and as records of its anatomy have been published by Vrolik (Recherches d'Anat. Comparée sur le Chimpansé, 1841, Amsterdam), Prof. Jeffrys Wyman (Proc. Boston Soc. of Nat. Hist. Nov. 21, 1855, vol. v.), Burt G. Wilder (Boston Journ. of Nat. Hist. 1862, vol. vii. No. 3. p. 352), Prof. Huxley (Med. Times & Gazette, 1864, p. 429), Prof. Humphry (Journ. Anat. & Phys. 1867, vol. i. p. 254), there is no necessity to refer to any of the structural points in which my dissection agrees with those already published. I will content myself with noticing such points as either have escaped the attention of these authors, or in which the animal dissected by us differed from those previously examined.

The poor creature was suffering from an extensive necrosis of the lower jaw; and this prevented us from observing the natural arrangement of the parts in this locality.

The occipito-frontalis was very thin and weak. Wilder found the fleshy fibres seemingly to meet at the vertex, both from the occipital and frontal bellies; this I did not notice, but found it arranged as in man. This is interesting; for I have elsewhere recorded the occurrence of a continuity of the occipital and frontal bellies of this muscle as a rare anomaly in man. The occipital belly was thicker than the frontal. I have found an occipito-frontal in every quadruman which I have dissected. In the Orang, Tyson and Traill state that they could not find it; but Prof. Owen traced it distinctly in this animal. The commonest form of occipito-frontalis in Quadrumana, I think, is that described by Dr. Wilder; for I have found it in *Ateles paniscus*, *Macacus cynomolgus*, *Cebus capucinus*, *Cercopithecus sabæus*, *Cynocephalus porcarius* and *hamadryas*.

The retrahens aurem was split into two in the manner that most commonly occurs in man; and it received a slip from the transversus nuchæ, which arose as usual from the middle line of the occipital bone, and passed outwards, overlying the trapezius; it crossed the occipital artery and occipitalis-minor nerve. This muscle was found by Prof. Franz E. Schultze, of Rostock, as a human muscle, and has not been noticed before in this animal. Wilder found the retrahens aurem with its upper border touching the occipito-frontalis.

The atollens aurem was very weak and indistinct, not nearly so large as the muscle which Wilder found over the parietal and frontal bones.

The attrahens aurem I could not distinguish; but it was found by Wilder as a slip parallel to the anterior border of the occipito-frontalis. The lobe of the ear was very short.

Of facial muscles the orbicularis palpebrarum was extremely indistinct and weak, but seemed to consist of orbital, ciliary, and subtarsal portions (Möll.). A triangular *dilatateur supérieur* (Bourjut St.-Hilaire) was present; but the tensor tarsi (Duvernoy and Horner) was scarcely detectable; and the valvula superior of the nasal duct was very weak and imperfect. The corrugator supercilii was inseparable from the orbicularis palpebrarum, as described by Fabricius in man: this, indeed, is the commonest arrangement among the Primates, as in *Troglodytes*, *Macacus*, *Cercopithecus*, *Hapale*, *Cynocephalus*, *Ateles*, *Mycetes*, *Cebus*, and *Cercocebus* this is the arrangement.

The pyramidalis nasi was absent. The compressor nasi was represented by a little cellular tissue. In a Bushwoman, Messrs. Murie and Flower describe it as "distinct, though scanty of fibres." It is generally extremely rudimentary in Quadrumana (Journ. of Anatomy, vol. i. p. 196). The zygomatics were inseparably united—not an uncommon human anomaly. A slip from the levator labii superioris took origin from the lower border of the tendo palpebrarum; otherwise this muscle could not be divided into two parts.

The other facial muscles were destroyed by the disease. The orbital muscles showed nothing abnormal.

The platysma has been described by Vrolik. I have found this muscle only in rudiment in other Quadrumana; but in the Chimpanzee it is developed as in man. There was not any other portion of the panniculus carnosus developed, as Dr. Wilder very accurately observes.

The sterno- and cleido-mastoids were separable and related to each other as in man, the former being the larger of the two in the proportion of 19 to 4; this is noticed by Wilder, but the proportion is not given by him. In the Gorilla, Duvernoy states that the cleido- exceeds the sterno-mastoid, but Prof. Wyman found it not so; however, the sterno-mastoid is much the smaller in *Cercopithecus*, and the two are inseparable; it is still smaller but present in *Macacus* (*rhesus*, *sinicus*, *nemestrinus*, and *cynomolgus*) and *Inuus sylvanus*: Vrolik states that it is absent in the latter genus (Cyclopædia of Anatomy and Physiology, art. "Quadrumana," vol. iv. p. 203). The spinal accessory nerve pierces the muscle in the Chimpanzee as in man. The omo-hyoid is extremely feeble, but biventral, and, as usual, scapular in origin; Vrolik states that it is absent in *Inuus* and *Cynocephalus*; but I have found it in the *Inuus* and in *Macacus cynomolgus*, as well as in *Cynocephalus porcarius* and *hamadryas*. Inscriptiones tendineæ cross the bellies of the sterno-hyoid and thyroid muscles, which are otherwise as in man.

Of the laryngeal muscles none were far removed from the human type. No trace of the muscle described by Eschricht in the *Hylobates albifrons* (Archiv für Anat. 1834, p. 218) was present. No kerato-cricoid, triticeo-glossal, or other of the curious aberrant fascicles so frequently found in the neighbourhood of the human larynx could be seen, except a small kerato-arytenoid muscle on the left side: this muscle is described as an anomaly in man by Professor Gruber, under the appellation "Schildknorpelhorn-Giessbeckenknorpelsmuskel."

Digastric. I did not notice a splitting of its broad anterior belly, as described by Wilder; but that such should be the case is what one might expect from the analogy of other Quadrumana: the anterior belly is split in some *Cercopitheci*; and in the *Macacus rhesus*, *cynomolgus*, and *nemestrinus* the mesial tendon is prolonged from one side to the other above the hyoid bone: this I have found the commonest arrangement in Quadrumana. The thyro-hyoid, genio-hyoid, and other lower-jaw muscles were matted together by the products of the inflammation of the lower jaw, and were consequently undistinguishable.

The muscles of the back were carefully dissected, and exhibited the following points:—The trapezius extended down to about the tenth dorsal spine, and overlapped the latissimus dorsi, but was very thin and indistinct at this part. Wilder found it to be apparently continuous with the latissimus dorsi; and Vrolik notices the same. Duvernoy found it arranged in the Gorilla as I have above described in the Chimpanzee; and I found the same arrangement in an undetermined species of *Macacus*; in general, however, in the lower monkeys the inferior part of the trapezius is with difficulty separable from the latissimus dorsi, as it becomes thinned and gradually lost below. The human character of the rhomboidei (being without the occipital slip) has been noticed by the various authors whose dissections have been published; the *major* and *minor* portions are scarcely divisible, as very often occurs in man. The levator anguli scapulæ is also peculiar for its possessing no connexion with the serratus magnus—a condition which is very constant in all the lower monkeys. The quadrumanous levator claviculæ (omo-atlantic) was very weak, but present; it only weighed $\frac{1}{500}$ of an ounce avoirdupois on each side: as I have elsewhere described, this is a rare human anomaly. The serratus magnus was divisible into three parts, as in man; Dr. Wilder found it only cleft into two in his specimen: the upper was attached to the first, second, and third ribs, the second to the fourth and fifth, and the lower to all the ribs between the fifth and twelfth (eleventh, Wilder, p. 356). The latissimus dorsi detached from its border a dorsi epitrochlear, which was short and ended in a fascia in the middle third of the arm, shorter than its corresponding part in most other Quadrumana, and proportionally feebler. The occurrence of this muscle as an anomaly in man has been noticed by Bergmann, and more recently by the late Professor Halbertsma (under the name anconeus quintus). It only weighed $\frac{1}{40}$ of an ounce.

The splenius capitis was quite distinct from the splenius colli, and its origin extended from the fourth to the seventh cervical vertebræ: the splenius colli arose from the spines of the last cervical and the six upper dorsal vertebræ, and was inserted into the four upper cervical transverse processes. The division between these muscles is seldom so well marked in Quadrumana.

The serratus posticus superior passed over the upper pair of ribs, and was inserted into the third, fourth, and fifth. The serratus posticus inferior is larger, but thinner, and attached to the lowest five ribs. The trachelo-mastoid is digastric, and extends from the transverse processes of the uppermost pair of dorsal and lower two cervical vertebræ; its insertion is as usual. Beneath it is a second, deeper trachelo-mastoid, perfectly separate, which arises from the transverse processes of the second, third, and fourth cervical vertebræ, and is inserted underneath the last muscle. I have not found this second trachelo-mastoid in any other quadruman.

The deeper spinal muscles resemble those of man in all respects.

The great pectoral was anthropoid, not segmented as described by Sandifort in the Orang, its clavicular and sternal fibres being inseparable at the insertion; the former occupied half the clavicle; the muscle gave rise to a tendon which was split into two laminæ. There was no pectoralis quartus, a muscle so commonly existing in other of the lower Primates. The pectoralis minor did not extend beyond the coracoid process, in which respect it differed from the corresponding muscle in the specimen described by Prof. Humphry (*loc. cit.* p. 266), as in his case it crossed the process to the great tuberosity of the humerus. In Dr. Wilder's specimen it was inserted into the coracoid on the left and into the humerus on the right. Prof. Humphry remarks that this is the most common quadrumanous arrangement; but though this is quite true as regards the humeral or capsular insertion of the pectoralis minor, yet it is, in my experience, far from common to find a lesser pectoral in monkeys crossing the coracoid process. I I have found the lesser pectoral thus inserted either into the greater tuberosity or the capsular ligament in *Macacus rhesus*, *cynomolgus*, *sinicus*, *nemestrinus*, *Inuus sylvanus*, *Cercopithecus ruber* and *sabæus*, *Colobus*, *Cebus apella* and *capucinus*, *Cercocebus fuliginosus*, *Cynocephalus porcarius*, and others.

Above the lesser pectoral on the left side was a small muscle, somewhat similar to a remarkable human anomaly described by Prof. Gruber, of St. Petersburg, the tensor semivaginæ humero-scapularis; it arose from the cartilages of the third and fourth ribs, and, passing outwards over the tendon of the lesser pectoral, was inserted into the capsule of the shoulder, under cover of the deltoid. In the Gorilla, Prof. Duvernoy found a second lower part of the lesser pectoral inserted into the short head of the biceps; and the same was seen by Prof. Wyman. No such arrangement existed in our Chimpanzee: the little tensor above described seemed at first sight like a second lesser pectoral; but its insertion was superficial to the seat of the normal attachment of a prolonged lesser pectoral tendon, if such had been present. The subclavius was normal, and the costo-coracoid membrane overlying it was, as usual, split by the pectoralis-minor tendon at its outer end. This is an extremely common human arrangement. The ligaments of the shoulder-joint are very like those of man, but all the accessory ligaments are weak: this is not the case in all monkeys; for I have found both the gleno-humeral ligament (Flood's) and the inferior ligament of Humphry very strong and cord-like in *Cercopithecus ruber*. (A specimen showing these I have placed in the Museum of the Royal College of Surgeons, Dublin.)

A very slight rudiment of a coraco-brachialis brevis was present, a muscle which has not been noticed by Wilder, but was seen by Vrolik; the rest of this muscle was split by the musculo-cutaneous nerve, and extended down rather further than usual on the arm. The coraco-brachialis brevis I have found in all the Quadrumana which I have dissected, either as a tendinous or muscular slip; it seems much more constant in them than in man.

The three scalenes were normal, not extending downward on the thorax beyond the second rib, as in man, and thus differing from the arrangement seen in almost all the lower monkeys. There is no rectus sternalis, nor supracostalis, nor was the rectus abdominis prolonged upwards on the thorax. The deltoid was normal, not continuous with the triceps and brachialis as it was in Prof. Humphry's animal (*l. c.* p. 264).

The supraspinatus was to the infraspinatus as 10 to 15, the teres minor was one-fifth the size of the infraspinatus, and the subscapularis was nearly equal to the sum of the two spinati. There was no subscapularis secundus or subscapulo-humeral separate; but a fleshy lower slip of the subscapularis seemed to represent it. The biceps and brachialis anticus were normal, and the two humeral heads of the triceps were with difficulty separated. The anconeus was small, and there was no anconeus epitrochlearis. The supinator longus did not arise as high as it did in Dr. Wilder's specimen, but its tendon was attached to the lower fourth of the radius. There was no coronoid origin of the pronator teres. The palmaris longus arose tendinously, and equalled the pronator teres in size. Traill failed to find it on one occasion; but all other authors describe it. The radial and ulnar flexors of the carpus were nearly equal, the radial on the left side being slightly larger than the ulnar, but they were both equal on the right; this was not the case in Wilder's animal (*loc. cit.* p. 363).

The flexor sublimis was three-eighths of the flexor profundus in weight, and had no radial origin; this has been remarked before: it had four tendons, as usual. Mr. Moore found, in the right arm of the Chimpanzee which he dissected, that the ring-finger received two tendons, and the little finger none; but in the left arm Dr. Wilder found it as in ours (Wilder, *loc. cit.* p. 365).

The flexor profundus et pollicis was a single muscle sending off five tendons to the four fingers and thumb; these all arose side by side, and the indicio-polliceal part was not separate as Wilder found it, or as Duvernoy saw it in the Gorilla; nor did the polliceal tendon cross the others, as it did in Prof. Humphry's specimen. This polliceal tendon seems thus to vary remarkably in its position and course. Vrolik found it with no tendon to the thumb. Humphry found it in one Chimpanzee as a slender tendon arising from the palmar fascia and going to the last phalanx of the thumb, and in another as a long thin tendon from the ulnar side of the flexor profundus (*l. c.* p. 267). Wyman found it as in ours; and Wilder found it conjoined with the flexor profundus indicis.

The pronator quadratus was very small and thin, but occupied the lower third of the radius, and was exceedingly weak. The radial extensors of the carpus were separate and nearly equal; and the short supinator was very large, equal to the combined round and square pronators in weight; the posterior interosseous nerve pierced it as usual. Neither the tensor ligamenti annularis anterior nor posterior (Gruber and Cruveilhier) was present.

The extensor digitorum longus sent single tendons to the second, third, fourth, and fifth fingers, and was not divisible readily, as was the case in Wilder's animal. This author, Vrolik, and Moore describe the absence of the little-finger tendon of this muscle.

The extensor minimi digiti went to the fifth finger alone, by a single tendon. The extensor carpi ulnaris was only half the size of either of the radial extensors, and had a distinct ulnaris-quinti tendon prolonged onwards to the first phalanx of the little finger. The indicator sent a tendon to the middle finger, and arose as usual; in Wilder's specimen it only supplied the index, and arose a little lower than usual. Prof. Humphry found the middle-finger slip in his animal (*loc. cit.* p. 267).

The extensors of the thumb agreed exactly with those described by Prof. Humphry, except that the first of his muscles went to the scaphoid and metacarpal bones, whereas in ours it ended in the trapezium; the second was, as he describes, attached to the metacarpal bone, and the third to the last phalanx of the thumb; the second of these was in size equal to the sum of the other two. Vrolik, Wilder, and Wyman have found the same arrangement.

The lumbricales were like those of man; and the fourth arose from its proper tendon, not as in Wilder's specimen. All the thumb-muscles were as in man. The abductor was not split into Sömmerring's slips; and the flexor brevis did not extend beyond the first phalanx, as Humphry found in his specimen. The interossei were also arranged on the human type; these muscles, though usually regular, are not always absolutely constant in this mode of arrangement in Quadrumana. Thus the disposition in *Ateles fuliginosus* (in which the thumb is only represented by a rudimentary metacarpal bone little more than half the length of the second metacarpal) is as follows:—Of palmar interossei there are, 1st, a normal first palmar, from the second metacarpal to the index finger; 2ndly, a thin superficial palmar interosseus arising from the front of the third and fourth metacarpal bones, and inserted into the ulnar side of the first phalanx of the index finger; this muscle looks like an adductor pollicis with a displaced insertion: the two other palmar interossei are normal. To the metacarpal bone of the pollex two small muscles are attached, one on the ulnar and one on the radial side, both springing from the second row of the carpus; the inner of these may either be an interosseus primus volaris or a flexor; the outer is evidently the adductor*. The flexor tendons in the Chimpanzee were not so contracted as those in Wilder's Chimpanzee, and they permitted the perfect extension of the fingers.

The muscles of the hinder limb were as follows:—Gluteus maximus and tensor vaginæ femoris forming one thin expansion, quadrilateral in shape, but with the femoral side prolonged; it equalled the gluteus medius in weight. Of all the muscles in the body this is perhaps the least anthropoid in appearance. Prof. Humphry found the tensor vaginæ femoris separate; but Wilder found them continuous, and describes the latter part as being larger than in man, while the lowest portion was also thick and strong. All agree in having seen this muscle extend along the entire of the back of the femur. It was not in our specimen continuous with the popliteus or external gastrocnemius, as found by Prof. Humphry. The gluteus medius, though wide, was only half the weight of the gluteus minimus, instead of being the largest of the three glutei, as it was in Dr. Wilder's Chimpanzee (*l. c.* p. 369); the latter muscle did not arise from the coccyx—a point about which Dr. Wilder was not certain. The gluteus quartus or scansorius was one-fifth the size of the gluteus medius; it has been found by Traill, Wilder, and Wyman, but was not found in Prof. Humphry's specimens. The pyriformis was perfectly separate; the gemelli were joined to the internal obturator, which was to the external obturator in the proportion of 6 to 5; the quadratus femoris was also present, and about half the size of the external obturator.

The psoas parvus was present on both sides, and was one-thirteenth the size of the psoadiliac muscle; it was not found by Vrolik, Wilder, or Wyman. The psoas magnus and iliacus are inseparable, and the anterior crural nerve lies on the inner side of both muscles. The pectineus was distinctly bilaminar; the three adductors also could be without any laceration separated, and they were developed in the following proportions:—pectineus, adductors longus and brevis nearly equal; adductor magnus nearly twice their combined weights.

* In the forearm of this specimen of *Ateles fuliginosus* I found a tendinous slip passing from the middle of the tendon of the flexor carpi radialis and running inwards to join the tendon of the palmaris longus, just as the last-named joined the apex of the palmar fascia.

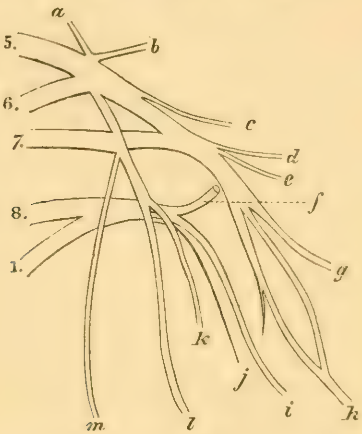
The sartorius is long, but normal; the rectus has but its straight single origin; and the parts of the quadriceps are thus related:—vastus externus = 13, rectus = 5, and the combined vastus internus and crureus = 14. There is no subcrureus. The biceps is arranged as in man. The semitendinosus presented its usual inscription; and the semimembranosus was, as described by Prof. Humphry, quite separate from the fascia. These hamstrings are developed in the following proportions:—biceps ischiaticus = 2, femoralis = 6, semimembranosus = $1\frac{1}{2}$, semitendinosus = $2\frac{1}{2}$. The femoral biceps nearly equals the vastus externus, and the ischiatic equals the rectus; the gracilis is larger than the semitendinosus. Altogether the flexors of the knee by weight are to the extensors as 150 to 100.

The popliteus was small, and had no sesamoid nodule in its tendon, thereby agreeing with Wilder's and differing from Vrolik's specimen. Traill did not find it present. The gastrocnemius internus was to the externus as 8 to 5; they were separate as far as the tendon; they were not quite fleshy to the heel, as Wilder found them. There was no tibial head of the solæus; but the fibular origin of this muscle was very large. Prof. Humphry found in one Chimpanzee that it was reduced to a small musculo-tendinous slip from the head of the fibula; and the same is described by Prof. Huxley (*l. c.* p. 429). The former author found a distinct tibial head to the solæus in a Chimpanzee. The plantaris was extremely fine and its tendon was inserted separately into the os calcis on the left side; on the right it was absent. This was just the contrary of the arrangement seen by Wilder, who found the muscle suppressed on the left and present on the right. Vrolik also found it, and so did Huxley and Humphry, while Traill reports its absence.

The tibialis anticus is double, one tendon being inserted into the scaphoid and one into the entocuneiform and the metatarsal bone of the hallux; this has been noticed by Vrolik, Wilder, Humphry, and Wyman. The extensor digitorum sends a tendon to all the toes, as Wilder found. The peronæus tertius was absent, as it is in all the Quadrumana, the so-called peronæus tertius of Wyman in the Howling Monkey being a peronæus quinti. The other peronæi were anthropoid. The extensor hallucis was normal, as also was the tibialis posticus. The flexors were as described by the various authors.

In the dissection I carefully sought for the various nerve-arrangements, and found in them few varieties which were not anthropoid; the disposition of the cervical plexus, the phrenic and vagus nerves were just as in man; the anterior crural lay internal to the psoas; otherwise the branches of the lumbar and sacral plexuses were not noteworthy. The coccygeal gland was very small, far more indistinct than in the *Macacus rhesus* or *cynomolgus*.

The brachial plexus, however, was arranged upon a type diverse from the ordinary human method of arrangement. The method of its branching can be better seen in the figure than it could be understood from a description.



Brachial plexus of Chimpanzee.

a, branch to fourth; *b*, muscular; *c*, suprascapular; *d*, anterior thoracic; *e*, posterior thoracic; *f*, circumflex; *g*, external cutaneous; *h*, median; *i*, musculo-spiral; *j*, lesser internal cutaneous; *k*, internal cutaneous; *l*, ulnar; *m*, posterior thoracic.

The general conclusions which can be drawn from this dissection are the following:—1. The facial muscles and head-muscles in this specimen were even more human than any of those hitherto described. The very strong risorius Santorini noticed by Vrolik may have existed; but the facial disease matted together the parts in this locality. 2. The neck- and laryngeal muscles were in general also far more anthropoid than pithecoid; this is especially true regarding the platysma, digastrics, omo-hyoid, and the laryngeal muscles, as well as the scaleni. 3. The back-muscles were anthropoid in the separateness of the levator anguli scapulæ and the serratus magnus, in the non-development of the occipital rhomboid, but pithecoid in the presence of a dorsi epitrochlear and of a levator claviculæ; the other shoulder-muscles were anthropoid. 4. The upper limb-muscles departed from the human type in the absence of a coronoid head of the pronator teres, of a radial origin for the flexor sublimis, and of a specialized flexor pollicis longus; but the presence of a third thumb-extensor and the limitation of the extensor minimi digiti to the fifth finger are tendencies towards the anthropoid disposition of parts. The small and variable psoas parvus, the absent pyramidalis, are interesting in consideration of the variability of these parts in man. 5. In the lower limb the most decidedly pithecoid features are the small size of the gluteus maximus and its elongated insertion, the position of the semimembranosus, the absence of a tibial head of the solæus and of the peronæus tertius, and the doubling of the tibialis anticus.

XLV.—*Contributions to the Crag-Fauna.* Part II.*

By Alfred Bell.

Close research in some new sections and excavations that have been made in the Suffolk-Crag district during the past autumn and winter has produced some very interesting results. Upwards of fifty species of shells (some being undescribed) new to our English Crags, and more than thirty species of others which occur at different horizons to those known previously, have amply rewarded the efforts of my brothers and self, the Red-Crag Polyzoa being also increased from fifteen to thirty species.

Species marked thus * signify the new additions; the others are simply new to the horizon to which they are referred.

C. C., R. C., Norw. C., and Chil. ser. are used as contractions for the Coralline, Red, and Norwich Crags, and the Chillesford series.

Mammalia.

**Balæna emarginata*, Ow. The only previously recorded cetotolite from the C. C. (now in the Museum of Practical Geology) was obtained by Col. Alexander, many years since, and is of another species, probably *B. gibbosa*, Ow. C. C. Orford. Second examples of *Castor veterior*, Lamk. (an incisor), and *Ziphius mediilineatus*, Ow., have been lately obtained by myself in the Red Crag.

Pisces.

No list of Crag fishes having been published (probably owing to the difficulty of identifying the fragmentary portions of the skeleton met with), I offer the following short one,

* For Part I. see Ann. & Mag. Nat. Hist. Sept. 1870.

based upon the teeth and otolites, the latter determined by Mr. Higgins.

Anarrhichas lupus, L. R. C. Waldringfield.
Carcharodon megalodon, Agas. R. C. Waldringfield.
Merlangus pollachius, Flem. C. C. (common).
—— *virens*, L. C. C. (very rare).
—— *vulgaris*, L. C. C. (very rare).
Morrhua æglefinus, L. C. C. (very rare).
—— *lusca*, L. C. C. (common).
—— *minuta*, L. C. C. (very rare).
—— *vulgaris*, Cuv. C. C. (common). R. C. Shottisham (very rare).
Platax Woodwardi, Ag. R. & Norw. C.
Raia antiqua, Ag. R. & Norw. C.
——, sp. R. C. Walton-Naze and Butley.

Sharks' teeth (of several genera, *Otodus*, *Lamna*, *Oxyrhina*, &c.) are very abundant in the lower division of the Red Crag, but are scarce in the Coralline Crag, and are generally considered to be derived from the abrasion of older deposits, chiefly London Clay. I venture to put in a word in favour of *Carcharodon megalodon*, Ag., being a native of the Red-Crag sea. Its distribution in Miocene times being world-wide, the British-Museum collection containing examples from Malta, Bordeaux, Maryland, Aspinwall (Panama), and New Zealand, it is likely to have lived on for some little time after the Miocene epoch had passed away.

The only sharks' teeth that I have seen in the Coralline Crag are a species of *Lamna* (1 sp.) and one of *Oxyrhina* (3 sp.), closely resembling *O. xiphodon*, Ag., a fossil of the French and Belgian Miocenes. I have no doubt of the *Oxyrhina* being an inhabitant of the Coralline-Crag sea. A few vertebræ resembling the figures given by Agassiz of *Platax Woodwardi* also occur.

Crustacea.

Atelecyclus heterodon, Leach. C. C.
Cancer pagurus, L. C. & R. C.
Carcinas mænas, L. C. C.
Ebalia Bryerii, Leach. C. C.
* *Gonoplax angulata*, Leach. C. C.
Pagurus Bernhardus, L. C. C.
Portunus puber, L. C. C.

(This list includes two or three that I have extracted from Prof. Morris's catalogue.)

ECHINODERMATA.

Echinus sphæra?, Müll. (plates only). C. C. Sutton. I have little doubt of the identity of the fossil and recent forms, the only difference being in the size of the tubercles.
Echinus Woodwardii, Desor. R. C. Walton-Naze.
Echinocyamus pusillus, Müll. Chil. ser. Aldeby.
Spatangus regina, Gray. R. C. Sutton.
Temnechinus excavatus, S. Wood. R. C. Waldringfield and Foxhall.

ANNELIDA.

Serpula triquetra, Lam. C. C. Sutton.
—— *vermicularis* (rough var.). C. C. Sutton. R. C. Walton-Naze.
—— ——, Ellis (smooth var.). Chil. ser. Sudbourn.
**Sabellaria conchilega?*, Pallas. R. C. Shottisham Creek.
**Spirorbis nautiloides*, Lam. C. C. Sutton.
Ditrupa gadus, Mont. C. & R. C.

MOLLUSCA.

(Freshwater.)

Corbicula fluminalis, Müll. R. C. Waldringfield.
Paludina parilis, S. W. R. C. Waldringfield. Figured by A. Künth (Zeitschr. d. deutsch. g. G. Berlin, 1865) as *P. diluviana*. *Loc.* Tempelhof, near Berlin.
Limnæa palustris, Müll. R. C. Butley.
—— *truncatulus*, Müll. R. C. Butley.

(Marine.)

CONCHIFERA.

**Pecten septemradiatus*, Müll. R. C. Foxhall.
**Lima squamosa*, Lam. Encycl. Méthod. t. 206. f. 4. C. C. Gedgrave.
—— *exilis*, Wood, =*L. inflata*, Lam.
Pinna rudis, L. R. C. Walton-Naze.
**Pectunculus insubricus*, Broc. Conch. foss. Subap. t. 11. f. 10. C. C. Orford, Sutton.
*—— *pilosus*, Born. R. C. Waldringfield.
Limopsis aurita, Broc. R. C. Waldringfield.
—— *pygmæa*, Phil. In Sept. 1870 I catalogued this species in the Ann. & Mag. Nat. Hist. from Walton-Naze. I have since seen it from Waldringfield and Felixstow.
**Nucula nucleus*, var. *radiata*, Hanley. R. C. Waldringfield.
**N.* (*Acila*) *Lyallii*, Baird, Proc. Zool. Soc. Feb. 1863. The only specimen I have found is, unfortunately, imperfect in the hinge; but the size, form, and peculiarity of sculpture

render the identification of the fossil with the recent shell an easy matter. *A. Lyallii* has been considered a variety of *N. Cobboldiæ*, altered by time, distance, and physical conditions; but, as the latter shell is a present inhabitant of the Japanese seas (*N. insignis*, Gould, Otia Conchol. p. 175), there are reasonable grounds for separating the two into distinct species, the more so as they differ in some important particulars from each other. I quote Dr. Baird's remarks:—

"This species differs from it (*i. e. N. Cobboldiæ*) in being less transversely ovate, in having the beaks more prominent, the posterior row in the hinge fewer in number, and in the costations being stronger in proportion to the size of the shell, and much fewer in number."

They also differ in the size of the adult shell, in sculpture, structure, and tumidity.

For the opportunity of examining the recent shells I have to thank Sir Charles Lyell and Mr. Jeffreys. The fossil *N. Lyallii* occurs at Butley, and the recent shell in 8–12 fathoms at Vancouver's Island.

**Scacchia elliptica*, Scacchi (Philippi, En. Moll. Sic. t. xiv. f. 8). R. C. Butley. The *Kellia elliptica* of the Mon. Crag Moll. vol. ii. t. 12. f. 13, does not appear to me to be the same shell as Scacchi's.

Astarte gracilis, Wood (non Münst.). Dr. Weichmann informs me that the English and German shells are not identical. *A. Galeotti*, Nyst, corresponds to the Crag species (see Mon. Crag Moll.).

Tapes texturata, Lam. A double specimen, nearly perfect. R. C. Waldringfield.

Donax politus, Poli. N. C. Walton-Naze, Sutton.

Glycimeris angusta, Nyst. Norw. C. (Sir Charles Lyell's coll.).

Pandora inæquivalvis, var. *obtusa*, Leach. C. C. Gedgrave.

Gastropoda.

**Cancellaria varicosa*, Broc. Conch. foss. Subap. t. 3. f. 8. C. C. Gedgrave. R. C. Waldringfield.

*—— *Bonellii*, var. *dertonensis*, Bellardi, Mon. Canc. Piemonte, t. 3. f. 11, 12. C. C. Gedgrave.

*—— *contorta*, Bast. (Bellardi, Mon. Canc. t. 3. f. 7, 8). C. C. Gedgrave.

*—— (*Columbella*) *avara*, Say (Gould, Inv. Mass. fig. 197). R. C. Waldringfield. This species belongs to the same section (*Merica*, Ad.) of the Cancellaridæ as *C. mitræformis*, Broc., and *C. Fischeri*, H. Ad.

—— *costellifera*, Sow. (*C. Couthouyi*, Jay, = *C. crispa*, Möll.,

= *C. buccinoides*, Couth. Bost. Journ. Nat. Hist. vol. xi. pl. 3. f. 3), differs somewhat from the typical Crag form in being shorter, broader, with the costæ more erect, closer, and less pronounced. The two forms occur in the R. C. at Waldringfield &c.

Tritonium viridulum, Fabr., comprises both varieties.

**Fusus americanus*, A. B. R. C. Waldringfield.

—— *cordatus*, A. B. (Mon. Cr. Moll., *F. gracilis*, var. β, t. 6. f. 10 *b*). I have separated this variety from the typical form because the shell is covered from the apex to (nearly) the base of the canal with strong, corded, broad striæ, and is less variable in outline, is more slender, and has the canal less recurved than the ordinary form; apex blunt, but not mammillated.

—— ——, var. *contrarius*. R. C. Woodbridge.

**Trophon barvicensis*, Johnst. R. C. Walton, Shottisham Creek, &c.

Terebra canalis, S. Wood. To distinguish the next species from this, I subjoin a description of the shell, Mr. Wood not having given one in the Mon. Crag Mollusca:—

Shell dextral, conical, with a broad base; spire pointed, apex rather obtuse; whorls 11–13, sides nearly *flat*, the upper ones plicated; surface finely striated from apex to base; body-whorl rapidly contracting below; outer lip sharp, spreading towards the canal; canal recurved, open; pillar twisted, suture distinct. Long. $1\frac{1}{4}$ inch.

Columbella minor, Philippi, differs from this shell in size only.

**Terebra exilis*, A. Bell, n. sp. Shell dextral, *slender*, apex obtuse or slightly mammillated; whorls 12–14, *convex*, contracting *towards* the top, suture well marked; plaits slight on upper whorls, finely striated longitudinally; columellar lip reflected; mouth small; canal recurved. Long. 1 inch.

Nassa pygmæa, Lam. R. C. Butley.

*—— *granifera*, Dujardin, Mém. Soc. Géol. France, vol. ii. pl. 20. f. 11, 12. C. C. Gedgrave.

*—— *Ascanias*, Brug. R. C. Waldringfield &c. The Mediterranean representative of *N. incrassata*.

*—— *pulchella*, A. Bell, n. sp. Shell ovate, turriculate; whorls 6, convex, plicated, deeply striated or grooved, groovings passing across the plaits, which are carried to the base of the shell; spire short, terminating in a point; suture deep; mouth roundly dilated below, acute above; outer lip slightly thickened (?), fluted in the interior by 11–13 narrow plaits; inner lip thickly enamelled, with a

strong ridge at the base; canal turned back. Long. $\frac{4}{10}$ inch, lat. $\frac{2}{10}$ inch. C. C. Gedgrave. R. C. Waldringfield.

**Nassa densicostata*, A. Bell, n. sp. The only specimen I have is, unfortunately, broken, wanting three or four of the upper whorls and part of the outer lip. It has some resemblance to *N. prismatica*, Broc., but is longer and slenderer. The costæ are slightly oblique, closely crowded, especially in the upper whorls. The whorls are covered with striæ, moderately elevated; pillar-lip having a fold at the base. Long. about $\frac{3}{4}$ inch.

Buccinopsis Dalei, Sow., var. *sinistrorsa*. R. C., near Woodbridge.

**Ranella anglica*, A. Bell, n. sp. Shell small; whorls 3–4 (apex wanting), convex, with coarse elevated ridges on the bottom whorl crossing the periodic growths (which are very distinct) and, extending to the mouth, becoming very marked at the base; mouth angulated above, outer lip spreading towards the base, where it is sharply angulated by one of the ridges; pillar reflected; canal rather open; umbilical chink small. Long. $\frac{6}{10}$ inch. R. C. Waldringfield.

Purpura lapillus, var. *incrassata*, S., closely resembles *P. septentrionalis*, Reeve (*Hab.* Sitka Sound, &c.), and is probably the same shell.

Cassidaria bicatenata, Sow. This shell is subject to considerable variation. Immature shells have the outer lip sloping inwards to the base, something like *C. tyrrhena*. I have had an uncommon variety from Sutton, in which the tubercles were almost absent, the shell narrow as compared with the usual type, the mouth long, and outer lip straighter. The Rev. Mr. Canham has a very fine example of this variety in his collection. Should it be distinct, *C. Canhami* would be a good name for the shell.

**Columbella scripta*, L. Figured in Olivi, Zool. Adr. t. 5. f. 1, 2, as *Murex conulus*. R. C. Walton-Naze, Waldringfield, and Shottisham Creek.

—— *sulcata*, Sow. The long and short varieties figured by Mr. S. Wood are so constant and easily distinguishable, even in immature specimens, that a separation into two species would not be perhaps altogether unadvisable. The short form is, as far as I have yet seen, a deep-water shell, and is confined to the Red Crag. The longer form I have seen in the Coralline. I would suggest the name *C. abbreviata* for the shorter shell.

Defrancia histrix, Jan. C. C. Sutton.

**Pleurotoma bicarinata*, Couthouy, Bost. Journ. Nat. Hist.

vol. ii. pl. 1. f. xi. The Crag form is larger than the American (type) shell, and is represented in size by Spitzbergen and Arctic specimens. I have had the pleasure of comparing the Crag shell with the recent species, through the kindness of Mr. Jeffreys. R. C. Butley.

Pleurotoma perpulchra, S. W. R. C. Walton-Naze.

—— *Bertrandi*, Payraudeau, Cat. des Moll. etc. Corse, t. 7. f. 12, 13. R. C. Bentley, Foxhall, &c.

*—— *decussata*, Philippi, En. Moll. Sic. t. 26. f. 23. Philippi's figure gives the cancellations rather coarser than is shown by the Crag shells; but, as these latter vary, I do not think there can be any doubt as to the identification being correct. C. C. Gedgrave.

*—— *harpularia*, Couthouy, Bost. Journ. N. H. vol. ii. p. 1, f. 10. R. C. Butley.

—— *tenuistriata*, A. Bell, = *Clav. lævigata*, S. Wood, non Philippi. C. C. Sutton.

—— *plicifera*, S. Wood. C. C. Sutton.

*—— *tarentini*, Phil. En. Moll. Sic. t. 26. f. 26. C. C. Gedgrave.

—— *pannum*, Basterot (Bellardi, Mon. Pleur. Piemonte, t. 2. f. 5), = *P. semicolon*, var. (S. Wood).

—— *violacea*, Mighels. R. C. Butley.

*—— ——, var. *gigantea*, = *P. arctica*?, Adams. Out of three specimens seen by myself all are deficient in the upper whorls. Judging from size and sculpture, they are the same as Mörch's variety, but are all less ventricose than their recent analogues. R. C. Waldringfield.

*—— *exarata*, Moll. R. C. Butley.

*?—— *gracile*, Phil. En. Moll. Sic. t. 11. f. 23. R. C. Waldringfield.

*?—— *pygmæum*, Phil. En. Moll. Sic. t. 26. f. 25. One specimen, in bad condition, but having the characters well marked, is all I have at present. R. C. Shottisham Creek.

*—— *gracilior*, A. Bell, n. sp. Shell elongately fusiform, attenuated, fragile; whorls 8–9, convex; ribs oblique, 9 or 10 on the body-whorl, with spaces between each, of the same breadth as the ribs; spire pointed; suture deep; mouth long and narrow, canal straight; pillar slightly flexuous; labial notch rounded, situate between the suture and the shoulder of the whorl, the whole covered with fine striæ. Long. $\frac{4}{10}$ inch, lat. $\frac{1}{10}$ in. C. C. Gedgrave.

*—— *striolata*, Scac. R. C. Shottisham Creek.

*—— *curtistoma*, A. Bell, n. sp. Shell (adult) nassæform; whorls 9, moderately convex, ribbed from fourth top whorl

to base; ribs stout, straight, widely separated; top whorls finely cancellated; spire long and pointed; mouth occupying two-fifths or less of the length; canal very short and open; labial notch deep, not very broad, situate upon the shoulder of the whorl; columellar lip straight, slightly polished, the whole of the lower whorls covered with fine striæ, some of which are occasionally more elevated than the others. Long. $\frac{6}{10}$ in. C. C. Gedgrave.

**Pleurotoma notata*, A. Bell, n. sp. Shell fusiform; whorls 7–8, convex, ornamented with ribs (8–9 on the second whorl) set erect and widely apart, diminishing in size towards the top, body-whorl falling in rapidly towards the base, forming an open canal; mouth narrow, outer lip sharp, inner lip strongly reflected over a slightly sinuous pillar; suture deep. The whole of the shell is covered with fine spiral striæ, some of which (6–8 on the body, diminishing to 2 on the next whorl) are coarse and elevated. In one of my specimens these coarse striæ are coloured pink. Marks of growth distinct; notch moderate, situated between the suture and shoulder of body-whorl. Long. $\frac{5}{10}$, lat. $\frac{3}{20}$ inch. C. C. Gedgrave.

*—— *volvula*, A. Bell, n. sp. Shell shuttle-shaped; whorls 6–7, flatly convex; ribs rather strong and oblique; suture channelled; spire shortly conical, apex pointed; body-whorl long; mouth narrow, canal longer than in last species; inner lip reflected over a nearly straight pillar; surface finely striated; notch as in last species. C. C. Gedgrave.

*—— *elegantula*, A. Bell, n. sp. Shell stoutly fusiform; whorls 7–9, convex, ornamented with close-set ribs, 10–12 on the second whorl; suture deep; mouth and canal open, pillar-lip reflected; notch sinuated rather deeply.

This species may be distinguished from *P. notata* by its stouter build and aspect, the greater number and prominence of the ribs, the spiral striæ being less pronounced; one, however, from its thickness, gives a subangulated look to the body and lower whorls, in which the ribs hardly reach the suture. Long. $\frac{7}{10}$ inch, lat. $\frac{2}{10}$ inch. C. C. Gedgrave.

The above three species have a general resemblance to each other; but as there are sufficient differences in them to enable a distinction to be made, I have considered them as separate species.

**Conopleura crassa*, A. Bell, n. sp. Shell thick, shortly conical, smooth, polished; spire occupying about half the length of the shell, apex pointed; whorls 8–10, slightly convex at bottom, constricted towards the top; suture slight, forming a channel on the top of the whorl; ribs stout, but hardly raised above the surface; mouth short, open, canal short and broad; pillar-lip straight, reflected, with the callus massed into a pad at the top, which forms one side of the labial notch; notch very large, broad, and deep; outer lip spreading. Long. $\frac{7}{10}$ inch. C. C. Gedgrave.

P. terebra, Dujardin, has a general resemblance to the above; but the diagnosis and figure are both too short for comparison. A worn specimen obtained from the R. C. appears to belong to this species.

Mitra ebenus, Lam. R. C. Waldringfield.

**Ovula adriatica*, Sow. (Mon. Crag Moll. tab. 2. f. 16, *Ovula Leathesii*, var.). A specimen in Mr. Jeffreys's collection is hardly to be distinguished from a Crag shell found by myself. It differs somewhat from the typical form in the expansion of the lower part of the lip. In all other particulars they agree. R. C. Butley.

**Natica borealis*, Sow. (Beechey's Voyage, pl. 37. f. 2). R. C. Butley. Norw. C. Thorpe, Suffolk. *N. borealis* bears the same relation to *N. grœnlandica* that is assumed by *N. occlusa* towards *N. affinis*.

*—— *grœnlandica*, Beck. R. C. Shottisham. Norw. C. Thorpe, Suffolk.

*—— *Alderi*, E. F. R. C. Butley, Shottisham Creek, &c.

Odostomia lactea, L. (*Chemnitzia elegantissima*, Mont.). R. C. Walton-Naze.

*—— (*Chemnitzia*) *plicatula*, Broc. Conch. foss. Subap. t. 7. f. 5. R. C. Walton-Naze, Butley.

—— (*Chemn.*) *internodula*, Wood. A shortly conical variety, unnoticed by Mr. Wood, is not uncommon in both the C. & R. C.

—— (*Chemn.*) *suturalis*, Phil. R. C. Waldringfield.

*—— *obliqua*, Alder. C. C. Sutton.

Triforis perversa, L. C. C. Sutton. *T. perversa* and *T. adversa* both occur in the C. C.

Cerithiopsis tubercularis, Mont. R. C. Shottisham Creek.

Vermetus glomeratus, Biv., = *V. intortus*, Mon. Crag Moll. t. 12. f. 8.

*—— *triqueter*, Biv. (Phil. En. Moll. Sic. t. 9. f. 21). R. C. Waldringfield.

—— *arenarius*, L. C. C. Orford.

Turritella planispira, S. Wood. R. C. Shottisham Creek.

*—— *subangulata*, Broc. Conch. foss. Subap. t. 6. f. 16. R. C. Waldringfield.

Cæcum mammillatum, S. Wood. R. C. Walton-Naze.

**Scalaria communis*?, Lam. R. C. Waldringfield.

**Menestho britannica*, A. Bell, n. sp. Shell slender, graceful, elongated; apex styliform and turned towards one side; whorls 8–9, slightly channelled at the top, and flatly convex, the last four diminishing rapidly; mouth entire, angulated above, broad below; pillar curved, suture deep; *sculpture* finely striated (under a lens) longitudinally. Long. $\frac{3}{10}$ inch, lat. $\frac{1}{10}$ inch. C. C. Sutton.

*—— *Jeffreysii*, A. Bell, n. sp. Shell short, broad, turreted, owing to the semiangulation of the upper part of the whorls; suture deep; whorls 5–6, the last composing three fifths of the entire shell; mouth long and oval, more so than in the foregoing species, and slightly patulated below; apex blunt; sculpture, deeply incised spiral striæ passing over the lines of growth, which are well marked; umbilical chink very distinct. Long. $\frac{1}{8}$ inch, lat. $\frac{3}{20}$ inch. R. C. Walton-Naze.

I have been able, by the kindness of Mr. Jeffreys (to whom I respectfully dedicate the species), to collate the above with an undescribed shell from the Greenland seas.

Hydrobia ulva, var. *subumbilicata*. R. C. Walton-Naze.

Rissoa striata, Mont. Chil. ser. Aldeby.

**Trochus bullatus*, Philippi, En. Moll. Sic. t. 28. f. 8. I have obtained two specimens, one decorticated (similar to the shell figured in the Mon. Crag Moll. t. 13. f. 4), from the Coralline Crag, Gedgrave. Prof. Seguenza has sent me a series of Philippi's *Trochus* in all stages of growth and preservation; and a close comparison of their sculpture and form enable me to correlate the Italian and Crag shells.

—— *millegranus*, Wood, non Philippi. R. C. Walton-Naze.

—— *multigranus*, Wood. C. C. Orford.

**Emarginula elongata*, Costa (Phil. En. Moll. Sic. t. 7. f. 13). C. C. Gedgrave.

Capulus unguis, Sow. (S. Wood, Mon. Crag Moll. t. 17. f. 2 *b*). This appears to be a deep-water variety (?) of *C. hungaricus* (if it is a variety). I have lately obtained it from the Coralline Crag at Gedgrave and the Red Crag of Waldringfield and Shottisham Creek. Mr. Wood mentions it from Sutton. I consider it to be a distinct species.

**Brocchia sinuosa*, Brocchi, Conch. foss. Subap. t. 1. f. 1. C. C. Gedgrave. This genus, established by Bronn, is in some respects unsatisfactory; but the constancy and position of the folds, both in the Suffolk, Belgian, and Italian shells, can hardly be the result of accident; and the occurrence of two other forms in the English Crag, equally distinct in outline and constancy of folding, seems to necessitate the separation of these sinuated forms from the ordinary run of *Capuli*, particularly as the adhesion of the latter is effected more by the long velvety epidermis than the test itself. The genus, being adopted by so many continental malacologists, is perhaps as well kept in the present instance as not. The whole of the fossil *Capuli* need revision.

Prof. Biondi, in a memoir upon this genus, enumerates eight species, one of which (*B. Meneghinii*, t. 5. f. 2) may be the one described by myself as *Capulus? incertus*. If it is so, my name must be expunged.

**Dentalium rectum*, Gmelin. R. C. Waldringfield.
—— *costatum*, Sow., =*D. dentalis*, L.

POLYZOA.

Coralline Crag.

Membranipora Savârtii, And. Sutton.

Red Crag.

Alveolaria semiovata, Busk. Waldringfield.
Cellepora cæspitosa, Busk. ,,
—— *compressa*, Busk. Waldringfield, Butley.
—— *edax*, Busk. Waldringfield (on *Littorina littorea*).
Eschara monilifera, M.-Edw. Waldringfield.
—— *sinuosa*, Busk. Waldringfield, Butley.
—— *Sedgwickii*, M.-Edw. R. C. Walton-Naze.
Fungella multifida, Busk. Butley.
Hemeschara imbellis, Busk. Waldringfield.
Heteropora pustulosa, Busk. Waldringfield.
Hornera frondiculata, Lam. Waldringfield, Foxhall.
—— *infundibulata*, Busk. Waldringfield, Sutton.
—— *rhomboidalis*, Busk. Waldringfield.
—— *striata*, M.-Edw. Waldringfield.
Lepralia Peachii, Johnst. Waldringfield (on otolite of *Phocæna*).
Membranipora Pouilletii, And. Waldringfield.
Salicornaria crassa, S. Wood. Walton-Naze.
—— *sinuosa*, Hassall. Walton-Naze.

Chillesford Clays.

Membranipora monostachys, Busk. Sudbourn.

ACTINOZOA.

Solenastræa Prestwichi, Duncan. R. C. Waldringfield.

PROTOZOA.

Clione celata, Grant. R. & C. C.

PLANTÆ.

Conifer, sp. R. C. Waldringfield.

XLVI.—*Physico-chemical Investigations upon the Aquatic Articulata.* By FÉLIX PLATEAU. Part I.*

THIS first part includes the investigation of the phenomena presented by the aquatic Articulata (Insects, Arachnida, and Crustacea) when placed in liquids the saline composition of which is not the same as that of the waters in which they habitually live. In the present memoir I have left out of consideration mineral waters properly so called, as their extremely varied composition would have necessitated a considerable number of experiments the results of which would have been of little use.

The influence of sea-water, or of salt water, upon the Articulata which usually inhabit fresh water, and that of fresh water upon the marine Articulata, on the contrary, possessed some real scientific interest. We have long known several species of fish which are able to live indifferently in both liquids, and we also know that there are Crustacea and beetles endowed with the same faculty. But, side by side with these few exceptions, what an enormous quantity of aquatic species which always seek the same water and the same conditions, and to which the least modification seems to be injurious! Why should the carnivorous larvæ of the fresh waters have a repugnance to exchange their ordinary fare for species of *Mysis*, *Slabberina*, and *Cetochilus*, or even young marine fishes? What is the cause that prevents many marine Crustacea from ascending the rivers by the aid of the tide, and taking up their abode in waters rich in living prey, and where, by their strength and the hardness of their integuments, they would soon reign as masters?

The very nature of the experimental researches to which these reflections have led me renders a summary exposition of them very difficult. As it is impossible here to reproduce the tables containing the results of numerous experiments, I shall confine myself to the enunciation of the various conclusions at which I have arrived, following these, if there is occasion, with some observations or with a few examples.

* Abstract of a Memoir in the 'Mémoires de l'Académie Royale de Belgique,' 1870. Communicated by the Author.

Freshwater Articulata.

1. Sea-water has, if any, only a very slight influence upon the aquatic Coleoptera and Hemiptera in the perfect state; this influence may be a little greater upon the larvæ.

2. Sea-water produces injurious effects upon the freshwater Articulata with a delicate skin or furnished with branchiæ; and these effects are, in general, the more marked in proportion as the delicate surface is considerable.

Thus larvæ of *Agrion* appear to live indefinitely in sea-water, whilst those of *Cloëon* die in it on the average in two hours and three minutes. Among Crustacea *Gammarus Roeselii* and *Asellus aquaticus* resist the action of sea-water for several hours; whilst the Cladocera, Ostracoda, and Copepoda perish in a few minutes. A special table shows the influence of the thickness of the integuments and of the presence or absence of branchiæ.

3. The freshwater Articulata which can live with impunity in sea-water are those in which no absorption of salt takes place by the skin; those which die in it in a comparatively short time have absorbed chlorides of sodium and magnesium.

The direct experiments which I have been able to make upon the aquatic Articulata had, as their starting point, a very important experiment of M. Claude Bernard's, which has lately been referred to and developed by M. H. Emery. M. Emery placed a frog in water containing about 25 per cent. of common salt. The frog at first moves about rapidly; in from three to five minutes it becomes insensible and motionless; it is then washed carefully and placed in pure distilled water, when the animal soon resumes its activity, and the distilled water is found to furnish an abundant precipitate with nitrate of silver.

I simply transcribe the description of a single one of my experiments, in order to show clearly how I operated in all those relating to the absorption by the skin or to the excretion of the salts of sea-water.

After ascertaining that the distilled water of which I was going to make use gave no precipitate with nitrate of silver, and carefully washing with this same water the glass tubes necessary for my experiments, I placed nine individuals of *Asellus aquaticus* in a solution of common salt containing (by weight) 6·092 of salt and 96·954 of water—that is to say, a quantity of salt exactly double that contained in sea-water.

The *Aselli* remained in this solution for eighty-seven minutes, at the end of which they manifested uneasiness; they were then taken out, placed for a moment upon bibulous paper, and then washed five times with distilled water, until the last washing-water scarcely produced a perceptible turbidity with nitrate of silver. The nine *Aselli* were then placed for the sixth time in pure distilled water (10 cubic centimetres) and left therein for two hours. At the end of this time they had recovered all their vivacity; and the water in which they had remained furnished, with nitrate of silver, a distinct *precipitate* of chloride, soluble in ammonia.

I have varied the conditions of these experiments, employing sometimes water containing less chloride of sodium than sea-water, sometimes pure sea-water; and I have always arrived at results of the same kind. These seemed to me to place it beyond doubt that certain aquatic Articulata absorb chloride of sodium by the surface of the body; but it was still necessary to show that all the freshwater Articulata are not in the same case, and that those in which there is no absorption are precisely those which are able to live with impunity in sea-water. Now the experiments made upon Coleoptera, Hemiptera, larvæ of *Agrion*, &c. showed no excretion, and consequently no absorption, of chloride of sodium.

4. The injurious salts contained in sea-water are the chlorides of sodium and magnesium; the sulphates may be regarded as having no effect.

I have arrived at this conclusion by examining successively the action of solutions of chloride of sodium, of chloride of magnesium, and of sulphate of magnesia, in such proportions that in each case the weight of the single salt employed might equal the sum of the weights of all the salts contained in sea-water. The experiments were tried only with species in which the presence of a delicate skin or of branchiæ rendered a great absorption probable.

The action of chloride of sodium proved to be sometimes analogous to that of pure sea-water, and sometimes more energetic. The action of chloride of magnesium is of the same kind as that of chloride of sodium, or weaker, according to the species; this salt must therefore be regarded as inferior to the preceding one in its injurious effects. The solution of sulphate of magnesia produces no effect, or leads to death only after a very long time.

I have also been able to ascertain, by operating in accordance with the process 3, that the larvæ of insects and the freshwater Crustacea experimented on only absorb a very little of the chloride of magnesium, which may explain the slowness of the action of this salt in many cases. They generally do not absorb any trace of the sulphate.

5. The difference of density which exists between fresh and

sea-water does not explain the death of the freshwater Articulata in the latter liquid.

Resuming the experiments indicated by me in a former memoir, I exposed some Articulata on which I had ascertained that sea-water has an injurious action to a solution of cane-sugar in water, brought, by means of Fahrenheit's areometer, to precisely the density of the water of the ocean. Out of eleven species eight lived with impunity in the solution of sugar; and with the others the action was much slower than that of sea-water or of the chlorides.

6. When the freshwater Articulata pass, by a very slow transition, from fresh to sea-water, and reproduction has taken place during this transition, the new generation resists the action of sea-water longer than the ordinary individuals of the species.

The exposition of this experiment would occupy more space than is desirable in a simple abstract; I shall therefore take the liberty of referring the reader for its details to my memoir.

I slowly modified the fresh water in which a great number of specimens of *Asellus aquaticus* were living, in such a manner as to transform it in the course of two months into natural sea-water, taking all the precautions necessary to keep the water sweet and to provide the Crustaceans with nourishment. During these two months (from the 21st January to the 16th March) the *Aselli* reproduced.

The result of the experiment was, not a modification of the original individuals, as these gradually died out, and none remained on the 3rd March, but a modification of their descendants, which almost rendered them a new variety, as to their aptitude for living in sea-water. In fact, under ordinary conditions the *Aselli* do not resist the action of sea-water, at the maximum, more than 5 hours 15 minutes, and the young die more quickly than the adults in this liquid, whilst seven of the individuals born during the experiment lived in pure sea-water *for* 108 *hours.*

Marine Crustacea.

7. The commonest Crustacea of the Belgian coast die in fresh water after the lapse of a variable time, which, however, does not exceed 9 hours.

8. The marine Crustacea when immersed in fresh water give up to this the salts (especially chloride of sodium) with which their tissues were impregnated.

If the freshwater Articulata, when immersed in sea-water, absorb certain of its salts, the marine Articulata lose in fresh water the salts contained in the liquids of their bodies. Hence the shortest resistance in fresh water ought to be observed in those Crustacea in which an extremely rapid respiration is combined with a comparatively delicate skin. This fact was, to a great extent, verified: the *Crangones* and *Gammari* which combine these two conditions are those which live the shortest time in fresh water; the young crabs whose skin is not thick perish more quickly than the hard-skinned individuals. A confirmation of these facts will be found under No. 10.

9. In most cases the presence of chloride of sodium forms one of the indispensable conditions of resistance for the marine Crustacea; but this salt appears to be the only one necessary.

The experiments consisted in the employment of saline solutions of the same compositions as indicated under No. 4.

10. The small individuals and those which have just moulted have the integuments delicate, and present less resistance than the others to the influence of liquids of exceptional composition.

11. The difference between the densities of sea-water and fresh water cannot be regarded as the cause of the death of marine Crustacea in fresh water.

12. (Applicable to both groups.) Endosmose enables us to explain the absorption of salts by the delicate skin or the branchial surfaces of freshwater Articulata when immersed in sea-water. Diffusion and dialysis, taking place with more energy in the case of the chlorides of sodium and magnesium than in that of sulphate of magnesia, show how it is that the chlorides of sea-water are alone absorbed. Lastly, dialysis explains how marine Crustacea, when placed in fresh water, lose the salts with which they are impregnated.

XLVII.—*On the supposed Legs of the Trilobite* Asaphus platycephalus.

To the Editors of the Annals and Magazine of Natural History.

DEAR SIRS,

I send you hereby an advance copy of an article of mine* on a subject which is exciting some interest, thinking that you would wish to publish it in your excellent Journal.

Yours truly,
JAMES D. DANA.

AT the request of Mr. E. Billings, of Montreal, I have recently examined the specimen of *Asaphus platycephalus* belonging to the Canadian Geological Museum, which has been supposed

* In 'Silliman's American Journal' for May 1871.

to show remains of legs. Mr. Billings, while he has suspected the organs to be legs so far as to publish on the subject*, has done so with reserve, saying, in his paper, that "the first and all-important point to be decided is, whether or not the forms exhibited on its underside were truly what they appeared to be, locomotive organs." On account of his doubts, the specimen was submitted by him during the past year to the Geological Society of London; and for the same reason, notwithstanding the corroboration there received, he offered to place the specimen in my hands for examination and report.

Besides giving the specimen an examination myself, I have submitted it also to Mr. A. E. Verrill, Professor of Zoology in Yale College, who is well versed in the invertebrates, and to Mr. S. I. Smith, assistant in the same department, and excellent in crustaceology and entomology. We have separately and together considered the character of the specimen; and while we have reached the same conclusion, we are to be regarded as independent judges. Our opinion has been submitted to Mr. Billings, and by his request it is here published.

The conclusion to which we have come is that the organs are not legs, but the semicalcified arches in the membrane of the ventral surface to which the foliaceous appendages or legs were attached. Just such arches exist in the ventral surface of the abdomen of the *Macrura*, and to them the abdominal appendages are articulated.

This conclusion is sustained by the observation that in one part of the venter three consecutive parallel arches are distinctly connected by the intervening outer membrane of the venter, showing that the arches were plainly *in the membrane* as only a calcified portion of it, and were not members moving free above it. This being the fact, it seems to set at rest the question as to the legs. We would add, however, that there is good reason for believing the supposed legs to have been such arches in their continuing of nearly uniform width almost or quite to the lateral margin of the animal, and in the additional fact that, although curving forward in their course toward the margin, the successive arches are about equidistant or parallel, a regularity of position not to be looked for in free-moving legs. The curve in these arches, although it implies a forward ventral extension on either side of the leg-bearing segments of the body, does not appear to afford any good reason for doubting the above conclusion. It is probable that the two prominences on each arch nearest the median line of the body,

* Quart. Journ. Geol. Soc. 1870, No. 104, p. 479, with a plate giving a full-sized view of the under surface of the Trilobite, a species that was over 4 inches in length.

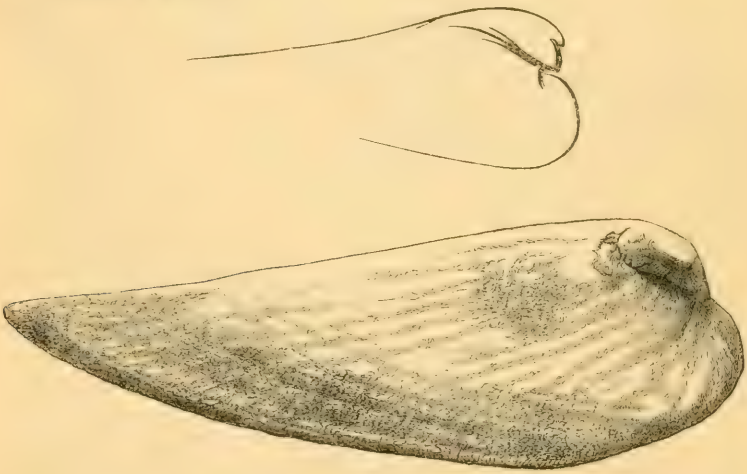
which are rather marked, were points of muscular attachment for the foliaceous appendage it supported.

With the exception of these arches, the under surface of the venter must have been delicately membranous, like that of the abdomen of a lobster or other macruran. Unless the under surface were in the main fleshy, Trilobites could not have rolled into a ball.

XLVIII.—*Notice of a new Australian Ziphioid Whale.* By G. Krefft, F.L.S.; *with a Note by* Dr. J. E. Gray, F.R.S.

I enclose the photograph of the tooth of a new whale, 18 feet long, caught in Little Bay. It is allied to the genus *Mesoplodon*, and I propose to call it *Mesoplodon Güntheri*. We have the entire skeleton. The tooth was imbedded in the mandible, and is bent, the tip towards the margin; but it was not visible from without. Unfortunately, the body was very much hacked and lacerated; but most of the abdominal viscera have been saved.

Sydney, Feb. 24, 1871.



The form of the tooth is so unlike that of any other Ziphioid known, that I regard it as indicating a new genus, which I would propose to call *Callidon*, characterized by the form and surface. It is here figured from Dr. Krefft's photograph and sketch.—J. E. G.

BIBLIOGRAPHICAL NOTICES.

The Honey-Bee: its Natural History, Physiology, and Management. By Edward Bevan, M.D. Revised, enlarged, and illustrated by William Augustus Munn, F.R.H.S. &c. 8vo. London: Van Voorst, 1870.

Among the almost infinite series of Bee-books of which our literature can boast, Dr. Bevan's volume has always deservedly taken a high place. But of late years the discoveries made in the natural history of the bee, and the changes thereby induced in the system of management adopted by enlightened apiarians, have thrown this excellent manual rather out of date; and Mr. Munn has therefore performed a task for which he deserves the thanks of all bee-keepers by taking up the subject from Bevan's stand-point, cancelling the antiquated parts of the book, and working into it, for the most part, so far as we can see, very conscientiously, the results of recent investigations into this most interesting department of practical entomology.

The first part of Mr. Munn's volume, occupying nearly one-half of it, is exclusively devoted to the description of the management of the beehive, and gives all necessary practical directions for the establishment of an apiary. The author, like all enthusiasts upon a single subject, has, of course, a pet plan of his own. This consists of a peculiar form of hive, which he calls "the bar-and-frame hive," and to which he ascribes great advantages, both with regard to the management of the bees, and to the carrying on of observations for the purpose of completing those parts of our knowledge of the habits and physiology of these interesting insects which still present some degree of obscurity. The merits of this peculiar apparatus, the structure of which is fully described and illustrated with figures, we will not venture to discuss; to the uninitiated mind it seems to be an admirable contrivance.

In his second part Mr. Munn enters upon those questions which are of interest to entomologists—the anatomy and physiology of the insect, its senses and instincts, its mode of architecture, &c.; but here also we find several chapters devoted to matters connected with pure apiarianism. The treatment of the natural history of the insect is somewhat defective, owing to an evidently imperfect knowledge of entomology on the part of the author, and in many cases to his scattering information upon particular points in the natural history of the bee through several chapters of the book, which are properly connected with matters treated of elsewhere. Some of his opinions will, no doubt, be warmly disputed both by his brother apiarians and by entomologists; whilst in other cases, as in his rejection of Siebold's theory of the parthenogenetic origin of the drones, he will certainly meet with little favour from most entomologists, whilst many bee-keepers will be inclined to support him; but the reader will find in these chapters a valuable series of observed facts, the importance of which is quite independent of the conclusions drawn from them, whether rightly or wrongly, by the author. With regard to the author's objections to Von Siebold's views, we may say that he does not seem to have comprehended their full significance, and that we cannot think that the arguments used by him at all invalidate the hypothesis of the parthenogenetic origin of drone-eggs.

Mr. Munn's book, which we recommend to the notice of all bee-masters and general entomologists, is illustrated with a considerable number of plates, some of which show the form and structure of different kinds of hives and other apiarian apparatus, whilst the rest exhibit figures of bees and their cells and combs in various conditions. The latter are coloured, and are drawn by the author himself; their execution is rough, but they are generally very characteristic.

British Insects: a Familiar Description of the Form, Structure, Habits, and Transformations of Insects. By E. F. Staveley. 8vo. London: Reeve, 1871.

Miss Staveley has followed up her excellent little book on the British Spiders with an equally good work on the insects of our islands, although, as might be expected from the difference in the extent of the two subjects, the treatment here necessarily adopted causes a fundamental difference between the two books. Miss Staveley's 'British Spiders' was in fact an abridgment of Mr. Blackwall's great work on the same class of animals, containing characters of all the species and figures illustrating all the genera; so that it would enable the serious study of the Araneida to be carried on to a considerable extent, and might be used as a pocket summary of Blackwall's monograph; whilst in the 'British Insects' the author has aimed only at guiding the beginner's first steps in the study of entomology. The number of species referred to is necessarily small in comparison with the enormous insect-population of Britain; and the figures given only illustrate the great groups or families.

But Miss Staveley has carried out the one plan as well as she did the other, and has produced an admirable manual for the tyro in entomology. Her classification, indeed, is somewhat antiquated, being founded chiefly upon the 'Introduction to the Modern Classification of Insects' of Prof. Westwood; so that we here once more meet with the orders Euplexoptera, Thysanoptera, Trichoptera, Aphaniptera, Homoptera, and Heteroptera, which most entomologists have long since given up. The Strepsiptera are mentioned as puzzling insects, but placed with the Coleoptera. Perhaps the undue multiplication of orders has advantages for the beginner in some cases, by enabling the definitions of these groups to be drawn up with less liability to exceptions; and probably this feeling may have weighed with the author in adopting Westwood's classification; but we think that, in the case of the Homoptera and Heteroptera, at any rate, greater perspicuity would have been attained by uniting them in a single order characterized by the structure of the mouth.

The information given as to the structure and natural history of insects in general and of the different groups and species referred to appears to be very correct; even the names of the groups and insects are generally rightly spelt—a rare occurrence indeed in popular books. The treatment adopted is as follows. After a short introduction, the author indicates the distinguishing characteristics of the class of Insects, and then describes in some detail the structure of the different parts of which these creatures are composed, and the nature of their metamorphoses, indicating, in connexion with the wings, the classification followed in the more special part of the book. This information is then summarized in a table of orders, with illustrative examples. Each order is then treated somewhat in the same fashion, characterized and divided into families or tribes, with descriptions of the appearance and habits of some of the commonest species belonging to it; and each of the larger orders has likewise its tabular synopsis, furnishing a summary of its contents. The systematic arrangement is doubtless open to criticism, and especially, as already stated, to the charge of being rather antiquated; but the learner who has acquired all the information which Miss Staveley affords will easily understand and appreciate the different views of other writers whose works may fall into his hands.

One of the great attractions of this book to the young entomologist will be the beautiful figures with which it is illustrated: these consist of sixteen excellent coloured plates by Mr. Robinson, and of a considerable number of woodcuts, both of details and of insects, scattered through the text. The whole of these figures are admirably executed; so that, both from a literary and an artistic point of view, we feel pleasure in recommending the book to our readers as an introduction to the study of entomology.

An Introductory Text-book of Zoology, for the Use of Junior Classes. By H. Alleyne Nicholson, M.D., D.Sc., Ph.D., F.R.S.E., F.G.S. Sm. 8vo. Edinburgh and London: Blackwood, 1871.

We have already had occasion to speak in favourable terms of Dr. Nicholson's zoological manuals; and we have now to call attention to a third publication, of a more elementary nature than either of its predecessors, and intended, as the author tells us, "for the use of junior classes." This little work seems to us well adapted for its purpose, although perhaps the "junior classes" will be inclined to think that the quantity of technical terms which they are called upon to learn in order to understand its teachings is rather too great. Dr. Nicholson would indeed have done well to have adopted a more popular style in a junior class-book.

The arrangement adopted is the same as in the larger manuals, namely that of Prof. Huxley, followed almost without a variation. The classification is carried as far as the orders, and illustrative examples are cited and described under each group. The illustrations are for the most part, if not entirely, identical with those employed in the author's previous books, and are generally good.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 30, 1871.—General Sir Edward Sabine, K.C.B., President, in the Chair.

"Experiments in Pangenesis, by Breeding from Rabbits of a pure variety, into whose circulation blood taken from other varieties had previously been largely transfused." By Francis Galton, F.R.S.

Darwin's provisional theory of Pangenesis claims our belief on the ground that it is the only theory which explains, by a single law, the numerous phenomena allied to simple reproduction, such as reversion, growth, and repair of injuries. On the other hand, its postulates are hypothetical and large, so that few naturalists seem willing to grant them. To myself, as a student of Heredity, it seemed of pressing importance that these postulates should be tested.

If their truth could be established, the influence of Pangenesis on the study of heredity would be immense; if otherwise the negative conclusion would still be a positive gain.

It is necessary that I should briefly recapitulate the cardinal points of Mr. Darwin's theory. They are (1) that each of the myriad cells in every living body is, to a great extent, an independent organism; (2) that before it is developed, and in all stages of its development, it throws "gemmules" into the circulation, which live there and breed, each truly to its kind, by the process of self-division, and that, consequently, they swarm in the blood, in large numbers of each variety, and circulate freely with it; (3) that the sexual elements consist of organized groups of these gemmules; (4) that the development of certain of the gemmules in the offspring depends on their consecutive union, through their natural affinities, each attaching itself to its predecessor in a regular order of growth; (5) that gemmules of innumerable varieties may be transmitted for an enormous number of generations without being developed into cells, but always ready to become so, as shown by the almost insuperable tendency to feral reversion, in domesticated animals.

It follows from this, and from the general tenor of Mr. Darwin's reasoning and illustrations, that two animals, to outward appearance of the same pure variety, one of which has mongrel ancestry and the other has not, differ solely in the constitution of their blood, so far as concerns those points on which outward appearance depends. The one has none but gemmules of the pure variety circulating in his veins, and will breed true to his kind; the other, although only the pure variety of skin-gemmules happens to have been developed in his own skin, has abundance of mongrel gemmules in his blood, and will be apt to breed mongrels. It also follows from this that the main stream of heredity must flow in a far smaller volume from the developed parental cells, of which there is only one of each variety, than from the free gemmules circulating with the blood, of which there is a large number of each variety. If a parental developed cell bred faster than a free gemmule, an influx of new immigrants would gradually supplant the indigenous gemmules; under which supposition, a rabbit which, at the age of six months, produced young which reverted to ancestral peculiarities, would, when five years old, breed truly to his individual peculiarities; but of this there is no evidence whatever.

Under Mr. Darwin's theory, the gemmules in each individual must therefore be looked upon as entozoa of his blood, and, so far as the problems of heredity are concerned, the body need be looked upon as little more than a case which encloses them, built up through the development of some of their number. Its influence upon them can be only such as would account for the very minute effects of use or disuse of parts, and of acquired mental habits being transmitted hereditarily.

It occurred to me, when considering these theories, that the truth of Pangenesis admitted of a direct and certain test. I knew that the operation of transfusion of blood had been frequently practised with success on men as well as animals, and that it was not a cruel operation—that not only had it been used in midwifery practice, but that large quantities of saline water had been injected into the veins of patients suffering under cholera. I therefore determined to inject alien blood into the circulation of pure varieties of animals (of course, under the influence of anæsthetics), and to breed from them, and to note whether their offspring did or did not show signs of mongrelism. If Pangenesis were true, according to the interpretation which I have put upon it, the results would be startling in their novelty, and of no small practical use; for it would become possible to modify varieties of animals, by introducing slight dashes of new blood, in ways important to breeders. Thus, supposing a small infusion of bull-dog blood was wanted in a breed of greyhounds, this, or any more complicated admixture, might be effected (possibly by operating through the umbilical cord of a newly born animal) in a single generation.

I have now made experiments of transfusion and cross-circulation on a large scale in rabbits, and have arrived at definite results, negativing, in my opinion, beyond all doubt, the truth of the doctrine of Pangenesis.

The course of my experiments was as follows:—Towards the end of 1869, I wrote to Dr. Sclater, the Secretary of the Zoological Society, explaining what I proposed to do, and asking if I might be allowed to keep my rabbits in some unused part of the Gardens, because I had no accommodation for them in my own house, and I was also anxious to obtain the skilled advice of Mr. Bartlett, the Superintendent of the Gardens, as to their breed and the value of my results. I further asked to be permitted to avail myself of the services of their then Prosector, Dr. Murie, to make the operations, whose skill and long experience in minute dissection is well known. I have warmly to thank Dr. Sclater for the large assistance he has rendered to me, in granting all I asked, to the full, and more than to the full; and I have especially to express my obligations to the laborious and kind aid given to me by Dr. Murie, at real inconvenience to himself, for he had little leisure to spare. The whole of the operations of transfusion into the jugular vein were performed by him, with the help of Mr. Oscar Fraser, then Assistant Prosector, and now appointed Osteologist to the Museum at Calcutta, I doing no more than preparing the blood derived from the supply-animal, performing the actual injection, and taking notes. The final series of operations, consisting of cross-circulation between the carotid arteries of two varieties of rabbits, took place after Dr. Murie had ceased to be Prosector. They were performed by Mr. Oscar Fraser in a most skilful manner, though he and I were still further indebted, on more than one occasion, to Dr. Murie's advice and assistance. My part in this series was limited to inserting and tying the canulæ, to making the cross-connexions, to recording the quality of the pulse through the exposed arteries, and making the other necessary notes.

The breed of rabbits which I endeavoured to mongrelize was the "Silver-grey." I did so by infusing blood into their circulation, which I had previously drawn from other sorts of rabbits, such as I could, from time to time, most readily procure. I need hardly describe Silver-grey rabbits with minuteness. They are peculiar in appearance, owing to the intimate mixture of black and grey hairs with which they are covered. They are never blotched, except in the one peculiar way I shall shortly describe; and they never have lop ears. They are born quite black, and their hair begins to turn grey when a few weeks old. The variations to which the breed is liable, and which might at first be thought due to mongrelism, are white tips to the nose and feet, and also a thin white streak down the forehead. But these variations lead to no uncertainty, especially as the white streak lessens or disappears, and the white tips become less marked, as the animal grows up. Another variation is much more peculiar: it is the tendency of some breeds to throw "Himalayas," or white rabbits with black tips. From first to last I have not been troubled with white Himalayas; but in one of the two breeds which I have used, and which I keep carefully separated from each other, there is a tendency to throw "sandy" Himalayas. One of these was born a few days after I received the animals, before any operation had been made upon them, and put me on my guard. A similar one has been born since an operation. Bearing these few well-marked exceptions in mind, the Silver-grey rabbit is excellently adapted for breeding-experiments. If it is crossed with other rabbits, the offspring betray mongrelism in the highest degree, because any blotch of white or of colour, which is not "Himalayan," is almost certainly due to mongrelism; and so also is any decided change in the shape of the ears.

I shall speak in this memoir of litters connected with twenty silver-grey rabbits, of which twelve are does and eight are bucks; and eighteen of them have been submitted to one or two of three sorts of operations. These consisted of:—

(1) Moderate transfusion of partially defibrinized blood. The silver-grey was bled as much as he could easily bear; that was to about an ounce, a quantity which bears the same proportion to the weight of

his body (say 76 oz) that 2 lbs. bears to the weight of the body of a man (say 154 lbs.); and the same amount of partially defibrinized blood, taken from a killed animal of another variety, was thrown in in its place. The blood was obtained from a yellow, common grey, or black and white rabbit, killed by dividing the throat, and received in a warmed basin, where it was stirred with a split stick to remove part of the fibrine. Then it was filtered through linen into a measuring-glass, and thence drawn up with a syringe, graduated into drachms; and the quantity injected was noted.

(2) The second set of operations consisted in a large transfusion of wholly defibrinized blood, which I procured by whipping it up thoroughly with a whisk of rice-straw; and, in order to procure sufficient blood, I had on one occasion to kill three rabbits. I alternately bled the silver-grey and injected, until in some cases a total of more than 3 ounces had been taken out and the same quantity, wholly defibrinized, had been thrown in. This proportion corresponds to more than 6 lbs. of blood in the case of a man.

(3) The third operation consisted in establishing a system of cross-circulation between the carotid artery of a silver-grey and that of a common rabbit. It was effected on the same principle as that described by Addison and Morgan (Essay on Operation of Poisonous Agents upon the Living Body. Longman & Co., 1829), but with more delicate apparatus and for a much longer period. The rabbits were placed breast to breast, in each other's arms, so that their throats could be brought close together. A carotid of each was then exposed; the circulation in each vessel was temporarily stopped, above and below, by spring holders; the vessels were divided, and short canulæ, whose bores were larger than the bore of the artery in its normal state, were pressed into the mechanically distended mouths of the arteries; the canulæ were connected cross-wise; the four spring holders were released, and the carotid of either animal poured its blood direct into the other. The operation was complicated, owing to the number of instruments employed; but I suspended them from strings running over notched bars, with buttons as counterpoises, and so avoided entanglement. These operations were exceedingly successful; the pulse bounded through the canulæ with full force; and though, in most cases, it began to fall off after ten minutes or so, and I was obliged to replace the holders, disconnect the canulæ, extract the clot from inside them with a miniature corkscrew, reconnect the canulæ, and reestablish the cross-flow two, three, or more times in the course of a single operation, yet on two occasions the flow was uninterrupted from beginning to end. The buck rabbit, which I indicate by the letter O, was $37\frac{1}{2}$ minutes in the most free cross-circulation imaginable with his "blood-mate," a large yellow rabbit. There is no mistaking the quality of the circulation in a bared artery; for, when the flow is perfectly free, the pulse throbs and bounds between the finger and thumb with a rush, of which the pulse at the human wrist, felt in the ordinary way, gives an imperfect conception.

These, then, are the three sorts of operations which I have performed on the rabbits; it is convenient that I should distinguish them by letters. I will therefore call the operation of simply bleeding once, and then injecting, by the letter u; that of repeated bleedings and repeated injections by the letter w; and that of cross-circulation by the letter x.

In none of these operations did I use any chemical means to determine the degree to which the blood was changed; for I did not venture to compromise my chances of success by so severe a measure; but I adopted the following method of calculation instead:—

I calculate the change of blood effected by transfusion, or by cross-circulation, upon moderate suppositions as to the three following matters:—

(1) The quantity of blood in a rabbit of known weight.

(2) The time which elapses before each unit of incoming blood is well mixed up with that already in the animal's body.

(3) The time occupied by the flow, through either carotid, of a volume of blood equal to the whole contents of the circulation.

As regards 1, the quantity of blood in an animal's body does not admit, by any known method, of being accurately determined. I am content to take the modern rough estimate, that it amounts to one-tenth of its total weight. If any should consider this too little, and prefer the largest estimate, viz. that in Valentin's 'Repertorium,' vol. iii. (1838), p. 281, where it is given for a rabbit as one part in every 6·2 of the entire weight, he will find the part of my argument which is based on transfusion to be weakened, but not overthrown, while that which relies on cross-circulation is not sensibly affected.

As regards 2, the actual conditions are exceedingly complex; but we may evade their difficulty by adopting a limiting value. It is clear that when only a brief interval elapses before each unit of newly infused blood is mixed with that already in circulation, the quality of the blood which, at the moment of infusion into one of the cut ends of the artery or vein, is flowing out of the other, will be more alienized than if the interval were longer. It follows that the blood of the two animals will intermix more slowly when the interval is brief than when it is long. Now I propose to adopt an extreme supposition, and to consider them to mix *instantaneously*. The results I shall thereby obtain will necessarily be less favourable to change than the reality, and will protect me from the charge of exaggerating the completeness of intermixture.

As regards 3, I estimate the flow of blood through either carotid to be such that the volume which passes through it in ten minutes equals the whole volume of blood in the body. This is a liberal estimate; but I could afford to make it twice or even thrice as liberal, without prejudice to my conclusions.

Upon the foregoing data the following Table has been constructed. The formulæ are:—Let the blood in the Silver-grey be called a, and let its volume be V, and let the quantity u of alien blood be thrown in at each injection, then the quantity of blood a remaining in the Silver-grey's circulation, after n injections,

$$=\mathrm{V}\left(1-\frac{u}{\mathrm{V}}\right)^n.$$

If the successive injections be numerous and small, so as to be equivalent to a continuous flow, then, after w of alien blood has passed in, the formula becomes $V.e^{-\frac{w}{V}}$.

A comparison of the numerical results from these two formulæ shows that no sensible difference is made if (within practicable limits) few and large, or many and small, injections are made, the total quantity injected being the same.

In cross-circulation the general formula is this:—If V' be the volume of blood in the other rabbit, after w of alien blood has passed through either canula, the quantity of blood a remaining in the Silver-grey exceeds*

$$\frac{V}{V+V'}\left\{V+V'e^{-\left(\frac{1}{V}+\frac{1}{V'}\right)w}\right\}.$$

This becomes $\frac{V}{2}\left\{1+e^{-\frac{2w}{V}}\right\}$ when $V=V'$; also, when V' is infinite, it gives the formula already mentioned for injection by a continuous flow of purely alien blood.

Table I.

(Contents of circulation of Silver-grey Rabbit = 100.)

Quantity of blood infused.	Maximum percentage of original blood remaining after: Successive injections of purely alien blood, each = $\frac{100}{12}$. Number of injections.	Successive injections (percentage)	Continuous flow of purely alien blood.	Cross-circulation. Rabbits of equal size.	Cross-circulation. Blood-mate $\frac{1}{10}$ larger than the Silver-grey.	Period, in minutes, during which the continuous flow through each carotid has lasted.
25	3	77	78	80	80	$2\frac{1}{2}$
50	6	59	61	68	68	5
75	9	46	47	61	60	$7\frac{1}{2}$
100	12	35	37	56	55	10
125	15	27	29	54	52	$12\frac{1}{2}$
150	18	21	22	52	51	15
175	21	16	17	51	50	$17\frac{1}{2}$
200	24	12	14	51	49	20
300	36	4	5	50	48	30
400	48	1	2	50	48	40
infinite	infinite	0	0	50	48	infinite.

I now give a list (Table II.) of the rabbits to which, or to whose

* I am indebted to Mr. George Darwin for this formula.

TABLE II.

Silver-grey Does.	Weight of rabbit.	Estimated weight of blood.	Nature of operation*.	Drachms infused, and period of cross-circulation.	Percentage of alienized blood.	Colour &c. of blood-mate.
	lbs. oz.	drachms.				
A	5 9	79	*u*	9	11	Common grey and white.
B	5 13	82	*u*	10	12	Yellow, large.
			x	10 min. perfect, 15 or 20 very good.	50, or more.	Common grey.
C	5 8	78	*u*	9·5	12	Albino, large.
D	5 4	75	*u*	8·5	12	Himalaya.
E	4 9	58	*u*	8	14	Common grey.
			x	13 min. good, 14 poor.	50, about	Common grey.
F	4 13	61	*u*	7·7	10	Black and white, large.
G	4 11	60	*w*	25·5, in 6 injections.	35	Grey and black, speckled.
			x	31 min. good, total.	75	Common grey.
H	...	...	*x*	15 min. perfect, 15 very good.	50	Common grey.
I†	...	...	*x*	16 min. perfect, not much more.	nearly 50	Common grey and white.
J†	...	...	*x*	35 min. perfect.	...	Yellow, brown mouth (? Himalaya).
S	...	...	*x*	too unsuccessful to be worth counting.	? any.	Angora, fawn and white.
T	...	...	None.	......	None.	......
Bucks.						
K	4 14	62	*u*	9	14	Yellow, brown mouth.
			w	14, in 4 injections, total.	32	Yellow and white.
L	4 13	61	*u*	7	11	Common grey.
M	4 0	51	*u*	7	14	Black and white.
			w	24·5, in 6 injections, total.	45	3 black and white in succession.
N	4 9	58	*u*	7·5	13	Angora, grey and white, red eyes.
			w	16·5, in 4 injections, total.	34	Yellow.
O (son of C (*u*) by K (*u*))	...	...	*x*	$37\frac{1}{2}$ min. perfect.	50	Yellow.
P†	...	...	*x*	25 to 30 min. perfect.	50	Common grey.
Q†	..	...	*x*	15 min. perfect, 15 very good.	50	Yellow and white.
	...	...	*x*	25 min. pretty good.	50	Common grey and white.

* *Note* (to 4th column).—*u* means simple transfusion, by one copious bleeding, and then injecting; *w* means compound transfusion by successive bleedings and successive injections; *x* means cross-circulation.

† These rabbits belong to a breed liable to throw "Sandy" Himalayas.

blood-mates, I shall have to refer. Every necessary particular will be found in the Table:—the weight of the rabbits; the estimated weight of blood in their veins; the operations performed on them, whether *u*, *w*, or *x*; the particulars of those several operations; the estimated percentage of alien blood that was substituted for their natural blood; and lastly, the colour, size, and breed of their blood-mates.

In another list (Table III.) I give particulars of all the litters I have obtained from these rabbits, classified according to the operations which the parents had previously undergone.

Table III.

Litters subsequent to first transfusion. Both parents Silver-greys. Average proportion of alienized blood in either parent $=\frac{1}{8}$; therefore in young $\frac{1}{8}$ also.

Out of	By	Number and character of litters.
A	K	4 true Silver-greys.
A	M	5 ditto, but 1 had a white foot to above knee.
B	K	5 true Silver-greys.
C	K	6 ditto.
D	K	4 ditto.
E	L	6 ditto.
		30 all true Silver-greys, except possibly one instance.

Litters subsequent to second transfusion of buck. Both parents Silver-greys. Average proportion of alienized blood in young about $\frac{1}{4}$.

Out of	By	Number and character of litters.
A	M	6 true Silver-greys.

Litters subsequent to cross-circulation of buck only, the does being 0 or *u*. Both parents Silver-greys. Average proportion of blood in young between $\frac{1}{4}$ and $\frac{1}{3}$.

Out of	By	Number and character of litters.
S	O	5 true Silver-greys.
C	O	5 ditto.
T	O	3 ditto.
		13 all Silver-greys.

Litters subsequent to cross-circulation of both parents (Silver-greys). Average proportion of alienized blood in young fully $\frac{1}{2}$.

Out of	By	Number and character of litters.
B	O	3 true Silver-greys.
H	O	7 ditto.
H	O	7 ditto.
I*	P*	6 ditto.
J*	Q*	6 ditto, all but one, a sandy Himalaya.
J*	P*	8 true Silver-greys.
		—
		37 36 Silver-greys, 1 Himalaya.

Litters subsequent to cross-circulation of both parents (common rabbits). Average proportion of alienized blood in young a little less than $\frac{1}{2}$.

Out of blood-mate to	By blood-mate to	Number and character of litters.
E	R	8 none Silver-grey, all like father or mother.
E	Q*	5 ditto.
G	O	9 ditto.
I*	Q*	8 ditto.
J*	Q*	8 ditto.
		—
		38 none Silver-greys.

I will now summarize the results. In the first instance I obtained five does (A, B, C, D, and E) and three bucks (K, L, and M) which had undergone the operation which I call *u*, and which had in consequence about $\frac{1}{8}$ of their blood alienized. I bred from these †, partly to see if I had produced any effect by the little I had done, and chiefly to obtain a stock of young rabbits which would be born with $\frac{1}{8}$ of alien gemmules in their veins, and which, when operated upon themselves, would produce descendants having nearly $\frac{1}{4}$ alienized blood (the exact proportion is $1-(1-\frac{1}{8})^2=\frac{15}{64}$). I obtained thirty young ones in six litters; and they were all true silver-greys, except, possibly, in one instance (out of the doe A (*u*) by the buck M (*u*)), where one, of a litter of five, had a white fore leg, the white extending to above the knee-joint. This white leg gave me great hopes that Pangenesis would turn out to be true, though it might easily be accounted for by other causes; for my stock were sickly (both those on which I had not operated and those on which I had suffering severely from a skin disease), and it was natural under those circumstances of ill health that more white than usual should appear in the young.

* These rabbits belong to a breed liable to throw "Sandy" Himalayas.

† I always allowed the bucks to run for awhile with waste does before commencing the breeding-experiments, that all old reproductive material might be got rid of.

Having, then, had experience in transfusion, and feeling myself capable of managing a more complicated operation without confusion, I began the series which I call *w*. I left my old lot of does untouched, but obtained one new doe (G(*w*)), which had undergone the last operation, and three bucks (K (*u*, *w*), M (*u*, *w*), N (*u*, *w*)) which had undergone both operations, *u* and *w*. On endeavouring to breed from them, the result was unexpected, they appeared to have become sterile. The bucks were as eager as possible for the does; but the latter proving indifferent, I was unable to testify to their union having taken place; so I left them in pairs, in the same hutch, for periods of three days at a time. Attempts were made in this way, to breed from them in seven instances; and five of them were utter failures. One case was quite successful; and that, fortunately, was of the same pair (A (*u*) and M (*u*, *w*)) which, under the *u* operation, had bred the white-footed young one. This time, the offspring (six in number) were pure silver-greys. The last case was unfortunate. The doe (E (*u*)) had been once sterile to its partner (N *u*, *w*)), and she had been put again in the same hutch with him for a short period, but was thought not to have taken him. She was shortly afterwards submitted to the operation *x*. From this she had nearly recovered when she brought forth an aborted litter and died. I was absent from town at the time; but Mr. Fraser, who examined them, wrote to say he fully believed that some were pied; if so, it must have been under the influence of the cross-circulation. But I have little faith in the appearance of the skin of naked, immature rabbits; for I have noticed that difference of transparency, and the colour of underlying tissues, give fallacious indications.

My results thus far came to this, viz. that by injecting defibrinized blood I had produced no other effect than temporary sterility. If the sterility were due to this cause alone, my results admitted of being interpreted in a sense favourable to Pangenesis, because I had deprived the rabbits of a large part of that very component of the blood on which the restoration of tissues depends, and therefore of that part in which, according to Pangenesis, the reproductive elements might be expected to reside. I had injected alien corpuscles but not alien gemmules. The possible success of the white foot, in my first litters, was not contradicted by the absence of any thing of the sort in my second set, because the additional blood I had thrown in was completely defibrinized. It was essential to the solution of the problem, that blood in its natural state should be injected; and I thought the most convenient way of doing so was by establishing cross-circulation between the carotids. If the results were affirmative to the truth of Pangenesis, then my first experiments would not be thrown away; for (supposing them to be confirmed by larger experience) they would prove that the reproductive elements lay in the fibrine. But if cross-circulation gave a negative reply, it would be clear that the white foot was an accident of no importance to the theory of Pangenesis, and that the sterility need not be ascribed to the loss of hereditary gemmules, but to abnormal health, due to defibrinization and perhaps to other causes also.

My operations of cross-circulation (which I call x) put me in possession of three excellent silver-grey bucks, four excellent silver-grey does, and one doe whose operation was not successful enough for me to care to count it. One of my x does (B) had already undergone the operation u, and I had another of my old lot (C (u)), which I left untouched. There were also three common rabbits, bucks, which were blood-mates to silver-greys, and four common rabbits, does, also blood-mates of silver-greys. From this large stock I have bred eighty-eight rabbits in thirteen litters, and in no single case has there been any evidence of alteration of breed. There has been one instance of a sandy Himalaya; but the owner of this breed assures me they are liable to throw them, and, as a matter of fact, as I have already stated, one of the does he sent me, did litter and throw one a few days after she reached me. The conclusion from this large series of experiments is not to be avoided, that the doctrine of Pangenesis, pure and simple, as I have interpreted it, is incorrect.

Let us consider what were the alternatives before us. It seems *à priori* that, if the reproductive elements do not depend on the body and blood together, they must reside either in the solid structure of the gland, whence they are set free by an ordinary process of growth, the blood merely affording nutriment to that growth, or else that they reside in the blood itself. My experiments show that they are not independent residents in the blood, in the way that Pangenesis asserts; but they prove nothing against the possibility of their being temporary inhabitants of it, given off by existing cells, either in a fully developed state or else in one so rudimentary that we could only ascertain their existence by inference. In this latter case, the transfused gemmules would have perished, just like the blood-corpuscles, long before the period had elapsed when the animals had recovered from the operations.

I trust that those who may verify my results will turn their attentionto the latter possibility, and will try to get the male rabbits to couple immediately, and on successive days, after they have been operated on. This might be accomplished if there were does at hand ready to take them; because it often happens that when the rabbits are released from the operating-table, they are little, if at all, dashed in their spirits; they play, sniff about, are ready to fight, and, I have no doubt, to couple. Whether after their wounds had begun to inflame, they would still take to the does, I cannot say; but they sometimes remain so brisk, that it is probable that in those cases they would do so. If this experiment succeeded, it would partly confirm the very doubtful case of the pied young of the doe which died after an operation of cross-circulation (which, however, further implies that though the ovum was detached, it was still possible for the mother gemmules to influence it), and it would prove that the reproductive elements were drawn from the blood, but that they had only a transient existence in it, and were continually renewed by fresh arrivals derived from the framework of the body. It would be exceedingly instructive, supposing the experiment to give affirmative results, to notice the gradually waning powers of producing mongrel offspring.

APPENDIX I.

It is important that I should give details of the operations of cross-circulation. I may mention that, having to deal with many rabbits, I distinguished them permanently by tattooing bold Roman numerals in the inside of their ears.

I. Experiments of cross-circulation on one buck and two does, pure silver-greys, of a breed obtained from Mr. E. Royds, of Greenhill, Rochdale, the same breed as that on which all my *u* and *w* experiments had been made.

Oct. 19, 1870.—*Silver-grey buck*, O, out of doe A (*u*) by M (*u*), and therefore own brother to the white-footed young one, a small rabbit, just six months old. His blood-mate was a

Yellow buck, lop-eared, white throat, probably one-fifth heavier than the silver-grey. I avoided unnecessary weighing, because it frightens the animals, and tends to interfere with the final success. At $12^h\ 30^m$ I made cross-circulation; flow was perfect; $12^h\ 35^m$, continued perfect; $12^h\ 40^m$, perfect, but yellow to silver-grey perhaps the stronger; $12^h\ 44^m$, ditto; $12^h\ 50^m$, perfect both ways; $12^h\ 55^m$, ditto; 1^h, ditto; $1^h\ 5^m$, ditto; $1^h\ 7\frac{1}{2}^m$, ditto. I then stopped and tied up. I tested the flow with a small and delicate but very simple pulse-meter on all these occasions, not liking to interfere overmuch with my fingers. I, however, used them at the commencement, at $12^h\ 50^m$, and at $1^h\ 5^m$.

Oct. 20, 1870.—*Silver-grey doe,* B (*u*), a fine large animal; her blood-mate was a *Common large grey lop-eared doe,* about one-tenth heavier than the silver-grey.

1^h, cross-circulation established, apparently perfect; I mean the throbbing of the canula and artery were obvious; $1^h\ 6^m$, felt and found the flow quite good; $1^h\ 12^m$, common to silver-grey quite good, *vice versâ* poor; $1^h\ 15^m$, ditto; I disconnected and cleaned and removed clots and reconnected. This I repeated several times; there was still much trouble in maintaining a proper flow from silver to common grey, but common to silver was always good. The operation continued till $1^h\ 40^m$; then I disconnected; and as the silver-grey had received too much, I let her bleed to 4 drachms.

Oct. 27, 1870.—*Silver-grey doe,* II, moderate size; her blood-mate was a *Common large grey doe,* certainly more than a tenth heavier than the silver-grey. There was some trouble with her, as the carotid was abnormal, and three offshoots from it had to be tied before the canula could be inserted.

$12^h\ 48^m$, cross-circulation established, perfect pulse, but silver to common the fullest; $12^h\ 53^m$, perfect; 1^h, silver to common perfect, *vice versâ* rather poor; $1^h\ 2^m$, ditto; $1^h\ 7^m$, common to silver stopped; I disconnected and cleaned and reconnected, and by $1^h\ 12^m$ had reestablished perfect cross-circulation; at $1^h\ 30^m$ I had stopped silver to common and made common to silver better; got five minutes good flow, then repeated cleanings and got three minutes more. My estimate at the close of the operation was that the silver-grey gave blood freely for thirty-five minutes, and received it freely for about the same time.

II. Experiments of cross-circulation on two bucks and two does of a silver-grey breed, reputed pure, and looking well-bred animals, but liable to show russet marks. They were procured of Mr. Vipan, of March, Cambridgeshire, and are of the same breed as those on which Mr. Bartlett made his well-known experiments about the production of Himalayas (Proc. Zool. Soc. 1861). They are liable to throw "Sandy Himalayas," as I found myself, as Mr. Bartlett also found, and as Mr. Vipan informs me is the case. I distinguish this breed by asterisks (*).

Oct. 6, 1870.—*Silver-grey buck*, P*, moderate size; his blood-mate was a *Common grey buck*, with some russet on his back and white on his belly; he was the larger of the two animals.

$12^h\ 50^m$, cross-circulation established, perfect; $12^h\ 55^m$, ditto, but silver to common, I think, a trifle the stronger; $12^h\ 59^m$, ditto; $1^h\ 5^m$, common to silver very faint. I stopped them and cleaned out twice and successively; $1^h\ 15^m$, good, but common to silver was the least good; $1^h\ 25^m$, disconnected. My estimate was that there had been an equivalent to fully twenty-five minutes, and perhaps thirty minutes, of capital flow both ways.

Oct. 7, 1870.—*Silver-grey buck*, Q*, moderate size; his blood-mate was a *Yellow buck, white belly, large.*

$11^h\ 40^m$, cross-circulation established; $11^h\ 45^m$, quite good; $11^h\ 50^m$, good but not perfect; $11^h\ 55^m$ good; 12^h both stopped. Then I made several disconnexions and cleanings, and obtained short periods of success; at $12^h\ 35^m$ I finally stopped. My estimate was thirty minutes' good running: the silver-grey received more than his share; there was a slip in the operation, and five drachms of blood were lost between the rabbits; so I did not care to let the silver-grey bleed more.

Oct. 6, 1870.—*Silver-grey doe*, I*, moderate size; her blood-mate was a *Common grey doe, large.*

$3^h\ 40^m$, cross-circulation was established; $3^h\ 44^m$, excellent; $3^h\ 50^m$, excellent; $3^h\ 55^m$, excellent; shortly after, something was twisted or otherwise went wrong, and both stopped. I had a good deal of trouble and but little further success. Ten drachms of blood was lost between the rabbits (partly by leakage of the canulæ).

Oct. 7, 1871.—*Silver-grey doe*, J*, moderate size; her blood-mate was a *Yellow doe, dark about mouth*, and also of moderate size. I afterwards became convinced she was simply a sandy Himalaya.

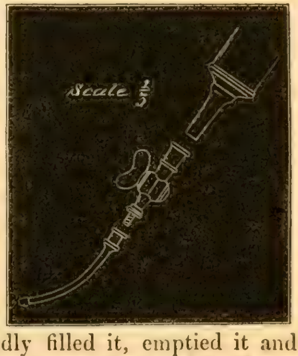
At $2^h\ 5^m$ established cross-circulation; $2^h\ 13^m$, quite good; $2^h\ 20^m$, excellent; $2^h\ 25^m$, excellent; $2^h\ 30^m$, ditto; $2^h\ 35^m$, ditto; $2^h\ 40^m$, ditto, then disconnected. An accident occurred at the end, by which the silver-grey lost four drachms of blood.

APPENDIX II.

Description of the method of performing the operations.

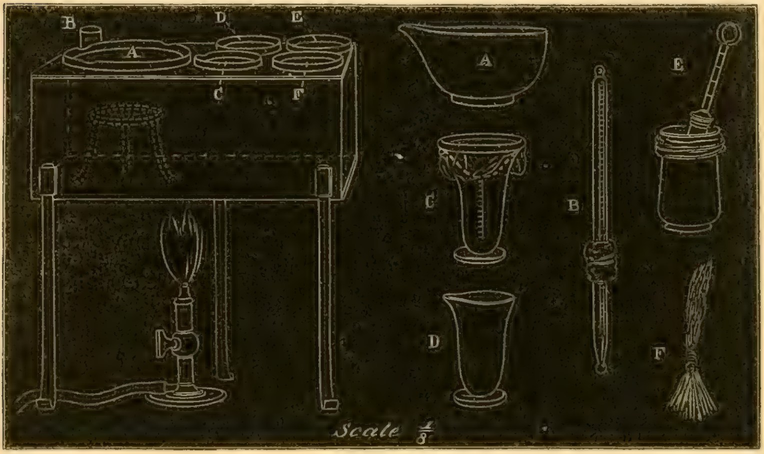
It is essential to a fair chance of success that the operator should have a large and thriving stock of full-grown rabbits. They cannot be procured at will in the market; and young ones are so timid and tender that they are not fit to be operated on. The next essential point is an operating-table, with ample and proper apparatus for holding the rabbits easily but rigidly. It is most improper to subject a helpless animal to an operation without taking every precaution for its success, so as to minimize the necessity for operating. The chief hindrances to success are, entanglement of instruments, or the breaking loose of blood-vessels, both owing to an unexpected start; also an animal will struggle violently, and become terrified if he is loosely held, hoping to get away, whilst if he is firmly secured he lies as though magnetized, without signs of fear or discomfort, and with his pulse and breathing perfectly normal. I regret extremely that, although I took pains to inquire, I did not at first hear of Czermak's recently devised apparatus for holding the head. I began by the old plan of putting the animals in a bag and holding them, which was very unsatisfactory. Then I devised a plan of my own, which was good, but inferior to Czermak's, and I therefore abstain from describing it. The latter, with recent modifications, can now be obtained at Mr. Hawkesley's, 4 Blenheim Street, Bond Street, London, to whom, I should say, I have been greatly indebted for the care and thought he gave to successive and very numerous modifications of my instruments (far more numerous than I care to describe). A drawing of Czermak's apparatus will be found in the 'Berichte der K. Sächs. Gesellschaft der Wissenschaften zu Leipzig,' 1867, p. 212.

For injections, I used a five-drachm ebonite syringe, whose stem was boldly graduated to drachms. The canula (to be inserted into the vein) was screwed into a light stopcock. This was filled with water, which, so long as the cock was closed, did not run out for want of a vent-hole. When it was thrust in the vein and the vein was tied round it, I held the syringe full of blood near the open end of the stopcock, drove out all air by allowing a few drops of blood to fall into its mouth, then pushed its nozzle firmly in, opened the cock and began to inject, steadily and slowly, at the rate of about one drachm in twenty seconds. When the syringe was emptied, I turned the stopcock, withdrew it, rapidly filled it, emptied it and again filled it with warm water, and returning to the canula with the same precautions as before, I threw in about $\frac{1}{4}$ drachm, to wash the blood out of the canula and adjacent vein. I do not think I lost



more than three (or perhaps four) rabbits by injecting air, although the removals and replacements of the syringe were very numerous, often ten times in a single operation of the *w* kind.

My apparatus consisted of a zinc warm-water bath, represented on the left of the diagram below; the vessels drawn to the right of it fitted into holes in its lid, as indicated by the letters. A is the basin to catch the supply-blood; it was whipped up by the whisk F; then poured into C, which consists of a short funnel with muslin below, resting in the top of a glass measure; when the blood had strained through, the funnel and muslin were set on the top of D, to get them out of the way and, at the same time, to keep them warm for future use; B is the thermometer; E is a spill-case full of water to contain the syringe. In addition to these, I required a large slop-pail, a jug of hot, and another of cold water.

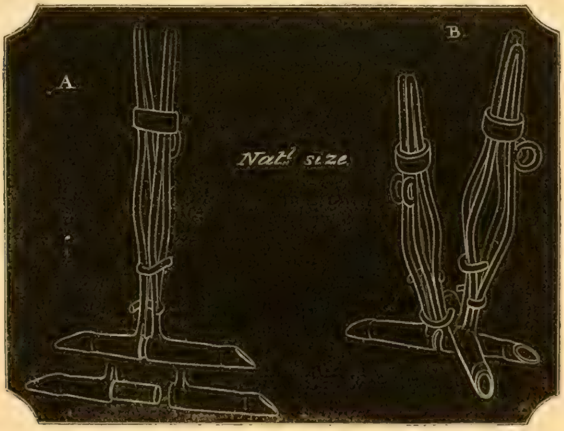


The sketch shows my latest outfit of basins and warm water for injecting. It was not perfected until I had nearly finished the experiments. Scrupulous cleanliness is requisite, and great orderliness; for the hazard lies, not in the performance of one difficult operation, but in making a mistake in some one of a great many easy operations. The course of an operation was as follows:—(1) secure the animal, (2) remove fur from neck, (3) anæsthetics, (4) expose jugular, (5) cut a slit in it and let the animal bleed as much as he can easily bear, about six drachms, (6) stop the flow with gentle pressure by spring forceps; the animal was then left for a minute while (7) Dr. Murie and Mr. Fraser divided the throat of the supply-rabbit, I catching the blood in a warmed basin and whipping it up, to defibrinize it, as it fell. I continued doing this while Dr. Murie was (8) inserting the canula; and when he was nearly ready he called to me, and I (9) filtered the blood, noting its amount, as a guide to what I had to dispose of, (10) drew up a syringe full, (11) injected a convenient number of drachms or half drachms, indicated by the graduations on the syringe-handle, (12) returned the overplus to the glass of supply-blood, (13) cleansed syringe and injected water, (14) let the rabbit bleed three or four drachms,—and then recommenced the series. I have not reinserted in this description before (11) and (13) what I previously described about turning the stopcock &c.; nor have I spoken of the continual jotting down of notes in my case-book.

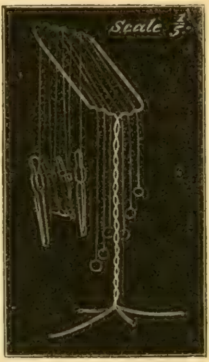
At the end of all, the vein was *tied*. It was, no doubt, the surest plan to avoid future hemorrhage, especially as the blood was defibrinized; but the rabbits were apt to suffer from phlebitis, and I lost some thereby.

Owing to the extreme rapidity and stiffness of the coagulation of rabbit's blood, it is quite easy to estimate the quantity that may have been spilt on the operating-table. It has simply to be sponged into a measuring-glass.

Cross-circulation would be a very easy operation in animals whose carotids were even a trifle larger than those of silver-grey rabbits; but it is difficult with these, because the smallest canula which can be used with propriety can only just be forced into the largest of them. It is of no use to operate with small canulæ; in every case, a layer of fibrine is sure to line the tube; if the bore is small this layer chokes it, while a layer of equal thickness in a larger tube leaves a free central passage. I found canulæ $\frac{1}{20}$ inch in diameter of bore were worthless; those I used were $\frac{1}{13}$ inch. If I were to operate again, I should not use silver-grey rabbits, on account of their smallness, but "Belgian hare" rabbits. When the canulæ are brought home together, the wire hooks, shown in the sketch, secure them; but I also slipped an India-rubber band over the tips of their handles. The cut ends of the artery were held open and stretched out by a pair of delicate curved forceps (a suggestion due to Dr. Murie), and the canula was pressed in (the shape of its mouth



was the result of many trials and modifications), and a ligature was put on. In the diagram (p. 387), A represents one pair of canulæ, both opened and closed. B shows their position at the time of crossed circulation. It will be observed that each artery requires four pieces of apparatus, viz. two spring forceps to stop the blood, and two canulæ. Thus, when the throats were brought close together, to connect the arteries cross-wise, there were no less than eight separate pieces at work in a deep hollow, close together, and attached to delicate arteries, none of which could be permitted to twist or interfere with each other. I append a reduced sketch of one of the two frameworks over which, as previously described, I suspended these instruments, with attached counterpoises, and so avoided all confusion. Both pair of canulæ and two pair of forceps are here represented; they might be so arranged; but it is better to divide the instruments, equally, between the two frames.



For removing clots from the canulæ, I tried a great many plans, none with as much success as I could wish. I have, however, been able to extract clots from the artery itself, a good quarter of an inch beyond the canulæ, with a wire whose end had been cut with a file into a delicate solid corkscrew. I washed out the canulæ, before reconnecting, with a thin stream of water sent through the quill of a small bird, which I had fastened, by help of a short India-rubber tube, to my syringe.

The wounds require careful dressing, just like those of a man. The rabbits bear the operations wonderfully well, and appear to suffer little or no pain when the influence of the anæsthetics happens to have left them temporarily sensible. They are often quite frisky when released, and sometimes look as though nothing whatever unusual had happened to them, all through the time of their recovery.

MISCELLANEOUS.

Note on the Ichthyosaurian Head.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—By an oversight, in my "Note on the Ichthyosaurian Head," the frontal bone was excluded from the anterior nares of Vertebrates. Exceptions should have been made in favour of *Monitors* and the *Mammata*. Whether the "Hell-bender" is also to be excepted might perhaps admit of discussion.

Faithfully yours,
H. G. Seeley.

Le Jélin of Adanson.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—In the 'Annales des Sciences Naturelles : Zoologie,' 4me série, vol. xv. pp. 369–374 (1861), I published a note on the Jélin of Adanson and the genus *Pleurodictyon* of Goldfuss.

During my visit to Cette last summer, I had the opportunity, through the kindness of M. Dumel-Adanson, the present possessor of the collection of Adanson, of examining the typical specimen of le Jélin in the 'Histoire Naturelle du Sénégal.' I ascertained that it was not provided with any internal *calcareous* tubes, and that its structure was unlike that of any coral or shell or Bryozoon. It showed, on the contrary, in this latter respect a great resemblance to *Myriosteon Higginsii*, Gray, which I had the opportunity of examining in the British Museum through the kindness of Dr. Günther. Notwithstanding its very different shape, I suspect that this enigmatical body may prove to belong to some part of a cartilaginous fish.

I am, Gentlemen,
Your most obedient Servant,
O. A. L. MÖRCH.

Copenhagen, April 2, 1871.

On the Action of the so-called Poisonous Shadow of various Tropical Plants. By Professor KARSTEN.

The author in the first place reported his experience of the properties of the Manchineel tree (*Hippomane manzanilla*, Linn.), which, like some other Euphorbiaceæ, Anacardiaceæ, and Artocarpeæ, is so much dreaded by the natives of the regions in which this plant is indigenous, that no one will approach it unnecessarily or stay any time in its vicinity ; for it is generally known that the comfort of repose in the cool shade of this thick-foliaged evergreen tree is paid for with painful inflammations, and, in persons of irritable constitution, even with death. Nevertheless, at present, naturalists regard this dread as exaggerated, especially since Jacquin stated that during a storm of rain he remained naked for several hours under an *Hippomane* without the smallest injurious consequences. The author remembered this statement of Jacquin's when he met with fine examples of the Manchineel on the coast of Venezuela, near La Guayra (on the sugar-plantation of Naiguata), and did not hesitate to carry out his desire of collecting some of the milky juice of this tree in order to investigate its constituents. This occupation, however, which lasted for several hours, was speedily followed by a burning sensation over the whole body, associated with a swelling of the moister parts of the skin, particularly the face, and especially the eyes. On the next morning the eyes were almost completely closed up, and at the same time so irritable that Karsten had to stay for some days in a perfectly dark room. After the lapse of three days the swelling diminished, and the epidermis began to separate.

This *Hippomane*, therefore, secreted a volatile matter which was taken up by the moist skin in a dry atmosphere, and being absorbed by the mucous membranes and sudorific glands caused them to become diseased; Jacquin, on the contrary, detected nothing of the kind, because the gaseous secretion was taken up by the rain-water, and thus rendered innocuous to his body.

The wood of this *Hippomane* also apparently contains a similar volatile matter; at least its combustion causes similar morbid phenomena, especially inflammation of the eyes.

Like the Manchineel, some other Euphorbiaceæ and Anacardiaceæ, especially species of the genus *Rhus* (e. g. *R. juglandifolia*), are dreaded in South America. Of the latter the author was also told that people have died of the cutaneous sores which were produced in consequence of the action of its shadow, *i. e.* its gaseous emanation.

The author finds an analogue of this deleterious exhalation of the *Hippomane* in the volatile organic bases, such as trimethylamine, and he thinks that such nitrogenous volatile compounds (substitution-products of ammonia) are more generally diffused than we suppose. They have probably been overlooked in the analysis of the gases exhaled from living plants, because they were attracted and retained by the water which the apparatus usually contains. In all the plants which Karsten has investigated for this purpose, in germinating Leguminosæ (lentils, peas, lupines), in the development of buds on trees and shrubs (*Æsculus, Syringa, Cratægus, Prunus, Pyrus, Viburnum*) and on tubers (*Helianthus, Solanum*), in fungi, &c. he detected volatile ammoniacal compounds, some of which rendered turmeric paper faintly brown, when he placed very dilute pure sulphuric acid upon the bottom of the air-tight receivers, shut off by acids, which contained these plants, left it there for a few days, and then mixed it with Nesler's reagent.

As the tissue of the above-mentioned plants at the same time always has an acid reaction, it is not probable that this volatile nitrogenous compound is merely ammonia or an ammonical salt; but this further investigations must settle.

His anatomical results led Karsten to the belief that these volatile and, in part, basic nitrogenous compounds originate during the transformation of the neutral proteine materials (which occur as thick-walled content-cellules in the tissue-cells of the organs) into acid compounds which permanently redden blue litmus-paper, whilst new generations of cells make their appearance in these cellules.

The oxygen which is taken up during this vegetative process by the embryos, buds, fungi, &c. which exhale this gaseous matter, probably belonging to the amide series, in combination with carbonic acid, would therefore not, as has hitherto been supposed, serve to convert certain carbon-compounds of the seed &c. directly into carbonic acid and water, but, in the author's opinion, the oxygen would rather act first of all upon the proteine materials present, which would thus be oxidized, dissolved, and converted partly into viscid compounds, dissolving the hydrates of carbon, fat, &c. (*dia-*

stase), and partly into gaseous compounds decomposed by contact with the air into carbonic acid and these ammoniacal derivatives.

The surprising circumstance that the plant should in this way give off as an excretion a part of its scanty supply of nitrogen loses its improbability, as the author remarks, when we know that the tips of the roots usually have an acid reaction, and that the ammoniacal derivatives carried down by water into the soil are again taken up by them.

Karsten expresses a hope that a thorough study of these conditions will elucidate many phenomena which are still obscure and inexplicable,—for example, the penetration of many germinating parasitic fungi into particular organs of plants, particularly such as the developing embryos of more highly organized plants, and their leaf- and flower-buds—and the finding of the fissures of these organs by the germinal mycelium of the fungus, which not unfrequently takes place—further, the finding of the micropyle of atropal ovules projecting freely into the cavity of the ovary by the pollen-tube; for probably each of these organs exhales a specifically peculiar compound which serves as the first nourishment of some one definite kind of growing fungal germ or pollen-tube, and guides it to the place of its subsequent development.—*Zeitschr. des allgem. österr. Apotheker-Vereines*, No. 11, 1871. Communicated by the Author.

A new Genus of the Eolididæ. By Prof. Salvatore Trinchese.

Prof. Trinchese, of Genoa, has described a new form belonging to the family Eolididæ, obtained upon seaweeds in the port of Genoa, in May 1869. He regards it as forming a new genus most nearly allied to *Hermæa*, Lovén, but also presenting considerable affinity to the genera *Phyllobranchus*, Bergh, and *Chioræra*, Gould. He characterizes it as follows, under the name of

Beccaria.

Corpus elongatum, subcompressum, postice attenuatum. *Caput* distinctum, utrinque in lobum planum extensum. *Podarium* latum, angulis anterioribus acutis, paullulum productis. *Branchiæ* numerosæ, foliaceæ, seriebus minus distinctis ad latera dorsi dispositæ. *Rhinophoria* (superior tentacles) longa, foliacea, convoluta. *Foramina generationis* (*et ani?*) ad dextrum latus. *Maxillæ* nullæ. *Radula* dentibus validis non denticulatis prædita.

The genus is named in honour of Prof. Beccari.

For the species he proposes the name of *Beccaria tricolor*; it is of a delicate green colour throughout, but covered with small globules of a splendid white and deep carmine-red colour. These extend also to the tentacles and branchial leaves. The white globules form a transverse band across the anterior margin of the body and another immediately in front of the pericardial sac. On the dorsal surface of the latter they are arranged in little round groups circumscribed and separated by red globules; and a similar arrangement occurs on the lower part of the branchiferous portion of the back. The animal is well figured, with elaborate details. Its total length is 0·0075 mètre.—*Annali del Museo Civico di Storia Naturale di Genova*, i. pp. 47–54, pls. 4–7.

On the Entozoa of the Dolphins. By M. H. GERVAIS.

About twenty species of Entozoa have been indicated as living in the toothed Cetacea, and M. van Beneden has lately published a complete list of them in the Bulletins of the Belgian Academy.

Of these the common porpoise (*Phocœna communis*) alone has furnished five—namely, *Ascaris simplex*, *Strongylus inflexus*, *S. minor*, *S. convolutus*, and *Filaria inflexicaudata*. Only two are cited from the common dolphin (*Delphinus Delphis*), namely *Echinorhynchus pellucidus* and *Phyllobothrium Delphini*. A dolphin of this species from Concarneau, dissected at the anatomical laboratory of the Museum, furnished, besides the *Phyllobothrium*, several other species, namely:—among the Nematoda, (1) *Ascaris simplex*, previously observed in the porpoise; (2) an undescribed species of *Trichosoma* found in the lung: among the Trematoda, a species of fluke (*Distoma*) extracted from the biliary canals: and among the Cestoda a very singular worm, with a long and slender body, without articulations, and resembling the *Ligulæ*, but possessing, like the scoleces of this order, a cephalic inflation furnished with four disks, but wanting the circlet of hooks. The scoleciform part is slender, and may be about one metre in length. From the head start two long, waved excretory canals, analogous to those found by M. van Beneden in the Cestode worms of various osseous fishes.

These worms were enveloped in cysts placed on the lower surface of the diaphragm, and some of them on the anterior abdominal muscles. The cysts are very voluminous, measuring 3 or 4 centimetres in length and 2 in breadth; they are generally oval or almond-shaped, but sometimes nearly spherical. Their walls are tolerably resistant; on cutting into them, a second envelope is found, forming a second cyst, of which the form varies greatly. The greater number of them were spherical, and one of the halves was invaginated in the other: this kind of sphere was umbilicated at one of its poles; and a very delicate nearly transparent membrane fixed it to the wall of the first cyst. Others were oval, flattened and festooned at the margins; others, united by their extremities, communicated through a short hollow pedicle. On opening the second cyst, the worm is found coiled up like a ball of thread.

The author regards this worm as constituting a new genus uniting the *Tæniæ* with the *Ligulæ*; but the generative form (*strobile*) has yet to be discovered. He proposes to name the animal *Stenotenia Delphini*. The dolphin which furnished it also contained numerous smaller cysts tenanted by *Phyllobothrium Delphini*; and the author has met with the latter species in a very old *Delphinus Tursio* taken in the Mediterranean near Cette.—*Comptes Rendus*, Nov. 28, 1870, p. 779.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 42. JUNE 1871.

XLIX.—*On the Base* (*Pelvis*) *of the* Crinoidea brachiata. By Prof. BEYRICH*.

SINCE the investigation of the living *Pentacrinus* by Johannes Müller, the name of *base* has been generally accepted for that part of the crinoidal skeleton on which the radially arranged parts of the calyx originate. The base, together with the stem, forms the dorsal surface of the animal; to the opposite, ventral surface belong the calycine apertures, which are double in the living and single in the fossil forms.

Both in extent and in composition the base of the calyx is subject to multifarious variations. Sometimes it forms a spherically hollowed sac, upon the upper margin of which the basal joints of the radii are inserted; sometimes it is a short funnel or cone, or a flat cup, which takes only a small part in the walling of the calycine cavity; sometimes it seems to have entirely disappeared, either by metamorphoses such as may be demonstrated in the living *Comatulæ*, or by amalgamation with the radii, or by an enveloping overgrowth of the latter, as is the case in *Eugeniacrinus*. Nevertheless the base always remains an essential part of the skeleton, which cannot be imagined as non-existent. A crinoid without a base (which does not exist) would be one in which the radii meet, separate from each other, in the dorsal pole, so that the pole would be surrounded by the first five radial joints.

The progressive study of the fossil Crinoidea has shown that the form and extension of the base furnishes a non-essential character, in accordance with which we can scarcely form generic divisions; on the other hand it has become more and more evident that the composition of the base furnishes the most important of all distinctive characters. The arrange-

* Translated by W. S. Dallas, F.L.S., from the 'Monatsbericht der kön. preuss. Akad. der Wiss. zu Berlin,' Feb. 1871, pp. 33–55.

ment which Bronn adopted for the Crinoidea, in 1860, in his 'Klassen und Ordnungen des Thierreichs,' divides the Brachiata, after Müller's example, first into the Tessellata and Articulata, and makes smaller sections in the arrangement of the genera within these divisions, exclusively from characters presented by the various composition of the base. The arrangement is artificial, and by no means brings the true relations of the Crinoidea in all cases to a correct and definitive expression ; but it has great advantages over other, older attempts at dividing the Crinoidea into families.

In accordance with their composition, the bases are to be distinguished as those which possess a regular quinquepartite structure, and those in which the regular quinquepartite composition becomes converted into a symmetrically quadri- or tripartite one. This conversion is subject to definite rules, the exposition of which is the principal object of this memoir. This must be preceded by a consideration of the regularly quinquepartite base in connexion with the structure of the stem.

The composition of the regularly quinquepartite base follows the following law :—Beneath the circle of the first radial joints a circle of equally numerous segments is inserted in alternating positions, the sutures of which strike the middle of the radial segments, so that the segments of the basal circle, when considered in their relation to the calycine radii, occupy an interradial position. A second circle of segments may follow, alternating in the same way with those of the first circle; so that their position beneath the calycine radii is maintained, and they would form a continuation of these if the first basal circle were deficient. In the pedunculate Crinoids the base is completed by the five sutures of the first basal circle when this alone is present, or of the second additional basal circle reaching down to the nutritive canal which unites the base with the stem. When only a single divided circle is present (as in *Cupressocrinus*), the five segments of the circle apply themselves around an undivided central segment which is perforated in the middle by the nutritive canal; such a central segment, as it essentially participates in the formation of the calycine cavity, must be referred to the base, and be regarded as the representative of the second basal circle. Pedunculate Crinoids with two divided circles in which a similar behaviour occurs in the second circle are unknown, as are also Crinoids with three divided basal circles*. It is only

* Hall's genus *Dendrocrinus*, to which that author ascribes three basal circles, cannot come into consideration here, as both the figure and description show that the statement rests upon the erroneous interpretation of imperfectly preserved remains.

among the non-pedunculated and later Crinoids that the remarkably isolated genus *Marsupites* is characterized by the circumstance that the five segments of the second basal circle surround a large pentagonal central plate in the same way as the segments of the first circle in *Cupressocrinus**.

For the sake of brevity, I will indicate the divided bases, according to whether one or two circles are present, as *monocyclic* or *dicyclic*. With the dicyclic base it is sufficient to distinguish the two circles as the upper and lower, or as the outer and inner, as has already been done in my memoir on *Encrinus*. In that memoir, also, the reasons have been given which are opposed to the unaltered retention of the terminology adopted by Johannes Müller for the parts of the base. In this the segments of the circle lying immediately upon the stem are everywhere called *basalia*—namely, both the segments of the monocyclic base and those of the inner circle of the dicyclic base; the upper circle of the latter receives, as something accessory, the special name of the *parabasis*. By this it is implied that the consideration of the base should start from the stem, and not, as is more natural, from the radii. Subsequent authors merely altered the names, without making any improvement. Of the parabasal segments De Koninck made *pièces sous-radiales*, from which resulted *subradialia*, and, with Bronn, the subradial zone. But the monocyclic base might with equal justice be named subradial. The name of *interradials*, recently employed by Quenstedt for the parabasalia, would, if adopted, be perfectly confusing.

In many Crinoids the stem is of so simple a structure that it only constitutes a transversely segmented appendage of the calyx. This is the case with the stems having a circular periphery, with a small round nutritive canal, and with indefinitely multiradiately striate articulating surfaces. From these we must distinguish other stems which in various ways display a quinqueradiate structure in directions which stand in a definite relation to the directions determining the arrangement of the calyx. Sometimes it is by the pentagonally prismatic

* Among the older Crinoids, F. Roemer's *Astylocrinus lævis* (Lethæa Geognostica, Taf. 4[1]. fig. 13) appears, like *Marsupites*, to possess two basal circles, the lower of which, however, does not surround a central plate, but is attached to an undivided central boss, nearly as, in *Apiocrinus*, the base is inserted upon the last joint of the stem. Roemer himself regards the central boss as the base, and only assumes one basal circle above it, which he calls the parabasis; but the arrangement of the lost plates is not reconcilable with this view, as is shown by the figure representing the corresponding plaster cast. The genus *Astylocrinus* would be very different from *Agassizocrinus*, if the preceding interpretation is correct.

form of the stem, sometimes by the five-leaved markings of the articulating surfaces well known in *Pentacrinus*, and sometimes by the pentagonal or five-lobed form of the nutritive canal that the directions determining the structure of the stem are indicated. In *Pentacrinus*, the five smooth leaf-like spaces of the articulating surfaces, the signification of which was pointed out by Johannes Müller, are directed from the nutritive canal to the angles of the pentagon of the stem; in the middle of the sides originate the cirri, which owe their position to a periodically recurrent division of the nutritive canal in the five intervening directions. These two directions, which are distinguishable in the same manner in other pedunculate forms, I will characterize as the *pentapetalous* and *pentamerous* directions of the stem; they may occur either together or alone.

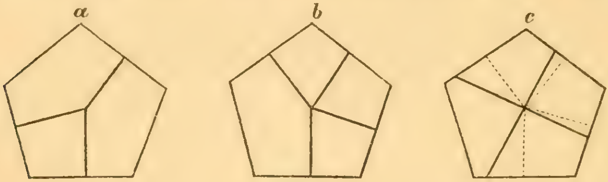
Stems like those of *Pentacrinus*, with pentapetalous angles and pentamerous cirriferous sides, occur also in ancient Crinoids. Goldfuss has figured such stems from the Eifel, belonging to *Poteriocrinus*, under the name of *Pentacrinus priscus* (Petref. Germ. Taf. 53. f. 7); and Murchison has given figures of similar stems, from Silurian strata, without special names (Silurian System, pl. 4. fig. 56). Pentagonal stems without five-leaved markings on the articulating surfaces, in which the pentamerous directions correspond with the angles of the pentagon, occur only in palæozoic strata (Goldfuss, Taf. 52. fig. 2, *Cyathocrinus pentagonus*). The directions of the quinqueradiate nutritive canal always correspond with the pentamerous directions of the stem, and therefore alternate with the five leaves of the articulating surfaces when these are present together with a five-lobed canal.

In their position with reference to the base, the directions of the stems of quinqueradiate structure are dissimilar. In *Pentacrinus* the interradially placed segments of the monocyclic base rest upon the five leaves of the pentagon of the stem; and the five pentamerous directions, or the five middles of the sides of the pentagon, correspond with the radii. Upon this peculiarity rests the assertion of Johannes Müller (Ueber den Bau des *Pentacrinus*, p. 16) that the base is a metamorphosed joint of the stem, and that its five pieces may be regarded as divided parts of the five leaves of the stellate prism of the stem-joints. This is the same thing as to say that the stem is an appendage of the base or of the lower basal circle, divisible in corresponding directions. That such a conception is not in accordance with nature, appears from the behaviour of the dicyclic base in *Encrinus*, or still more distinctly in the species of *Poteriocrinus* with a pentapetalous stem, such as *P. fusiformis* of the Eifel: here, contrary to what occurs in *Pentacrinus*, the sutures of the circle in immediate contact with the stem lie over the angles, and the middles of the segments over the sides of the pentagon of the stem. We may consequently distinguish the quinqueradiate stems according to their different relation to the division of the base, as *isomeral* and *antimeral* stems. Stems with a five-lobed nutritive canal, whether the base is divided monocyclically or dicyclically, have always an antimeral position, which appears from the mode of entrance of the five lobes or rays into the calycine cavity. The segments of the basal circle in apposition to the stem are always notched in the middle by one of the five rays of the nutritive canal.

These various peculiarities in the structure of the stem will have to be taken into consideration in the discussion of the circumstance that quadriradiate and triradiate stems also occur in which the deviation from the quinqueradiate form is recognizable sometimes by their quadrangular or triangular prismatic outline, sometimes by an apparently regularly quadri- or tripartite nutritive canal.

The change of the regular quinque-partition into a symmetrical quadri- or tri-partition does not start from the radii, but is peculiar to the dorsal pole of the Crinoid; it occurs, therefore, both in the monocyclic base and in the lower circle of the dicyclic base. The regular quinquepartite pentagon becomes converted into a symmetrical quadri- or tripartite figure as follows:—Either one of the five directions of division turned towards the sides of the pentagon, or two directions not belonging to adjacent sides, pass, as it were, out of action. Where the division is wanting, a larger plate, of pentagonal outline, is produced, occupying the space of two of the quadrangular plates of the regularly divided pentagon. The pentagon broken up, in accordance with this law, into four or three parts is said to be symmetrically divided, because it can be separated into two similar halves only in the direction of one of the five axes drawn from the angles to the opposite sides. In the tripartite pentagon this axis cuts the single small plate, and in the quadripartite the middle one of the three smaller and the large plate.

In the quadripartite pentagon the tendency to equalize the differences of the four inner angles predominates, so that the four sutures meet at the nutritive canal, crossing each other at right angles. This equalization is to be observed in all gradations in species of *Melocrinus*. The symmetrical divisibility is not altered by this, as the originally larger segment retains its pentagonal form; but the sutures are displaced, and no longer strike the middle of the sides. A similar equalization of the inner angles might also be possible in the tripartite pentagon by the displacement of the two sutures bounding the unpaired segment; but this appears to occur but rarely.



In the preceding three figures, *a* shows the symmetrically tripartite and *b* the symmetrically quadripartite pentagon; *c* the latter with the inner angles equalized. The dotted lines in *c* are in the position of the undisplaced sutures.

Simple as these conditions are, they were not, when first observed, either correctly interpreted or particularly valued. We may see this from the erroneously indicated divisions, such as are represented in the figures in Goldfuss, Petr. Germ. Taf. 58. fig. 3, or in Johannes Müller, *l. c.* Taf. 6. fig. 1 *a*. That both the tripartite and the quadripartite pentagon are only modifications of the quinquepartite, and formed in accordance with a definite law, was first explained by L. von Buch in his memoir on the Cystidea; at first, also, he had a notion that there might be a certain connexion between the occurrence of a symmetrically divided base and a lateral position of the vertical aperture; but by the further carrying out of this idea, he arrived at false conclusions. His opinion was that the axis in accordance with which the base is divisible into two similar halves, if prolonged meridionally round the Crinoid, must strike the excentrically placed vertical aperture; and he went so far as to believe that a central vertical aperture can occur only where the base is of regular quinquepartite structure (Ueber Cystideen, p. 5). It would almost appear that at the time when he was endeavouring to decypher the nature of the Cystidea, this observer, otherwise so acute, had never seen the well-preserved calyx of a Brachiate Crinoid with a pentagonal tripartite base. He depends chiefly upon the genus *Actinocrinus* (Cystideen, Taf. 2. fig. 9), which, however, does not possess the pentagonal base ascribed to it, but an hexagonal one; and for *Platycrinus* he refers to the figures of Johannes Müller, in the memoir on *Pentacrinus* (Taf. 6), in which there is nothing to be seen but an erroneously figured base, and nothing of the relations of the base to the excentrical vertical aperture.

In this way the first conception of the so-called "bilateral" structure of the Crinoids originated (Cystidea, p. 2, note). Subsequent authors retained the conception, but limited it to the consideration of the deviations in the regular arrangement of the radii, which certainly are connected with an excentric position of the vertical aperture (as F. Roemer in 'Lethæa Geognostica,' i. p. 221). A special relation of the symmetrically divided base to the symmetrical division of the radii was ignored; nevertheless it exists, and is subject to definite laws.

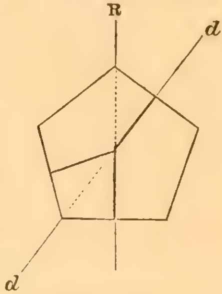
The regular quinqueradiate arrangement of the radii of the calyx is converted into a symmetrical arrangement by one of the five interradial directions becoming particularly marked; when this occurs the radii arrange themselves symmetrically, in accordance with an axis which cuts through the interradius characterized as polar and the opposite radius. In many cases the distinction of the polar interradius is perceptible only by the vertical aperture taking up an excentric position, by moving towards the side from the ventral pole in the direction of one of the interradii. In other cases, where the covering of the vertex between the radii which have grown together to form the calyx is prolonged downwards, and forms the so-called interradial spaces, that interradial space towards which the excentric vertical aperture is directed acquires a composition different from that of the others, or pushes further downwards between the adjacent radii. But it also happens, as in *Actinocrini* with the vertex prolonged like a proboscis, that one of the five interradial spaces possesses the abnormal composition, whilst the vertical aperture has retained its central position. As appears from this, it was incorrect to speak of anterior and posterior in the Crinoids, as if the peculiar interradius were always to be called posterior or anal, even when the vertical aperture is central and when we have no knowledge of its position. Leaving out of consideration the question whether the single vertical aperture is to be called the *mouth*, after the example of Müller and L. von Buch, or the *anus*, as recent anatomists wish, the *anal* interradius is still an unsuitable term, because the distinction of the interradius is not called forth by the vertical aperture, the excentric position of the latter being rather only a consequence of the fundamental condition of the polar distinction of one of the interradial directions. Accordingly I shall call the axis according to which the radii arrange themselves symmetrically the *radial axis*, in contradistinction to the *dorsal* *axis*, in accordance with which the base is symmetrically divided.

Only in a few ancient Crinoids is the calyx so perfectly regular in structure that neither a radial nor a dorsal axis is distinguishable. In others only the radial axis is developed, whilst the base is regularly divided; and others, again, possess regular radii and a central vertical aperture, with the base symmetrically constituted. Those Crinoids in which only one axis is developed would be divisible into two similar halves from the vertex to the root, through one and the same plane, which in one case would be to be drawn through the radial, and in the other through the dorsal axis. But in the numerous Crinoids in which both axes have attained development, it is the rule that the dorsal axis maintains a direction peculiar to it, differing from the radial, but constant in each individual case. The observations to be brought forward in the following pages relate to genera with both monocyclic and dicyclic, tripartite and quadripartite bases.

Observation is most simple in the *monocyclic tripartite base* of *Platycrinus*. The symmetrical division of the calyx in accordance with a radial axis is possible in this genus only in species allied to *P. pileatus*, Goldf., or *P. rugosus*, Müll., in which the calycine aperture has a perfectly lateral position. If such calyces be examined in the reversed position, with the base turned upwards, making the orientation of the pentagon of the base accord with the interradius above which the vertical aperture is situated, it is easy to see that in all individuals the three segments of the base have the same position, and that the dorsal axis does not coincide with the radial.

In order to institute more detailed comparisons, it is necessary to give the radial axis a fixed position. In what follows I shall, when examining the calyx in the reversed position, turn its interradial pole forward, and indicate it by the letter R in the explanatory figures, which are always referable to this position. The lateral paired radii and interradii 1 distinguish as the adjacent and abjacent radii and interradii of the right and left side. As by this means the denomination anterior and posterior radii or interradii is avoided, we obtain the advantage that in the upright position, in which observers are accustomed to turn the vertical aperture backward, the expression for the lateral parts remains the same.

As in the pentagon of the monocyclic base the angles correspond with the interradial and the sides with the radial directions of the calyx, the law for *Platycrinus*, illustrated by the annexed figure, runs as follows:—The dorsal axis, *d d*, in accordance with which the base is symmetrically divided, leads over from the right adjacent radius to the left abjacent interradius. This expression will remain the same when, the calyx being placed erect, the vertical aperture is directed backward.



Platycrinus.

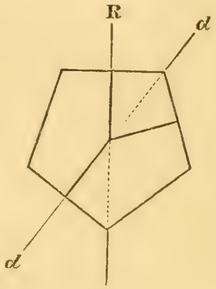
A *dicyclic tripartite base* is possessed by the family Taxocrinidæ, to which *Taxocrinus*, *Forbesiocrinus*, *Ichthyocrinus*, *Mespilocrinus*, and *Lecanocrinus* are to be referred.

The above-mentioned five genera are nearly allied to each other, both by the similar composition of the base and by the structure of their radii. The latter divide repeatedly, but retain uniserial joints, on the sides of which distinct marginal plates are sometimes visible, but no pinnules. In none of them has a perfectly preserved ventral covering with the vertical aperture been observed; but the polar interradius is usually indicated by the circumstance that the ventral covering descends between two radii to the base, so that the subjacent segment of the upper basal circle acquires a form different from that of the other segments of the circle. One or more interradial plates make their appearance in the polar interradial space (and sometimes others in the lateral interradii); but they did not serve as a firm shelly union of the radii, which retained the power of movement by means of chamfered joints as far as the first radial segment. The family is most nearly allied to the Poteriocrinidæ, to which *Poteriocrinus*, *Cyathocrinus*, and other similar genera with a dicyclic, regularly quinquepartite base belong.

The genera *Taxocrinus* and *Forbesiocrinus* are so nearly related that it is a question whether both can be maintained. Phillips, in 1841, first united four Crinoids previously described as belonging to *Cyathocrinus* and *Poteriocrinus*, on account of the concordant structure of their radii, under the name of *Isocrinus*, which has since become *Taxocrinus*. *Forbesiocrinus* should be chiefly distinguished, according to De Koninck, by the presence of interradial segments. The genera, however, can only be retained if *Taxocrinus* be limited to those species in which the first division of the radii takes place in the third joint, whilst four primary radial segments are characteristic of *Forbesiocrinus*. To *Taxocrinus* thus limited belong the English *T. tuberculatus*, the American *T. interscapularis*, and the two Rhenish species, *T. rhenanus* and *T. affinis*. The other species placed in the genus by L. Schultze are either to be removed or doubtful.

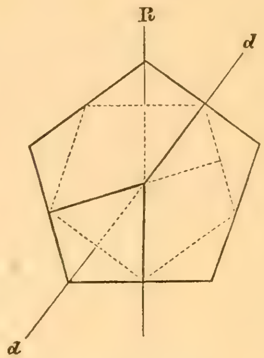
The base in both genera is exceptionally small, and for the most part covered by the stem; its composition was unknown to or misunderstood by the founders of the genera. That *Taxocrinus* possesses a dicyclic tripartite base was first established by Johannes Müller; in *Forbesiocrinus* it was first observed by Hall in species from the Carboniferous Limestone of America. Among the materials in the Berlin Museum, the composition of the base was visible in a well-preserved *Taxocrinus tuberculatus*, and in two isolated calycine bases from the Carboniferous Limestone of Bolland and of Altwasser, in Silesia, of which the first probably belongs to *Forbesiocrinus nobilis*, and the other to a still unknown species of the same genus. In the two calycine bases the inner basal circle is very small, and visible with distinctly preserved sutures only on the inside of the base; on the outside, in the surface of attachment of the stem, no sutures presented themselves, even on the application of acids; so that in perfectly preserved heads the composition of the base in these species would hardly be demonstrable.

In the three observed cases the sutures of the inner basal circle exhibited the position shown in the annexed figure. As the segments of the second basal circle alternate with those of the first, the pentagon, compared with that of the monocyclic base of *Platycrinus*, has received a reversed position, and the sides now correspond with the interradial, the angles with the radial, directions of the calyx. The segments and the sutures of the symmetrically divided lower basal circle have acquired a totally different position; but the direction of the dorsal axis has remained precisely the same; as in *Platycrinus*, it passes from the right adjacent radius to the left abjacent interradius.



Taxocrinus.

In order to review the simple foundation of this phenomenon the more easily, we must start from the geometrical condition that a symmetrical tripartition of the regular pentagon may take place in two different ways, as the unpaired suture between two larger segments might issue from any one of the five angles or from the middle of any one of the five sides. As the division takes place in a pentagon the segments of which alternate with the superjacent ones, the divisions starting from the angles are excluded, and five modes of division remain possible, only one of which occurs. In the pentagon of the inferior basal circle, which has the opposite position, the sutures of the possible divisions acquire the directions of those which were impossible in the superior pentagon; and it will be seen from the annexed figure that the mode of division observed in *Taxocrinus* or *Forbesiocrinus* is the only one that was possible if the dorsal axis of the dicyclic tripartite base was to preserve the same position that it possesses in the monocyclic base of *Platycrinus*.



In the figure, the two pentagons of the monocyclic and dicyclic base divided in accordance with the same dorsal axis are placed one within the other, the latter, with the sutures belonging to it, being distinguished by dotted lines.

From the two first mentioned genera of the Taxocrinidæ *Ichthyocrinus* is distinguished by the fact that the radii, which consist of flat broad segments, may become firmly interlocked in a state of rest. As early as the year 1839, Phillips, when comparing the *Cyathocrinus pyriformis* of the 'Silurian System,' which belongs to *Ichthyocrinus*, with *Taxocrinus tuberculatus*, remarked that the two Crinoids presented great analogies, and that the former might probably form a new genus; his judgment was confirmed by Hall, who ascertained the presence of the dicyclic tripartite base in the American *Ichthyocrinus lævis*. According to the diagram which this author has given in the 'Palæontology of New York' (vol. ii. pl. 45. fig. 2), the polar interradius would be recognizable also in *Ichthyocrinus* by a small high-placed interradial segment, and the division of the inferior basal circle would correspond with that of *Taxocrinus*.

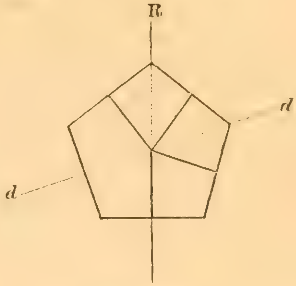
De Koninck's genus *Mespilocrinus* is not, as L. Schultze judged, identical with *Lecanocrinus*. It is distinguished from *Ichthyocrinus* only by a larger and more developed calycine floor, in which the dicyclic base in combination with the first radial segments has acquired the form of a patina. Of the two species of the genus, the Berlin collection has received from M. de Koninck a patina of *Mespilocrinus Forbesianus*, the division of which is clearly like that of *Taxocrinus*, as is the case also in the diagrams which M. de Koninck has given for his two species.

Lecanocrinus is distinguished from *Mespilocrinus* by the polar interradius, as in *Poteriocrinus*, having received an oblique extension or a sort of twisting by the intercalation of an accessory segment sinking downwards towards the right side. In consequence of this, the radial segments laterally adjacent to the polar interradial space, as well as the adjoining segments of the upper basal circle, have an irregularly distorted form, which, however, exerts no influence upon the division of the inferior basal circle. The division of the base may be observed in the patina of an undescribed Silurian species from Gotland; it is as in *Taxocrinus*, and agrees with the various diagrams given for the genus—by Hall, of *L. macropetalus* (Pal. New York, ii. pl. 45. fig. 1 *g*), of *L. ornatus* (*l. c.* pl. 44. fig. 2 *g*), and of *L. caliculus* (*l. c.* pl. 46. fig. 3 *b*), and by Schultze of the Rhenish *L. Roemeri* (Echin. des Eifler Kalkes, p. 40).

Thus, from what precedes, the observed division of the base in the Taxocrinidæ was the same in all cases, which, indeed, are not very numerous; and the agreement with the diagrams cited is in favour of the condition observed being a law generally prevalent for the whole family. Deviations, such as are shown by Hall's diagram of *Forbesiocrinus* in the 'Palæontology of Iowa,' and by Schultze's diagram of *Taxocrinus* in the 'Echinodermen des Eifler Kalkes' (p. 32), I am inclined to ascribe to the circumstance that the authors had not yet directed their attention to the relation here under consideration.

Among the Crinoids with a *monocyclic quadripartite base* there is scarcely one, except *Melocrinus*, that is fitted for corresponding observations. As in *Platycrinus*, certain species of this genus possess a central or subcentral vertical aperture, and the five interradial spaces are alike in composition, so that the calyx does not admit of being divided in accordance with a radial axis. But in the majority of the species the vertical aperture has a decidedly lateral position, turned towards one of the interradii, and the subjacent interradial space acquires a greater number of plates, as, indeed, was remarked by Goldfuss. In such *Melocrini* a definite rule for the position of the dorsal axis is also demonstrable, but exceptions from this occur, which has not been observed in *Platycrinus*.

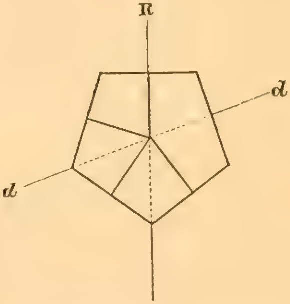
The normal position of the dorsal axis in *Melocrinus* is different from that in the tripartite base of *Platycrinus*; it runs, as the annexed figure shows, from the right adjacent radius to the left abjacent interradius, and is therefore turned further from the radial axis by one decimal space.



Melocrinus.

The observation was made on twenty calyces, partly belonging to *M. hieroglyphicus*, from Stolberg, and partly to undescribed Upper Devonian species from Senseille, near Couvin, in Belgium. In seventeen calyces the normal division appeared; in the other three it deviated in the same way—namely, so that the dorsal axis coincided with the radial.

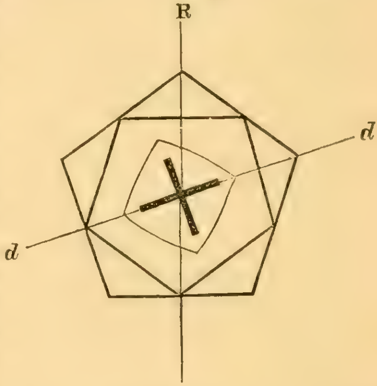
If a *dicyclic quadripartite base* were divided in accordance with the same axis as the monocyclic base of *Melocrinus*, and therefore stood in the same relation to this as the base of the Taxocrinidæ to that of *Platycrinus*, the segments of the inferior basal circle would be placed as in the annexed figure. A base divided in this manner has not yet been observed, but it has to be taken into consideration in the examination of the structure of the genus *Cupressocrinus.*



Cupressocrinus has perfectly regularly constructed radii, without interradial plates. The ventral covering is unknown; but the internal framework, extended between the radii, which is peculiar to the genus, possesses an interradially placed aperture, indicating the position of the vertical aperture—by means of which we are enabled to regard the calyx as divided in accordance with a radial axis, and therefore also to discuss the question whether the quadriradiate division of the stem, which occurs in most species of the genus, stands in the same relations to the radial division of the calyx as the division of the base in other genera.

The dicyclically constituted base of *Cupressocrinus* consists of a regularly quinquepartite upper circle and an undivided central plate, which sometimes extends flatly beyond the end of the stem, sometimes is erected for a short distance, and sometimes entirely concealed by the stem. The quadriradiate cross of the nutritive canal enters the pentagonal central plate in the same position that it occupies in the quadrangular stem, so that in any calyx with the vertical framework preserved the directions of the five calycine radii may be easily compared with those of the four stem-rays. The examination of numerous calyces of *Cupressocrinus gracilis* showed that in the great majority the four rays of the nutritive canal occupy such a position in the pentagon of the central plate that one of the four rays is turned towards the left abjacent angle, and the opposite one towards the middle of the right adjacent side, whilst the direction of the two other rays is determined by their crossing at right angles.

In the following figure the two pentagons of the outer basal circle and the central plate are placed one within the other, and the above-described position, which is to be regarded as normal, is given to the cross in the central plate. The outline of the four-sided stem, as it appears on the lower surface of the calyx, is added.



Such a position of the cross does not correspond with the position of sutures by which the pentagon of the central plate might be broken up symmetrically into four parts; it would therefore also not be possible in a stem the rays of which were in isomeral position to the segments of a divided inferior basal circle. But if we draw in the pentagon of the central plate, as shown in the annexed figure, four sutures crossing each other at right angles, to which the four rays of the nutritive canal stand in an antimeral position, we have the division which would occur in a dicyclic base which is divided into four parts in accordance with the same axis as the monocyclic base of *Melocrinus*. The four segments have the same position as in the lower

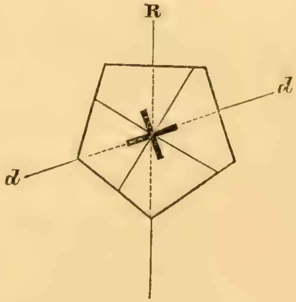
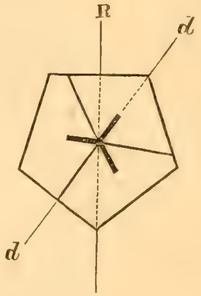


figure on p. 405, but with this difference, that the inner angles are equalized.

Besides quadriradiate stems, stems with triradiate nutritive canals also occur in two species of *Cupressocrinus*. One of these species is frequent in the Eifel, and was characterized almost simultaneously by L. Schultze as *C. inflatus* and by Quenstedt as *C. trimerus*; the second has been described by Schultze as *C. hieroglyphicus*. On the examination of ten calyces of *C. inflatus*, it soon appeared that here also the three rays of the stem are not symmetrically placed with regard to the radial axis; but yet in the majority the position did not correspond with the dorsal axis, which was the determinant for the quadriradiate stems. In the most regularly formed calyces one of the three rays appeared rather to be turned towards the right adjacent angle of the pentagon of the central plate—that is, in correspondence with the axis which was determinant for the symmetrically tripartite base of *Platycrinus* and the Taxocrinidæ. In the annexed figure the character is illustrated in the same way as that of the quadriradiate stem, by drawing in the pentagon of the central plate three segments in accordance with the axis indicated, so that the three rays of the nutritive canal have the antimeral position.



Perhaps the deviations from the rules assumed for the stem of *Cupressocrinus*, which are comparatively not uncommon, may be referred to the occurrence of something like hesitation in the selection of one or the other axis in the formation of the stem. The proportion of abnormal to normal positions in the observed cases is as follows:—in the quadriradiate stems of *C. gracilis* three or four abnormal occurred to fourteen normal, in *C. abbreviatus* two abnormal to five normal, and in *C. inflatus* three abnormal to seven normal. It must, however, be taken into consideration here that few other genera have such a tendency as *Cupressocrinus* to produce numerous and multifarious monstrous formations.

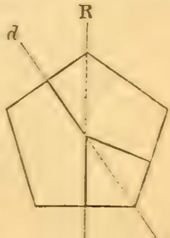
The nearly allied genera *Gastrocoma*, *Ceramocrinus*, *Nanocrinus*, and *Lecythocrinus* would be especially fitted for further investigations upon the fundamental law of the quadriradiate structure of the stem; these all resemble *Cupressocrinus* in the composition of the base. Among the materials in the Berlin

Museum the position of the stem-rays could be determined only in two specimens, a *Gastrocoma* and a *Ceramocrinus*; in both the position was the normal one of *Cupressocrinus*. *Myrtillocrinus* is also nearly allied to the above-mentioned genera, especially according to Hall's representation of *M. americanus*. A more accurate examination of this genus would be especially desirable, as it is the only one to which both a quadriradiate stem and a divided inferior basal circle is ascribed.

In the preceding only the various symmetrical modes of division of pentagonal bases have been taken into consideration. Besides these, however, monocyclic hexagonal bases occur, which are divided in *Actinocrinus* and *Hexacrinus* into three, and in *Dichocrinus* into two equal parts. As the hexagon is only produced by two radii being pushed asunder down to the base by an interradial space, the hexagon acquires for the Crinoid the signification of a symmetrical hexagon, one side of which as interradial is opposed to the five other sides as radial. Such a hexagon is consequently divisible into equivalent halves only in accordance with one axis, which runs across from the middle of the single interradial to the opposite radial side, *i. e.* in accordance with an axis which coincides with the radial axis of the calyx. Consequently the tripartition of the only apparently regular hexagon has to be regarded as a symmetrical one, produced in accordance with the rule that one of the three dividing sutures is placed interradially, and the other two radially. The median suture in the base of *Dichocrinus* is to be conceived as having one half interradial and the other half radial.

The observations made on the Crinoidea brachiata led to a comparative investigation of the Blastoidea and Cystidea.

The Blastoidea all possess a monocyclic, pentagonal, symmetrically tripartite base, and have, above one of the five interradial plates, a single opening, which probably represents the vertical aperture of the Brachiata. We may therefore in them also regard the calyx as divided in accordance with a radial axis, and express the division of the base in the same way as in the Brachiata. When viewed in the same relative position that was given the calyces of the Brachiata, the dorsal axis acquires the direction from the left adjacent radius to the right abjacent interradius. This is a position which has not been observed in Brachiate Crinoids with a tripartite base, but which has proved to be constant in a great



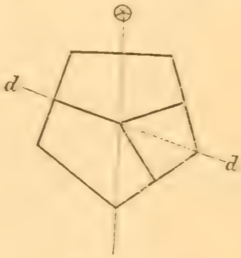
Pentatremites.

number of *Pentatremites* of various species, and could also be demonstrated in some specimens of *Elæacrinus* and *Codonaster*.

The Cystidea are generally not well fitted for such investigations, because in them the radii, ventral covering, and vertical aperture are not separated from each other, as in the Brachiata. Only the two genera *Stephanocrinus* and *Cryptocrinus*, which depart so widely from the other Cystidea by the want of calycine pores and their simple regular structure, could be taken into consideration.

Stephanocrinus has almost exactly the same composition as *Pentatremites*, and is essentially distinguished only by the free development of the radii; the lateral pyramidal orifice, on account of which the genus is referred to the Cystidea, has the same position as the lateral vertical aperture of the Blastoidea. The investigation of some well-preserved specimens from Lockport, for which the collection is indebted to M. Roemer, showed that, with similar orientation, the dorsal axis also has the same position as in *Pentatremites*.

In *Cryptocrinus* the symmetrically tripartite pentagon to which the stem is attached is immediately followed by a regular quinquepartite circle, above which the pyramidal vertical aperture is so placed that the two inferior circles may be compared to the dicyclic tripartite base of a Brachiate Crinoid. If, in accordance with this, we place the pyramidal aperture as the pole of a radial axis, the dorsal axis (as shown in the annexed figure) runs from the left adjacent side to the right abjacent angle of the pentagon. The position stands in the same relation to the axis of the Blastoidea as the axis of *Melocrinus* to that of *Platycrinus* or *Taxocrinus*—namely, towards the same side, but turned by one decimal space further from the radial axis.



Cryptocrinus.

The results of the observations upon the symmetrically divided base of the Crinoids here communicated may be summed up in the following propositions:—

1. In all Crinoids in the calyces of which the radii may be arranged in accordance with a radial, and the parts of the base

in accordance with a dorsal axis, the two axes have a normal position towards one another.

2. If the interradial pole of the radial axis be turned forwards in the reversed position of the calyx, or hindwards in in its erect position, and, starting from the interradial pole, we distinguish the lateral radii and interradii as adjacent and abjacent, the following law applies to all Brachiata, namely,—that the dorsal axis runs either from the right adjacent radius to the left abjacent interradius, or from the right adjacent interradius to the left abjacent radius.

3. In the Brachiata with a pentagonal tripartite base, whether monocyclic or dicyclic, the dorsal axis goes from the right adjacent radius to the left abjacent interradius. *Platycrinus* and *Taxocrinus* and allied genera were examined.

4. In the monocyclic quadripartite base of *Melocrinus* the dorsal axis goes from the right adjacent interradius to the left abjacent radius.

5. In genera with quadriradiate and triradiate stems (*Cupressocrinus*, *Gastrocoma*, and allied genera) the rays of the stem are so arranged that they would cut into the segments of a base divided either quadripartitely or tripartitely in accordance with the observed axial directions, in an antimeral direction.

6. The hexagonal base of *Actinocrinus*, *Hexacrinus*, and *Dichocrinus* is symmetrically divided, as one of the dividing sutures, starting from the dorsal pole, runs to the single interradial side of the hexagon.

7. In the Blastoidea (*Pentatremites*, *Elæacrinus*, and *Codonaster*) the dorsal axis of the pentagonal tripartite base runs from the left adjacent radius to the right abjacent interradius—a position which has not been observed in the Brachiata.

8. The genus *Stephanocrinus*, which is referred to the Cystidea, has the same position of the dorsal axis as the Blastoidea.

9. If we look at the Cystidean genus *Cryptocrinus* in the same way as at a Brachiate Crinoid with a tripartite base, its dorsal axis corresponds with a position from the left adjacent interradius to the right abjacent radius.

In conclusion, the question may be touched upon, how far there are analogies between the peculiar division of the base in the Crinoids and the symmetrical development of other Echinoderms, especially the sea-urchins.

Of the parts of the *Echinus*-shell arranged in meridional rows of segments, the ambulacral and interambulacral spaces represent the radii and interradii of the Crinoids. In the same way as in the Crinoids, the radii of the *Echini* do not unite in the dorsal pole, but remain separated therefrom by the vertical apparatus, which, from its position, is the analogue of the base of the Crinoids. The symmetrical *Echini* acquire their so-called bilateral structure by one of the interradial spaces being distinguished from the rest by the occurrence of the anal aperture; the radii and interradii, as a consequence of this, arrange themselves in accordance with a radial axis, in the same way as in the Crinoids. In the composition of the vertical apparatus of the *Echinus* no phenomena occur which are to be compared to the deviations from the regular quinquepartition in the base of the Crinoids; but the vertical apparatus acquires a symmetrical arrangement in another way, by the combination of one of its plates with the madreporic plate, which is peculiar to the *Echini*. The ten radially and interradially placed plates of the vertical apparatus may therefore, like the symmetrically divided base of the Crinoids, be arranged in accordance with a dorsal axis cutting through the interradially placed madreporic plate and the opposite radially placed ocellar plate. As in the Crinoids, the dorsal axis does not coincide with the radial; it has an oblique but regularly fixed position with regard to this. The expression for the position of the dorsal axis in the *Echini* differs from that in the Crinoids, because, by the presence of the madreporic plate, it acquires a fixed interradial pole, of which the dorsal axis of the Crinoids is destitute. In the symmetrical *Echini* the law of the position of the dorsal axis is expressed by regarding the madreporic plate as turned towards the right anterior interradius. If we wish to indicate the position in the same way as with the Crinoids, we must place the polar interradius forwards, as in the reversed position of the Crinoidal calyx; and then we obtain the expression that the dorsal axis of the symmetrical *Echini* runs from the right adjacent radius to the left abjacent interradius. This is the position observed in *Platycrinus* and *Taxocrinus* among the Crinoids. The regular *Echini* are comparable to those Crinoids in which a radial axis cannot be distinguished; for which reason we cannot speak in them of a normal position of the dorsal axis or of the madreporic plate.

L.—*Descriptions of new Species of Butterflies from Tropical America.* By Osbert Salvin, M.A., F.L.S., &c.

[Concluded from vol. iv. p. 181.]

33. *Melinæa scylax.*

♂. Exp. 3·70 in. Antennæ yellow, black at the base; somewhat like *M. mneme*, Linn., as regards the markings of the upperside of the anterior wings; the transverse yellow band beyond the cell is narrower; the basal half of the inner margin is tawny, and not black: the posterior wings are tawny, with a narrow black margin: beneath as above, the base of the costa of the hind wings yellow; there are no white spots on the outer margin.

Hab. Bugaba, Chiriqui (*Arcé*).

Mus. S. & G.

34. *Melinæa orestes.*

♂. Exp. 3·50 in. Somewhat similar to *M. lucifer*, Bates (Trans. Linn. Soc. xxiii. p. 551), the yellow spot on the costa and that in the apex being wanting: the posterior wing, instead of being black between the cell and the outer margin, has a double transverse row of black spots, the outer margin being very narrowly bordered with black.

Hab. Peru, Pozzuzo (*Pearce*).

Mus. S. & G.

35. *Melinæa cydippe.*

♂. Exp. 3·80 in. Very similar to *M. messenina*, Feld. (Voy. Nov. p. 356, t. 45. f. 11), differing chiefly in the cross band of the anterior wings being entirely tawny, instead of the outer half being yellow: there is a black spot in the angle between the second section of the median nervure and its first branch: both the outer and inner margins of the tawny band are less deeply sinuated.

Hab. S. Ecuador, Guadalquiza (*Pearce*); Peru, Pozzuzo (*Pearce*).

Mus. S. & G.

Obs. This species is coloured exactly as *Mechanitis mothone*, Hew. Ex. B. ii. t. 15. f. 14.

36. *Pronophila timanthes.*

♂. Exp. 3·30 in. Similar to *P. obscura*, Butl. (Cat. Satyridæ, p. 184, t. 4. f. 10), as regards the pattern of the underside of the posterior wings; the ocelli of the anterior wings are each surrounded by an oblong rufescent mark; on the upperside a similar series of marks is conspicuous, but the ocelli are not pupillated; the general colour of both upper and under surface is of darker hue, and the apex of the anterior wings is more pointed than in *P. obscura*.

Hab. Veragua, Volcan de Chiriqui (*Arcé*).

Mus. S. & G.

37. *Oxeoschistus cothon.*

♂. Exp. 2·35 in. Close to *O. tauropolis* (D. & H. Gen. Diurn. Lep. p. 358, t. 66. f. 1); on the upper surface are two additional yellow spots close to the apex of the anterior wing, and another between the second and third branches of the median nervure; the spot on the hind wing is larger; the band crossing the hind wings through the end of the cell on the underside is much broader, and includes a considerable portion of the extremity of the cell; the narrow band through the middle of the cell is concave instead of nearly straight.

Hab. Veragua, Volcan de Chiriqui (*Arcé*).

Mus. S. & G.

38. *Heliconius sisyphus.*

♂. Exp. 3·80 in. Wings fulvous, edged and marked with black; antennæ yellow, black at the base; apical third of anterior wings, costa, outer margin, region of subcostal nervure, a comma-shaped spot within and a triangular spot at the end of the cell, three indistinct spots between the branches of the anterior wings, black; outer margin of posterior wings and a macular transverse central band black, outer margin spotted with white: beneath as above, but paler; the black apex of the anterior wings includes a faint submarginal row of white and four yellowish spots; there is a black streak between the costal and subcostal nervures of the posterior wings.

Hab. Peru, valley of the Cosnipata (*Whitely*).

39. *Heliconius venustus.*

♂. Exp. 3·30 in. Like *H. anactoria*, Dby. (D. & H. Gen. Diurn. Lep. t. 15. f. 4); but the spot over the end of the cell of the anterior wing is wholly yellow, does not extend so far towards the apex, and has a black spot at the origin of the lower radial nervure.

Hab. Bolivia, Apolobamba (*Pearce*).

Mus. S. & G.

Obs. This species belongs to the *H. vesta* group; but the characters of its markings appear to be so strongly defined that the insect may fairly be considered a distinct race, if not a good species.

40. *Heliconius etylus.*

Exp. 3·30 in. Similar to *H. vesta*, but differs in having the anterior wings more elongated, and the yellow patch on the middle of the wing is represented by a small oval spot halfway between the cell and the apex. In the position of this spot this species differs from all races and varieties of *H. vesta*.

Hab. Ecuador, Guadalquiza (*Pearce*).

Mus. S. & G.

41. *Heliconius montanus.*

♂. Exp. 3·70 in. Like *H. clysonyma*, Latr., from New Granada, but is larger, and the red band across the posterior wing is twice as broad.

Hab. Costa Rica, Orosi (*Kramer*).

Mus. S. & G.

42. *Heliconius pachinus.*

♂. Exp. 3·40 in. Somewhat like *H. aranea*, F., but differs notably in the following points:—The base of the anterior wings is wholly black; the central yellow cross band is only interrupted by the nervures, and is altogether beyond the cell; the apical band is nearer the apex of the wing: the posterior wings are crossed transversely by a conspicuous yellow band, which is divided by the black nervules; the cilia of the outer margin is black: the underside is marked exactly as above, the red spots at the base of the posterior wings being just as in *H. aranea*.

Hab. Volcano of Chiriqui.

Mus. S. & G.

43. *Heliconius sotericus.*

♂. Exp. 3·45 in. Very closely allied to *H. telesiphe* (D. & H. Gen. Diurn. Lep. t. 15. f. 2) in all its markings, and differs only in having the transverse band on the hind wings yellow instead of pure white; it is also slightly broader.

Hab. Guaymay, Ecuador (*Buckley*).

Mus. S. & G.

Obs. This species and *Colænis tithraustes*, described below, in Ecuador take the place of *H. telesiphe* and *Colænis telesiphe*, which are found together further south in Peru. The resemblance between the *Heliconius* and *Colænis* is most remarkable; but still more singular is the complete isomorphism in both genera as regards the band of the hind wings.

Mr. Buckley captured several specimens of this species during his recent visit to Ecuador.

44. *Colænis tithraustes.*

Exp. 2·90 in. Very closely allied to *Colænis telesiphe*, Hew., but differs in having the transverse band of the hind wings yellow instead of white; in other respects the two species are quite alike.

Hab. Canelos, Ecuador (*Pearce*).

Mus. S. & G.

Obs. Mr. Buckley also took specimens of this species in Ecuador.

45. *Eurema Arcæi.*

♂. Exp. 2·50 in. Like *E. dione*, Latr., but darker; a broad subtriangular tawny band crosses the anterior wing from the costa towards the posterior angle; the inner edge of this band is nearly straight, and passes close to but outside the elongated transparent spot between the first and second median branches. There are no transparent spots near the apex as in *E. dione*. The undersides of the two species are quite alike.

Hab. Volcano of Chiriqui (*Arcé*).

Mus. S. & G.

46. *Melitæa crithona.*

Exp. 1·70 in. Outer margin of anterior wings somewhat strongly emarginate, dark brown; anterior wing with two deep-tawny spots in the cell, three others between the median nervure, its second branch, and the inner margin; a broad tawny transverse band crosses the wing from the costa to the posterior angle: posterior wings with three undulating narrow tawny lines parallel to the outer margin. Underside with band on the anterior wings as above; basal half with ochre spots margined with dark brown; apex reddish brown, with a few whitish spots: posterior wings grey, with irregular brown lines; outer margin dark brown, running into a large patch near the costa; apical angle grey, with dark lines; the markings of the underside of the posterior wings much resemble those of *M. ardys*, Hew. The band across the anterior wings is somewhat like that in *M. elaphiæa*, Hew.

Hab. Volcano of Chiriqui (*Arcé*).

Mus. S. & G.

Obs. This is a well-marked species, and distinct from any I have seen.

47. *Leptalis cinerascens.*

♂. Exp. 2·45 in. Antennæ black, palpi greyish, head and thorax black mixed with grey: anterior wings pointed, posterior angle rounded, not projecting; black, with five grey spots—one at the end of the cell and reaching to the costal nervure, one near the origin of the upper and lower radials, one between the second and third median branches, and two near the apex: posterior wings rounded at the anterior angle; a sooty-brown patch surrounded by glossy brown occupies the costal half of the wing to the median nervure; outer margin and region of the median nervure black; rest of the wing grey, with yellow scales about the inner margin and anal angle. Beneath glossy brown: anterior wings with a large central fuliginous patch; outer extremity of the costa variegated with whitish: outer margin of the hind wings and the region of the anal angle yellowish; a yellow spot at the extremity of the precostal nervure.

Hab. Costa Rica (*Carmiol*); Chiriqui (*Arcé*).

Mus. S. & G.

Obs. Similar in form and the position of its markings to *L. nemesis*, Latr., but differs chiefly in the markings of both wings being grey instead of yellow.

48. *Leptalis oreas.*

♂. Exp. 2·40 in. Antennæ, head, and thorax black; palpi black, with scattered grey hairs; abdomen black above, whitish beneath: apex of the anterior wings rounded, outer margin slightly concave; black, with a wide patch of clear yellow extending almost from the costa over the anterior angle of the cell and beyond it to the second median branch; this patch is somewhat concave, and is cut by the black nervures, the upper discocellular showing like an acute black projection; near the apex are three faint yellowish spots placed obliquely: posterior wings produced, slightly pointed at the end of the subcostal, and, as in other members of the genus, silky white at the base and along the inner margin, the region of the outer angle brownish; outer and inner margins and region of the median nervure black, enclosing an irregular oval patch of white. Anterior wings beneath cretaceous white on the inner portion; costal region silky grey, variegated with white, especially at the apex: posterior wings silky grey variegated with white about the base and outer margin; a band of glossy white, cut by the nervures, crosses the wing through the end of the cell; two other prominent spots of the same colour are placed, one between the third median branch and lower radial, the other between the costal and subcostal nervures; there are also two orange spots at the base of the wing—one over the precostal, the other between the median and submedian nervures.

Hab. Calobre, Veragua (*Arcé*).

Mus. S. & G.

LI.—*The Descendence-Theory considered from some special points of view.* By W. Veltmann*.

Deviations from the average constitution of the species may be advantageous to the individuals and, according to Darwin's view, may induce the production of new species by natural selection in five different ways:—

1. From birth a longer duration of life. Here that duration of life is meant which is attained by the animal when it dies a natural death, after existing during its life under normal conditions. The greater this duration of life pertaining to the animal in accordance with its original constitution, the greater also, on the average, will be its actual duration and, consequently, the assistance given by it to the maintenance of the species.

2. Easier nourishment, *i. e.* attainment of the necessary food. In connexion with the inheritance of peculiarities this comes into consideration, inasmuch as deficiency of nourishment is prejudicial to the development and activity of the sexual system, and may also abridge the duration of the time of reproduction, and even life itself.

3. The faculty of more easily escaping pursuers and other dangers. In this, greater protectedness of the eggs and young from destruction is included.

4. Greater facility of effecting copulation (clasping, seizing the female, &c.).

5. Greater fertility.

Among these various momenta, 2, 3, and 4 depend in part upon the stronger and more persistent constitution of the internal organs; but 1 is also dependent upon this. But 2, 3, and 4 are conditional upon the production of special internal and external organs or other properties (colour &c.). The differences in participation in propagation hereby produced, as also those in connexion with 5, may, however, always be very small, as very considerable deviations always occur very rarely and quite isolatedly. The differences in congenital duration of life are, on the contrary, very considerable. These will therefore always have so predominant an influence, that that of the other casual deviations disappears before it. It follows from this that from a species no other species possessing a shorter period of life can be produced. Of all deviations in the external or internal constitution, only those can become constant which tend to a longer period of life.

Differences in fecundity could only have an equal degree of

* Translated from the 'Archiv für Naturgeschichte,' Jahrg. xxxvi. pp. 235–246, by W. S. Dallas, F.L.S.

influence in very fertile animals, therefore in such as lay thousands of eggs.

Whoever endeavours to elevate the Darwinian doctrine from a very general and indefinite hypothesis into a scientific theory must therefore at any rate always take the above point into consideration. He must arrange his "genealogical tree" only in such a manner that all the ramifications which issue out of any given branch possess a longer duration of life than the latter.

Palæontology furnishes us something actual in connexion with the sequence of species. In general it does not agree with an increase in the duration of life. The insects which for the most part, like summer plants in the vegetable kingdom, are extremely short-lived, were preceded by Polyps, Mollusca, and Crustacea; and although we cannot now ascertain how long a Graptolite or Trilobite of the Silurian formation lived, it can hardly be supposed that the insects have originated from animals with a shorter vital period. This could be possible only if Mollusca, Insecta, &c. originated from a common short-lived stem. But where, then, would the side-line have remained which led up from this stem, by the Mollusca &c., to the Insecta? How can it have come about that nothing of it is preserved, whilst of the Mollusca and Crustacea innumerable petrified examples exist? Moreover experience teaches us that even the lowest animals, polyps, rhizopods, &c., possess a longer duration of life than the insects, and also exceed them in fertility.

The case is the same with the Mammalia. With certainty we can scarcely ascribe to these an earlier than Tertiary origin. Fishes and reptiles preceded them; and they can only be regarded as produced from the latter. But reptiles in general live longer than mammals. Among tortoises we have examples of an age of more than 200 years, whilst the most long-lived of terrestrial mammals, the elephant, is rather more than 100 years old.

Darwin, on the foundation of his hypothesis, describes the demonstration of the production of a peculiarity injurious to the animal as destructive of the hypothesis. F. Müller, in his work 'Für Darwin,' calls upon opponents to indicate any one among the great number of natural-history facts which is incompatible with Darwin's opinion. He regards the circumstance that this has not yet been done, even by the observers who are most familiar with the animal world, as a proof of the Darwinian doctrine. But so long as the latter is nothing more than a mere hypothesis, containing only the most general outline of a theory, definite facts can no more be cited in opposition to it than definite assertions are contained in it. The indefiniteness of the theory causes an equally great indefiniteness in its refutation. The above arguments against the Darwinian opinion, derived from the results of palæontology, make no claim to be unassailable. But so far as it can be regarded as possible to demonstrate the production of an injurious property from the multifarious data standing at the command of Darwinism, even in connexion with this point, it must be the case here. The abridgment of the duration of life is such a property.

The species of the animal kingdom have been very aptly compared with the paths of the planets (Blasius, 'Fauna Deutschlands,' preface). The orbits of the planets are not invariable, any more than a given species of animals is exactly the same in one year as in another. The variations, however, are, for long periods, confined within definite limits. But, strictly speaking, this cannot be proved for *all time*, as in this case we must also take into consideration the matter existing between the planets &c. Nor can we conclude from the present state of the planetary system as to any given earlier period. It has been attempted to derive the present state of the planetary system from an earlier simpler one—as which a rotating nebular sphere was assumed. This hypothesis was first proposed by Kant, who, however, was by no means the profound mathematician that he is represented by Häckel (Natürliche Schöpfungsgeschichte). Laplace subsequently presented it in a somewhat more mathematical dress, though not in his strictly scientific 'Mécanique Céleste,' but in a more popular work. Among astronomers, however, it is in tolerable estimation, but only as a simple hypothesis, which is quite incapable of further development into an actual theory (as has been shown by the attempt made by Weiss).

The Darwinian doctrine also will perhaps always number its adherents, as, indeed, its erroneous nature can no more be strictly demonstrated than that of any view as to the flora and fauna of the moon. But every attempt to convert the hypothesis definitely into a theory, even if it should be in tolerable agreement with zoological, botanical, and palæontological facts, would always have something arbitrary about it, as a thousand others might be set in its place.

Considering the near affinity of Laplace's hypothesis of creation and the Darwinian doctrine, it was to be expected that the Darwinists would revert to the former. All such physical views originate from a weakness which attaches even to the greatest naturalists—namely, the tendency to deduce everywhere multiplicity from unity. This has its foundation in the finiteness of the human reason, which, from its incompetence to grasp the infinite multiplicity of nature, finds itself compelled to refer this back as much as possible to unities. But in this case it cannot arrive at absolute unity, as multiplicity is not included in unity. Such endeavours stand in contradiction to the causal principle, upon which, however, the Darwinists (as, *e. g.*, Häckel, in his 'Generelle Morphologie') lay so much stress. A homogeneous mass of vapour which at a definite moment is so arranged about its axis of rotation as to represent a body of rotation the diametral sections of which agree perfectly with each other with regard to the diffusion of matter in them, will always retain this property; the unity remains unity. But if we ascribe to the various diametral sections from the commencement any definite difference, there is no reason whatever why we should not regard any other difference that we please, and therefore the condition of the planetary system such or such a number of years ago, as aboriginal.

This applies just in the same way to that particle of primordial slime which, according to Häckel, formed the commencement of organic nature. Häckel ascribes to his "*Monera*" a perfect homogeneity without any internal differentiation. All movements that occur in such a body from a given period are then necessarily functions of its form and of the arrangement of all other matter at that moment. The perfectly irregular manner in which the Monere extends its pseudopodia would agree with this, as the arrangement of external matter is likewise perfectly irregular. But now let us imagine that such a particle of plasma acquires a calcareous or siliceous shell. The form of this can only be quite irregular; for, like the growing forth of the pseudopodia, it is a consequence of causes acting quite irregularly. Observation teaches us, however, that the solid shells of the Polythalamia have in part a perfectly definite form. This can be no function of the external world, as the totality of matter certainly stands in no definite relation to the form and arrangement of the spiral shells of these little animals, which, like those of many Cephalopoda, are divided into chambers. We must therefore necessarily assume that the apparently homogeneous and formless mass of plasma which produces the shell stands in a definite relation to the latter, or that a foreign force, not attached to the atoms of the plasma, produces the shell. Häckel touches upon this point in his 'Generelle Morphologie' (Bd. i. p. 190), and is of opinion that the cause of this phenomenon must be sought in the special combination of the atoms into molecules. In those Protozoa whose shell has a geometrically regular form this supposition might not be absolutely absurd, as we must assume something of the same kind in the case of crystals. But at the assumption that the molecules of any chemical compound stand in a definite relation to the spiral form of the shell of *Cornuspira planorbis* or of the fossil *Nummulina radiata*, every "thinking" naturalist would certainly shake his head.

In connexion with the first appearance of life, Häckel lays great stress on the artificial preparation of organic compounds. Hitherto, however, no one has prepared hydrates of carbon and albuminates from their elements; and, with respect to the artificial preparation of urea, formic acid, and other *retrogressive products* of the animal organism, there was never really any cause for making so much fuss about it. The expired carbonic acid is also a retrogressive product; and this had long been prepared artificially. The chemical processes which take place in organic bodies seem much rather to speak in favour of the assumption of special forces.

Let any vegetable be planted in pure siliceous sand containing as nourishment for it only carbonic acid, ammonia, and the necessary inorganic salts. Let the whole be kept at a temperature of about 68° F., and covered with a glass vessel which is always kept at a scarcely higher temperature. The plant and the soil in which it grows therefore receive light and heat from without. Let us now see what becomes of these two agents.

If we burn hydrates of carbon in oxygen, two things take place:—

1. Separation of the carbon from the water of the hydrate of carbon; 2, combination of the carbon with the oxygen. At the same time heat is always evolved.

In the above plant the direct opposite of this takes place. Under the influence of light the oxygen of carbonic acid separates from the carbon, and the latter combines with water to form hydrate of carbon. During this, heat, or, at any rate, mechanical motion (in the form of light and heat) must necessarily disappear.

If, then, the plant be allowed to grow, say, through a whole summer, and the hydrates of carbon produced be then burnt, carbonic acid and water are again formed. A portion of the heat manifested during this process can then be converted into mechanical work, whilst another part passes over to bodies which are at least at a temperature of 68° F., and by this means the products of combustion again acquire this original temperature.

Now this whole process seems to stand in contradiction to the second principle of the mechanical theory of heat, or to

Carnot's principle, which lies at the foundation of this theory. According to this, heat cannot be converted into mechanical work without at the same time heat passing somewhere from a warmer to a colder body. But such a transfer has in this case nowhere taken place. We might, indeed, say that the heat of the sun has passed in the form of light from the hotter sun into the colder plant. But the quantity in question can be only a very small fraction of the heat which has become latent in the hydrates of carbon; at any rate, it is much less than that converted into work during combustion. The amount of heat represented by the absorbed light is therefore included in that converted into work, and therefore has not, as Carnot's principle requires, been *permanently* transferred to a colder body.

No one has yet succeeded in devising any process in inorganic nature in which Carnot's principle does not apply, although many physicists and technicists (*e. g.* Hirn) have tested their acumen upon this point. If, now, we detect such processes in organic nature, this indicates that special forces are active in the latter. In fact, the above departure from Carnot's principle may be simply explained by the assumption that in the plant a force is at work capable of ruling in a definite manner the irregularly interwhirling heat-movements. In order that we may not thus come into contradiction with the principles of the vital forces, we must assume that this force always forms a right angle with the path of an atom upon which it acts, and therefore, in the mechanical sense, performs no work.

The Darwinists often claim for themselves the privilege of being the only "thinking" naturalists. In order to attribute this superiority to themselves with greater justice, one might advise them to make themselves a little better acquainted with the doctrines of mathematics. From the upholders of the exclusively mechanical conception of nature we must necessarily require that they should be thoroughly versed in mathematics and mechanics. Natural history and mathematics are, indeed, two departments which lie rather far apart; but just as the union of the dissimilar has led to many new results in cattle-breeding and horticulture, it may also be possible that a hybridization of the sciences might lead to new and peculiar results. It is true that the union must be such that bastard productions in the bad sense may not proceed from it. Of many of the views put forward in Häckel's 'Morphologie' and other Darwinistic writings it may be affirmed that they would have received an essentially different form by "adaptation" to the laws of mathematical thought.

LII.—*On* Amphipleura pellucida *and* Surirella gemma *as Test-objects.* By J. J. WOODWARD, Assistant Surgeon, U. S. Army*.

THE attention of microscopists has frequently been directed, of late years, to the *Amphipleura pellucida* or *Navicula acus* as a test-object well suited to try the defining-powers of the very best object-glasses. The length of this diatom is stated by Pritchard as ranging from $\frac{1}{140}$ to $\frac{1}{300}$ of an inch. The average length is given in the 'Micrographic Dictionary' at ·0044 of an inch. The striæ, which are exceedingly difficult, were first described by Messrs. Sollitt and Harrison, who estimated them at from 120,000 to 130,000 to the inch. Their estimate has been adopted in the 'Micrographic Dictionary' and by the majority of modern writers who have referred to this test; but so many difficulties beset the resolution, that few microscopists appear to have attempted to verify the original estimates. Indeed most observers would seem to have been unsuccessful in their efforts to resolve the *Amphipleura* even with the best objectives; and some have gone so far as to deny the existence of any striæ upon the frustules of this species.

Among the microscopists who claim to have seen the striæ, several would seem to differ from the original estimates of Sollitt and Harrison as to their fineness. Dr. Royston-Pigott, whose papers on "high-power definition," in the 'Monthly Microscopical Journal,' have recently attracted much attention, sets down their number at 150,000 to the inch. Dr. Carpenter, on the other hand, in the 4th edition of 'The Microscope and its Revelations,' expresses the opinion that even the estimates of Messrs. Sollitt and Harrison are too high; and we are told by Mr. Lobb (Monthly Microscopical Journal, vol. iii. p. 104) that Mr. Lealand has recently "succeeded in counting the *Amphipleura*-lines, and finds them 100 in $\frac{1}{1000}$ of an inch."

A few months ago two slides of *Amphipleura pellucida* were received at the Army Medical Museum from Messrs. Powell and Lealand, and I succeeded in obtaining excellent resolution by the immersion $\frac{1}{16}$ of these makers. The frustules on the two slides were found to measure from $\frac{1}{170}$ to $\frac{1}{400}$ of an inch in length. Resolution could be satisfactorily effected and the striæ counted on any of them. I took eight successful negatives from medium-sized and small frustules, and verified the counts made in the microscope by counting the striæ on the glass negatives. I found the striæ on medium-sized frustules, say $\frac{1}{200}$ of an inch in length, counted usually from 90 to 93 striæ to the $\frac{1}{1000}$ of an inch; in that selected for the two photographs

* From 'Silliman's American Journal,' May 1871.

which accompany this memorandum the number was 91 to the $\frac{1}{1000}$ of an inch. Larger frustules exhibited rather coarser, smaller ones rather finer striæ. On the smallest frustules at my disposal (several of them only $\frac{1}{400}$ inch in length) I found no example in which the number of striæ exceeded 100 to the $\frac{1}{1000}$ of an inch. The striæ of these smallest and most difficult frustules do not, then, rival in fineness the nineteenth band of the Nobert's plate, as has been asserted by some; they compare rather with the sixteenth and seventeenth bands.

After making the photographs, I extended my observations to a number of other slides of *Amphipleura pellucida*—including two of the original specimens from Hull, kindly sent to the museum some time since by Mr. W. S. Sullivant, of Columbus, Ohio, and the example in the First Century of Eulenstein. I found that different slides varied considerably in the ease with which I could resolve them, chiefly, as I think, on account of the thickness of the glass covers, which in several instances did not permit the best work of the immersion $\frac{1}{16}$. Perhaps, however, the markings on some frustules may be shallower than on others whose striæ count the same number to the $\frac{1}{1000}$ of an inch. In any event, I have found, as yet, no slides the covers of which permit the $\frac{1}{16}$ to be approximately adjusted, on which it was impossible to resolve the frustules, and no frustules the striæ of which exceeded 100 to the $\frac{1}{1000}$ of an inch.

The best resolution I was able to obtain by ordinary lamplight was not very satisfactory. I used, therefore, during the investigation, direct sunlight rendered monochromatic by passage through the solution of ammonio-sulphate of copper. A parallel pencil of such light was concentrated by the achromatic condenser, which was suitably decentred to obtain obliquity. The same illumination was employed in making the photographs. I have since had the pleasure of exhibiting the resolution in quite as satisfactory a manner to several microscopists by monochromatic light obtained from the electric lamp.

The *Surirella gemma* has been recommended by Hartnack as a test for immersion-objectives of high powers. I have not gained access to his original description, but find accounts of his views, with figures, in the works of Drs. Carpenter and Frey (The Microscope and its Revelations, 4th ed. p. 182; Das Mikroskop, 3rd ed. p. 40). Hartnack observed fine longitudinal striæ in addition to the fine transverse ones previously known to exist between the large transverse ribs; he supposed the true markings to have the form of elongated hexagons.

Two handsome slides of this diatom were received at the

Army Medical Museum, a few months since, from Bourgogne of Paris. A careful study of these by monochromatic sunlight inclines me to the opinion that Hartnack's interpretation is erroneous, and that the fine striæ are in reality rows of minute hemispherical bosses, from which, as in the case of other diatoms, the appearance of hexagons would readily result if the frustule was observed by an objective of inferior defining-power to that I used, or if the illumination was unsuitable. This memorandum is accompanied by two photographs exhibiting what I saw; one is magnified 1034, the other 3100 diameters. The principal frustule shown in these photographs is $\frac{1}{290}$ of an inch in length (the mean length of *S. gemma* is stated in the 'Micrographic Dictionary' as $\frac{1}{240}$ of an inch). The fine transverse striæ counted longitudinally at the rate of 72 to the $\frac{1}{1000}$ of an inch. Transversely these were resolved into beaded appearances which counted laterally 84 to the $\frac{1}{1000}$ of an inch. If the structure consists, as I suppose it does, of fine hemispherical bosses projecting from the surface of the frustules, the fact that these bosses are set together more closely in the transverse direction than in the longitudinal would account for the elongated form of the pseudohexagons when seen.

Some parts of the photographs closely approach Hartnack's description, but it is easy to observe that these are not the parts which are most nearly in focus.

I have also resolved this diatom by monochromatic light derived from the electric lamp. The appearances obtained were identical with those above described.

LIII.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and C. E. Broome, Esq., F.L.S.

[Continued from vol. vi. p. 469.]

[Plates XVIII., XIX., XX., & XXI.]

* *Coprinus fuscescens*, Fr. Ep. 244.

This species, introduced on the authority of a drawing by Lady Orde, has been found lately at Walthamstow.

1263. *Cortinarius* (Phlegmacium) *triumphans*, Fr. Ep. p. 256.

C. sublanatus, Hussey, seems to be a form of this species.

1264. *C.* (Phlegmacium) *russus*, Fr. Ep. p. 261; Trans. Woolh. Cl. 1870, t. 1.

In moist woods, W. G. Smith.

1265. *C.* (Phlegmacium) *dibaphus*, Fr. Ep. p. 266.

Fordingbridge, Hants, Worthington G. Smith.

A most beautiful addition to our list.

1266. *C.* (Myxacium) *stillatitius*, Fr. Ep. p. 277.

W. Wilson Saunders.

1267. *C.* (Myxacium) *pluvius*, Fr. Ep. p. 277.

In woods. Lea, near Gainsborough, Sept. 1865.

1268. *C.* (Dermocybe) *ochroleucus*, Fr. Ep. p. 284.

Mossburnford, Roxburghshire, A. Jerdon, Esq.

1269. *C.* (Dermocybe) *anthracinus*, Fr. Ep. p. 288.

In a wood. Coed Coch, Mrs. Lloyd Wynne.

Certainly different from *C. sanguineus*. The Welsh plant exactly accords with a drawing from Fries. It has been found on the same spot in two successive years.

1270. *C.* (Dermocybe) *orellanus*, Fr. Ep. p. 288.

In a wood, on the ground. Coed Coch, Oct. 12, 1869. With *C. cinnamomeus*, to which it is nearly related, but very distinct.

1271. *C.* (Telamonia) *bivelus*, Fr. Ep. p. 292.

In woods. Coed Coch, Oct. 1867.

1272. *C.* (Telamonia) *incisus*, Fr. Ep. p. 301.

Loughborough, F. T. Mott, 1866.

1273. *C.* (Telamonia) *hæmatochelis*, Fr. Ep. p. 302; Huss. vol. i. tab. 19.

In woods. Coed Coch, Oct. 1869.

This appears to be a very different species from *C. armillatus*, of which we have a fine drawing from Prof. Fries.

1274. *C.* (Hygrocybe) *obtusus*, Fr. Ep. p. 313.

In woods. Coed Coch, Ap. 25, 1867, Mrs. Lloyd Wynne.

1275. *C.* (Hygrocybe) *subferrugineus*, Fr. Ep. p. 303; Batsch, f. 186.

In woods. Coed Coch, Sept. 6, 1866.

1276. *Paxillus filamentosus*, Fr. Ep. p. 317.

On the ground, and about old stumps and chips. Forres, Rev. J. Keith.

This interesting species differs from *P. involutus* in the scaly pileus and the yellow flesh of both stem and pileus.

1277. *Hygrophorus limacinus*, Fr. Ep. p. 324.

St. Leonards, W. G. Smith.

1278. *H. caprinus*, Fr. Ep. p. 326.

Near Bath, C. E. Broome, 1866.

1279. *H. turundus*, Fr. Ep. p. 330. *A. superbus*, Lasch. in Linn. vol. iii. no. 118. Var. *mollis*. Aureus; pileo subplano, demum leviter depresso, pilis mollibus brevibus radiantibus concoloribus vestito; stipite æquali, farcto; lamellis distantibus, arcuatis, decurrentibus.

In plantations, on the naked soil. Coed Coch, Oct. 1869–70.

Pileus $\frac{1}{2}$–$\frac{3}{4}$ inch across; stem 1–1$\frac{1}{4}$ inch high, 1–2 lines thick; gills narrow.

Quite distinct from every species in the section, except *H. turundus*, of which we consider this pretty species a form, which occurs every year at Coed Coch.

1280. *H. irriguus*, Fr. Ep. p. 329.

In grassy pastures. Laxton, Norths., Oct. 28, 1866.

1281. *H. puniceus*, Fr. Ep. p. 331.

This fine species occurred in great perfection at Coed Coch, Oct. 17, 1867. There is a splendid figure in Fries's 'Atlige och Giftiga Svampar.'

1282. *Lactarius controversus*, P. Syn. p. 430; Woolh. Cl. 1868.

In woods.

This interesting species has been exhibited on more than one occasion at South Kensington, and appeared at the late meeting of the Woolhope Club. There is a good figure by Mr. Worthington Smith in Seemann's 'Journal of Botany.'

**L. pubescens*, Fr. Ep. p. 335.

The small normal form occurred abundantly amongst pebbles on the side of Loch Ceneord, Aberdeenshire, at the end of August 1870.

**Russula vesca*, Fr. Ep. p. 352.

Bowood, Oct. 19, 1869.

**R. fragilis*, Fr. Ep. p. 359. Var. *odore R. fœtentis*, Fr. Syst. Myc. p. 58.

Edge of Loch Cenord, Aberdeenshire, amongst pebbles.

This may perhaps as well be considered a small form of *R. fœtens*, if not a distinct species.

1283. *R. nauseosa*, Fr. Ep. p. 363.

Coed Coch, Mrs. Lloyd Wynne, Oct. 17, 1867. Bowood, C. E. Broome, Oct. 19, 1869.

**Cantharellus radicosus*, B. & Br. no. 1134.

Specimens have been communicated to Prof. Fries, who believes our plant, which has now been found in other localities, to be *Merulius carbonarius*, A. & S. It has nothing whatever to do with *C. umbonatus*.

1283*. *Lentinus resinaceus*, Trog. Reg. Bot. Zeit. 1832, p. 525. Forres, M. Terry.

**Panus conchatus*, Fr. Ep. p. 398.

This species, which is certainly too near *P. torulosus*, occurred abundantly at Sibbertoft, on old elm-stumps, Oct. 1870, exactly agreeing with Bulliard's figure.

1284. *Boletus collinitus*, Fr. Ep. p. 410.

In fir-woods. Ascot, Nov. 1868.

1285. *B. pruinatus*, Fr. Ep. p. 414.

On grassy ground, Kew, 1868. It has occurred since in other localities.

1286. *Polyporus* (Pleuropus) *melanopus*, Fr. Syst. Myc. vol. i. p. 347.

On dead wood. Hopetoun, Lady Hopetoun, who sent an excellent drawing. It also occurs at Belvoir, and has lately been sent by the Rev. J. Keith from Forres.

Mr. W. G. Smith has lately sent what is undoubtedly *Boletus imbricatus*, Bull; but the substance is not fibroso-caseasius, and can therefore scarcely be *P. imbricatus* of Fries and Rostkovius. It is probably merely a thin form of *P. sulphureus.*

1287. *P.* (Anodermei) *epileucus*, Fr. Ep. p. 452.

On elm-trunks. Nov., London, W. G. Smith.

1288. *P.* (Placodermei) *populinus*, Fr. Syst. Myc. vol. i. p. 367.

On the trunk of a poplar, abundantly. Uffington, Lincolnshire.

Has very much the habit of *P. connatus.*

1289. *P.* (Resupinatus) *micans*, Ehb. Silv. Ber. p. 30.

On dead wood. Leigh Wood, Bristol, Oct. 6, 1865.

1290. *P.* (Resupinatus) *sanguinolentus*, Fr. Syst. Myc. vol. i. p. 385.

Epping Forest, Nov. 17, 1867, C. E. Broome and W. G. Smith.

1291. *P.* (Resupinatus) *hibernicus*, n. s. Totus effusus, non separabilis, albus; margine tenui, tomentoso; poris parvis, angulatis; dissepimentis rigidiusculis.

On decorticated branches of fir. Luggela, county Wicklow, Sept. 1867.

At first orbicular, then by confluence forming effused patches, with a narrow, very thin, tomentose margin; pores $\frac{1}{72}$ inch across; dissepiments mostly entire.

Apparently nearer to *P. radula* than to *P. vaporarius.*

1292. *P.* (Resupinatus) *farinellus*, Fr. Syst. Myc. vol. i. p. 384.

On beech. Penzance, Dec. 9, 1869, C. E. Broome, J. Ralfs. Aboyne, 1870.

1293. *Trametes Bulliardi*, Fr. Ep. p. 491.

On dead wood. Resupinate form, Bathampton, Oct. 1859, C. E. Broome.

1294. *Hydnum scrobiculatum*, Fr. Obs. i. p. 143.

In fir-woods. Minstead, near Lyndhurst, Oct. 1868, C. E. Broome. Forres, Nov. 1868, the Rev. J. Keith, Mr. Michael Terry.

1295. *H. melaleucum*, Fr. Ep. p. 510.

In fir-woods. Ascot. With *H. tomentosum*.

1296. *H. nigrum*, Fr. Syst. Myc. vol. i. p. 404.

In fir-woods. Street, Somersetshire, Oct. 23, 1868, Aubrey Clarke, Esq.

1297. *H. bicolor*, A. & S. p. 270. On bramble. Batheaston, C. E. Broome, March 20, 1869.

It is quite clear that *Hydnum gelatinosum* does not belong to the same category as normal *Hydna*. The structure is that of a *Nematella*; and Mr. Currey and ourselves propose for it the genus *Hydnoglœa*. There is a fine species amongst Kurtz's Fungi, which will probably soon be published by Mr. Currey.

**Irpex obliquus*, Fr. Ep. p. 523. Epping Forest, Feb. 1869, C. E. Broome.

1298. *Radulum fagineum*, Fr. Ep. p. 525.

W. G. Smith, Epping Forest, 1868; abundantly.

1299. *Odontia barba Jovis*, Fr. Ep. p. 528.

On decayed wood. Epping Forest, C. E. Broome.

Sowerby's figure seems to represent the true plant; but the specimens in his herbarium are *Radulum quercinum*.

**Kneiffia setigera*, Fr. Ep. p. 529.

As this plant has occurred in excellent fruit, we give a figure.

The spores are elliptic, and ·0004–·0005 long.

Plate XVIII. fig. 1. *a*. one of the setigerous aculei, magnified; *b*. tip of one of the barren echinulate setæ; *c*. spores: both more highly magnified.

1300. *Stereum frustulosum*, Fr. Ep. p. 552.

On hard oak-wood. Found by Mr. Burchell in great perfection in the south of England.

Mr. English has more than once found at Epping fine specimens of *Thelephora multizonata*, B. & Br.

**Solenia ochracea*, Hoffm. Bot. Tasch. t. 8. f. 2. *Peziza anomala*, Fr.

Plate XVIII. fig. 3. Spores magnified, ·00035 inch long.

1301. *S. fasciculata*, Pers. Myc. Eur. t. 12. figs. 8, 9. *S. candida*, Moug. No. 96.

Plate XVIII. fig. 4. Various individuals, magnified.

This was mentioned, in the 'Transactions of the Bath Field Club,' as *S. candida*, Hoffm.; but, on comparison of specimens, it appears to be *S. fasciculata*.

Plate XXI. fig. 30. Mougeot's species, for comparison.

**Sparassis crispa*, Fr. Ep. p. 570.

This noble fungus has been found this year in Kent by Miss Susan Broadwood, and it has occurred also in Herefordshire.

1302. *Clavaria spinulosa*, P. Obs. ii. tab. 3. fig. 1.

In pine-woods. Coed Coch, 1866.

Stem thick at the base, but not so thick as in Persoon's figure.

1303. *C. fumosa*, P. Comm. p. 76.

Frome, 1866, C. E. Broome.

1304. *Pterula multifida*, Fr.

This interesting addition to our list of Fungi was communicated by Sir W. C. Trevelyan, Sept. 1865.

1305. *Dacrymyces sebaceus*, B. & Br. Albidus, subrotundus, e filamentis varie ramosis, superne sæpe clavatis compositus; cœlo pluviali tantum conspicuus.

Forming circular patches on twigs of ash and maple, in winter. Bath, 1868, C. E. B.

Allied to *D. cæsius*, Sommerf. Individual plants 2–4 lines broad; spores ovato-triangular, ·0005 long, ·0002–·0003 broad; filaments here and there breaking up into globose conidia. Spores producing globose secondary spores. On the same threads occur multiseptate, curved, fusiform spores, ·001–·003 inch long.

Plate XVIII. fig. 2. *a. D. sebaceus*, nat. size; *b.* group of threads with two kinds of fruit, magnified; *c.* spores; *d.* ditto bearing secondary spores; *e.* spores of different forms, one germinating; *f.* fusarioid spores, all more or less magnified; *g.* conidia.

1306. *Geaster tunicatus*, Vitt. Mon. p. 18, tab. 3. fig. 3.

Found in considerable abundance amongst Rhododendra at Castle Ashby by Mr. Beech in 1869–1870.

1307. *Lycoperdon Hoylei*, B. & Br. Peridio stipitato, subgloboso, verrucis rigidis fuscis elongatis echinato; basi sterili parca cum capillitio sporisque lilacinis confluente.

Reading, Mr. Hoyle, Oct. 1870.

Stem 1 inch high, ¾ inch thick, lacunose, olivaceous within; peridia 2 inches across; warts 1½–2 lines high; capillitium and spores lilac; spores globose, echinulate, ·00015 in diameter; mycelium thread-like, white.

Agreeing exactly with an authentic specimen of Persoon's *L. echinatum* externally, who could, however, scarcely have overlooked the lilac spores. The stem is lacunose, the cavities verrucose.

**Lycoperdon echinatum*, P. Syn. p. 146.

Brought to the Fungus Show at South Kensington, Oct. 1870, from the neighbourhood of Marlow, by Mr. Sawyer.

As far as the present specimens go, the species seems to be a form of *L. atropurpureum*. Vittadini refers it doubtfully to *L. hiemale*.

1308. *Scleroderma geaster*, Fr. Syst. iii. p. 46.

Near Hereford, Dr. Bull, Oct. 6, 1870, during an excursion of the Woolhope Field Club.

**Physarum metallicum*, B. in Ann. Nat. Hist. No. 29.

Batheaston, March 1869.

Spores ·0005 in diameter.

1309. *Cribraria intricata*, Schrad. Nov. Gen. t. 3. fig. 1.

On fallen branches of fir. Glen Tanner, Aberdeenshire, Sept. 8, 1870.

Stem $\frac{1}{27}$ inch high; spores ·0003 in diameter.

**Ophiotheca chrysosperma*, Curr. Micr. Journ. vol. ii. pl. 9.

On cabbage-stalks, Feb. 25, 1869. Batheaston, C. E. Broome. Mr. Currey's specimens occurred on the inner bark of a dead tree.

**Nidularia pisiformis*, Tul.

On the ground in great abundance, often attached to chips and sticks. Powerscourt, on the road leading to the waterfall, county Wicklow.

**Sphæronema subulatum*, Tode, Meckl. Fung. fig. 117.

A form occurred at Ascot, Oct. 31, 1867, with much shorter appendages to the spores.

1310. *Nemaspora grisea*, Cord. fasc. iii. f. 68.

On dead twigs. Hatton, May 23, 1867.

**Puccinia veronicarum*, DC.

On *Veronica montana*. Langridge, Ap. 20, 1869, C. E. Broome.

**Thecaphora hyalina*, Fingerh.

This rare species has occurred lately near Bath and in some other locality.

**Stilbum bicolor*, P. Syn. p. 682.

On dead wood. Langridge, March 1869.

Stem with head ·02–·05 high.

**S. turbinatum*, Tode, Fung. Meckl. t. 2. f. 20.

On stems of umbelliferous plants.

1311. *Microcera coccophora*, Desm. Pl. Crypt. no. 1750.

Penzance, Dec. 1869, C. E. Broome.

1312. *Chætostroma stipitatum*, Cd. fasc. iii. fig. 83.

On elder. Batheaston, March 1869, C. E. Broome.

This belongs properly to the genus *Volutella*.

1313. *Epicoccum micropus*, Cd. fasc. iii. tab. 5. fig. 82.

On decaying *Lactarius deliciosus*. Ascot, Oct. 31, 1867.

1314. *Spondylocladium fumosum*, Preuss. St. Deutsch. Fl. no. 35. tab. 53.

On rotten sticks. Batheaston, March 29, 1869.

Spores ·001 inch long, ·0004–·0005 wide.

Plate XVIII. fig. 7. *a.* threads with verticillate spores, magnified; *b.* septate spores, more highly magnified.

1315. *Graphium stilboideum*, Cord. Ic. fasc. ii. tab. 11. fig. 69.

On cabbage-stalks. Batheaston, April 1869.

Spores ·0002–·0004 long.

1316. *Rhinotrichum lanosum*, B. & Br. MS. *Clinotrichum lanosum*, Cooke, MS.

On damp wall-paper. London, March 1870, M. C. Cooke.

1317. *Peronospora entospora*, B. & Br. *Basidiophora entospora*, Roze et Cornu, Ann. d. Sc. Nat. ser. 5. vol. xi. tab. 4.

On *Erigeron canadense.* Wimbledon, Rev. M. J. B. June 1867.

Resting spores echinulate, ·001 in diameter.

PLATE XVIII. fig. 8. *a.* fertile threads, magnified; *b.* spores, more highly magnified.

If this species is to be assigned to a new genus, *Peronospora curta* must follow the same rule, for the structure is altogether similar. It is strange that the authors should have taken no notice of a species which has been more than once figured.

ENDODESMIA, n. g. Acervuli floccis nitidis glaucis lævibus e septatis leviter curvatis cooperti; sporæ concatenatæ, uniseptatæ, ellipticæ, utrinque appendiculatæ.

1318. *E. glauca*, n. s. On cabbage-stalks. Batheaston, April 1869.

Spores ·0004–·0005 long, ·0002 wide.

PLATE XX. fig. 9. *a.* single plant; *b.* portion of plant, showing flocci and necklace of spores, magnified; *c.* spores, more highly magnified; *d.* another form of spore, if belonging to the same plant.

1319. *Acremonium ranigenum*, n. s. Stipite e floccis aggregatis composito, apicibus elongatis, liberis, sporis globosis echinulatis breviter pedicellatis conglomeratis obsitis.

On dead frogs. Dr. Bird, Monkton Farleigh, Sept. 1868.

Stem composed of a multitude of septate threads, of a delicate lemon-yellow, which diverge upwards and form a subglobose head; the threads give origin on all sides to globose spores crowded so as to form little masses. Spores ·0004 in diameter.

PLATE XVIII. fig. 10. *a.* single plant; *b.* portion of the same, to show the threads of which the stem is composed, and their fertile apices, magnified; *c.* spores, more highly magnified.

**Psilonia discoidea*, B. & Br. no. 1150. Var. *lateritia*, B. & Br. Irregularis, disco aurantiaco, margine tomentoso, carneo, floccis flexuosis articulatis; sporophoris setaceis; sporis fusiformibus.

On elder. St. Catharine's, Bath, Feb. 1869.

Spores ·0004–·0005 in. long, white when young.

**P. nivea*, Fr. This has been recognized long since as the produce of an insect. Mr. A. Murray now informs us that it is a *Coccus* named *Adelges fagi*.

1320. *Peziza* (Discina) *macrocalyx*, Russ. Seem. Journ. of Bot. tab. 98.

Sporidia ·0006–·0008 long, ·0003–·0004 wide.

Plate XIX. fig. 11. *a.* asci and jointed paraphyses, magnified; *b.* sporidia, more highly magnified.

**P.* (Discina) *viridaria*, B.

Sporidia ·0005 long, ·0003 wide.

Plate XIX. fig. 12. *a.* asci and paraphyses, magnified; *b.* sporidia, more highly magnified.

**P.* (Dasyscyphæ) *rufo-olivacea*, A. & S. p. 320.

Sporidia elliptic, binucleate, ·0006 long; paraphyses filled at the top with dark green endochrome.

Plate XIX. fig. 13. *a.* asci and paraphyses, magnified; *b.* sporidia, one of which is germinating, more highly magnified.

1320*. *P.* (Humaria) *hinnulea*, B. & Br. Cupulis sessilibus, flexuosis, marginatis, badiis, carnoso-ceraceis; sporidiis globosis, lævibus, nucleo globoso magno.

On soil amongst grass. Powerscourt, Sept. 27, 1867.

Sporidia ·0006 in diameter.

1321. *P.* (Dasyscyphæ) *citricolor*, B. & Br. Cupulis brevissime stipitatis v. sessilibus, carnoso-ceraceis, turbinatis, subtiliter tomentosis, citrinis; sporidiis fusiformibus, guttulis oleosis maculatis.

On rotten wood, March 1869.

Cups ·0009 inch across; paraphyses linear; sporidia ·0008–·001 long; ·0002–·00025 wide; asci ·0035–·004 long.

Plate XIX. fig. 14. *a.* plant, slightly magnified; *b.* ascus and paraphyses, magnified; *c.* sporidia, more highly magnified.

1322. *P.* (Dasyscyphæ) *escharodes*, B. & Cr. Cupula sessili, rugosa, floccis brevibus albidis asperata, sordide olivaceo-viridi; margine pallido, floccis subtilibus fimbriato; hymenio cinereo.

On *Rubus fruticosus*. St. Catharine's, Bath, Feb. 1869.

Sporidia fusiform, ·0004 long, sometimes with two nuclei. Cup at first closed, globose, ·03 inch in diameter, quite black when the hairs have vanished.

Plate XIX. fig. 15. *a.* plant, magnified; *b.* section of ditto; *c.* ascus and paraphyses; *d.* sporidia; *e, f.* asci and sporidia from another specimen (all more or less highly magnified).

1323. *P.* (Hymenoscyphæ) *amenti*, Batsch, Fuckel, no. 1159.

On female catkins of *Abele*. Langridge, March 31, 1869.

Sporidia obovate, ·0004 inch long, ·0002 wide.

PLATE XIX. fig. 16. *a.* asci and paraphyses, magnified; *b*, sporidia, more highly magnified.

1324. *P.* (Mollisia) *Bullii*, Sm. Cupulis subhemisphæricis, demum irregularibus, sessilibus v. brevissime stipitatis, albidis, margine inflexo grumaceo-pulverulento e velo massa albida partim obtectis; hymenio sæpe prolifero; mycelio fusco.

On a waterbut, W. G. Smith, Dec. 1869.

Sporidia subelliptic, ·0002–·0003 inch long.

PLATE XIX. fig. 17. *a. P. Bullii*; *b.* separate plant, to show the mycelium; *c.* asci; *d.* sporidia more highly magnified.

1325. *P.* (Mollisia) *elaphines*, B. & Br. Cupulis subglobosis, pallide cervinis, labro pallidiore albo, granulis saccharinis obsitis; hymenio aquose griseo.

On dead wood. St. Catharine's, Jan. 29, 1869.

Granules often disposed in lines so that the cups are radiated. Asci ·0015 long; sporidia fusiform, ·0003–·004 long, hyaline, smooth, uniseriate.

PLATE XIX. fig. 18. *a. P. elaphines*; *b.* asci; *c.* sporidia, more highly magnified.

1326. *P.* (Mollisia) *aquosa*, B. & Br. Cupulis primum ferme clausis, dein expansis, planis vel leviter concavis, viridi-brunneis, glabris; hymenio aquose griseo; sporidiis ovatis, hinc apiculatis biserialibus.

On or with *Sphæria hirsuta*, on willow. Batheaston, Jan. 1867.

Resembling *P. cinerea*, but smoother and more concave when young, with totally different spores. Cup ·024 in diameter, growing on *Sphæria hirsuta* and its mycelium, accompanied by a brown mould consisting of erect, simple, articulated threads surmounted by a single oblong uniseptate spore, ·0005 long. Asci ·002 long; sporidia ·0002–·00025 long, ·0001–·00015 wide, bright orange when treated with iodine.

PLATE XX. fig. 19. *a.* ascus and paraphysis; *b.* sporidia; *c.* threads with naked spores; *d.* spores: all more or less magnified.

1327. *P.* (Mollisia) *hydnicola*. Cupulis ex orbiculari irregularibus, planis, atroviridibus; ascis cylindricis; paraphysibus ramosis; sporidiis subglobosis, uniserialibus.

On *Hydnum ochraceum*. Spores ·0004 long, ·0003 wide; conidia oblong, ·0001–·00015 long.

PLATE XX. fig. 20. *a.* plant growing on *Hydnum*; *b.* asci and paraphyses, magnified; *c.* sporidia; *d.* conidia: both more highly magnified.

1328. *Stictis graminum*, Desm. Pl. Crypt. no. 1071.

On *Carex paniculata*. Batheaston, June 1867, C. E. Broome.

**S. chrysophæa*, P. Syn. p. 674.

On decorticated fallen oak-branches. Aboyne, Sept. 1870.

1329. *Ascophanes aurora*, Crouan, An. d. Sc. Nat. ser. 5. vol. x. tab. 11. fig. 36.

On cow-dung. Eltham, Kent, Feb. 14, 1869.

Sporidia ·00015–·0003 long.

1330. *Phacidium abietinum*, Schmidt in Myc. Heft i. p. 30.

Roxburghshire, A. Jerdon, Esq.

**Patellaria atrovinosa*, Blox.

Sporidia ·001 long, ·0003 wide.

Plate XX. fig. 21. *a.* ascus and paraphysis, magnified; *b.* sporidia, more highly magnified.

1331. *Nectria furfurella*, B. & Br. E strato carneo effuso oriunda; peritheciis carneis, subglobosis, demum collapsis, particulis micantibus furfurellis obsitis, ostiolo distincte punctiformi.

On cabbage-stalks. Batheaston, Feb. 1869.

Paraphyses branched; sporidia ovate, ·00015–·0002 unc. long; conidia ·0002–·0003 long.

Plate XX. fig. 22. *a.* perithecia; *b.* asci and paraphyses; *c.* sporidia; *d.* conidia: all more or less magnified.

1332. *Sphæria* (Villosæ) *felina*, Fuck. Fung. Rhen. no. 945. *Leptospora felina*, Fuckel, Symb. Myc. p. 141.

On *Rubus*. Orton Wood, Rev. A. Bloxam. Batheaston, March 1869.

Sporidia clavato-falciform, ·0025 in. long; conidia brown, pentagonal or doliiform, concatenate, ·001–·002 long, springing from flexuous horizontal threads.

Plate XX. fig. 23. *a.* perithecia; *b.* hairs of ditto; *c.* mycelium with conidia; *d.* ascus with paraphysis; *e.* sporidia; *f.* sporidium germinating.

**S.* (Villosæ) *tristis*, Tode, var. sporidiis majoribus.

Hainault Forest, Feb. 1859. Batheaston, March 22, 1869.

Sporidia ·0005–·0006 long, ·0002–·00025 wide.

1333. *S.* (Villosæ) *cupulifera*, B. & Br. Peritheciis conicis, obtusis, demum collapsis, subtiliter rugulosis, nitidis, hic illic floccis rectis, articulatis, rigidis, lævibus, articulis ultimis cuneato-cupuliformibus in conidia cuneata utrinque truncata resolutis.

On rotten elm-roots. Langridge, April 16, 1869. St. Catharine's, April 1861.

Sporidia fusiform, at length 4-septate, ·0008–·001 long; conidia ·0005 long, ·0003 wide at the top. The Cladotrichoid hairs sometimes spring immediately from the mycelium. The sporidia resemble those of *S. mutabilis*, which are ·0008 long. The conidia are sometimes pentangular.

PLATE XXI. fig. 24. *a.* perithecia with conidiiferous threads; *b b.* conidiiferous threads; *c.* ascus; *d.* sporidia: all more or less magnified.

**S.* (Denudatæ) *caudata*, Curr.

Sporidia ·0025 long. Very near *S. ovina*, if really different.

PLATE XXI. fig. 25. *a.* group of perithecia; *b.* ascus; *c.* sporidia: all more or less magnified.

**S.* (Denudatæ) *brassicæ*, Klotzsch, MS.

Sporidia ·0015–·002 long, ·0008–·0012 wide, with the appendages ·003–·005 long.

PLATE XXI. fig. 26. Portion of an ascus in a peculiar condition.
Fig. 27. *a.* ascus; *b.* sporidia: both more or less magnified.

**S.* (Denudatæ) *pomiformis*, P. Syn. p. 65.

This occurs with a mould which appears to be the conidiiferous state, which is apparently *Sporocybe albipes*, B. & Br. MS.

Floccis rectis, simplicibus, articulatis, albis, duobus articulis superioribus minute echinulatis; sporis ellipticis, brunneis, e sporophoris totidem oriundis, ·0003–·0006 long, ·0002–·00025 wide; threads ·004–·009 high.

PLATE XXI. fig. 28. *a. Sporocybe albipes*, magnified; *b.* separate head; *c.* spores: all more or less magnified.

**S.* (Subtectæ) *apiculata*, Curr.

On bramble. Batheaston.

Sporidia ·0005–·0006 long, ·0002–·0003 wide.

1334. (*S.* (Obtectæ) *rhodobapha*, B. & Br. Peritheciis semi-immersis, compressis, ostiolo papillæformi; matrice tota roseotincta.

On dead decorticated branches. Batheaston, April 8, 1869.

Perithecia fragile, for the most part compressed and elongated so as to approximate Pertusæ and Macrostomæ. Ostiolum papilliform. Asci clavate; sporidia fusiform, with several nuclei, ·001 inch long. The subjacent wood is tinged throughout with magenta-pink.

PLATE XXI. fig. 29. *a.* ascus; *b.* sporidia: both more or less magnified.

[To be continued.]

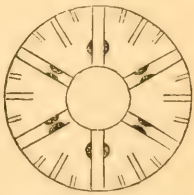
Figs. 5 & 6 on Plate XVIII. represent the spores of *Agaricus metulæspora* and those of *A. cristatus*, referred to in page 462 of the preceding volume.

LIV.—*On the Structure of the Actiniæ and Corals.* By Prof. A. Schneider*.

[This is a report by Prof. Schneider on the investigations made by him and M. Rötteken in the Zoological Institute of the University of Giessen. Prof. Schneider's own investigations relate solely to the laws of the position of the septa and calcareous lamellæ.]

In the Hexactiniæ the septa always stand in pairs, as Hollard has already correctly indicated, so that the members of each pair are symmetrical in their formation. If we examine a transverse section below the stomachal tube, we may distinguish three kinds of septa merely from the measure of their radial diameter, which we may designate septa of the first, second, and third order. The smallest number that occurred consisted of six pairs of the first, six pairs of the second, and twelve pairs of the third order. The six pairs of the first order divide the circumference into six equal sectors, each of which is again halved by a pair of the second order; the space between a pair of the first and a pair of the second order is then again halved by a pair of the third order. As Hollard has already remarked, the septa bear upon the surfaces which are turned towards each other very prominent, thick longitudinal muscles, which we shall designate, for the sake of brevity, by the name of vanes (*Fahnen*). In some Actiniæ all the septa bear vanes, in others only those of the first order. But all the pairs by no means bear vanes on the surfaces turned towards each other, as Hollard thinks; there are always two diametrically opposite pairs of the first order which bear the vanes on the surfaces which are turned from each other (fig. 1). Whatever number of septa there may be in an *Actinia* (and their number may be hundreds), there are always only septa of the three orders; they all stand in pairs; and there are always two pairs of septa distinguished as above described, which indicate the bilateral symmetry of the Hexactiniæ.

Fig. 1.



Hitherto we have distinguished the septa of the three orders only by the size; but they are also distinguished by other peculiarities of structure, as appears from M. Rötteken's accurate investigations.

In the Octactiniæ the septa do not stand in pairs; they also

* Translated by W. S. Dallas, F.L.S., from the 'Sitzungsbericht der Oberhessischen Gesellschaft für Natur- und Heilkunde,' March 8, 1871.

possess vanes, but in a totally different order. In *Veretillum cynomorium* (fig. 3) eight septa are present, and these are differently constructed according to whether they stand upon the left or the right half of the body. In the one half the vanes are turned in the opposite direction to those in the other.

How the calcareous lamellæ of the corals constructed in accordance with the number 6 originate has not yet been investigated. Certainly they do not originate by the calcification of the septa themselves; but it is very probable that they are produced in the inner space of each pair of septa. When the number of lamellæ does not exceed a certain limit (*e. g.* in *Galaxea*), we may easily find individuals with only six lamellæ of the first order, then older ones with six of the

Fig. 2.

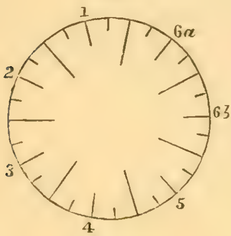
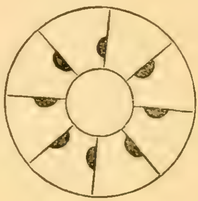


Fig. 3.



second, and still older ones with twelve lamellæ of the third order. When more lamellæ make their appearance, the increase takes place as follows:—In the space between a lamella of the first and of the third, or of the second and of the third order, a new lamella of the third order arises, the old lamellæ of the third and second order grow further and become lamellæ of the next higher order (namely, second and first)—for example, in fig. 2, in which the sixth sector has enlarged and nearly become two new sectors. A new formation of this kind seems to be capable of taking place in any sector.

This very simple law of growth applies to all corals with the number 6, although it is more difficult to ascertain in such genera as *Fungia* &c., because, on account of the great size and gradual growth of the lamellæ, these occur of very different lengths. It has been tested on numerous specimens of corals and on many figures of living and fossil corals, and has always, without exception, been found correct. The well-known very complicated law of Milne-Edwards and Jules Haime can scarcely be verified, and is subject, as its inventors themselves say, to numerous exceptions. It cannot pass as the true expression of the facts.

For the corals with the number 8 (*e. g.* the *Rugosa*) another law of the origin and increase of the calcareous lamellæ must be adopted. Nevertheless it is important that we see, in the *Rugosa*, that the numerous calcareous lamellæ exhibit not only bilateral symmetry, but, as in the Octactiniæ, a distinction of back and belly. We cannot, however, at present define the dorsal and ventral surfaces.

The investigations of M. Rötteken have been extended to the whole histology and anatomy of the Hexactiniæ, and have brought to light numerous new facts.

In the first place, he has found that the whole of them possess an annular canal which closely surrounds the mouth. This must not be confounded with the apertures of the septa, which occur frequently but not regularly, and which were discovered by Hollard. By this annular canal the Actiniæ approach the Medusæ more closely than has hitherto been supposed.

He has also discovered that the so-called "bourses marginales" (Hollard) are undoubtedly organs of sense, and, indeed, compound eyes. These organs are pyriform diverticula of the body-wall, standing between the tentacles and the outer margin of the peristome; they are constructed after the fashion of a retina, and allow the following layers to be distinguished in them (fig. 4):—1, externally a cuticular layer which is broken up into bacilli by numerous pore-canals; 2, a layer of strongly refractive spherules, which may be regarded as lenses; 3, cones, consisting of hollow, strongly refractive, transversely striated cylinders or prisms rounded at the ends, which have probably hitherto been confounded with urticating capsules: at the exterior end of each cone there is generally one lens, sometimes even two or three other lenses may stand in the interspaces; 4, a granular fibrous layer, which also occupies the interspaces of the cones; 5, a layer which is deeply coloured by carmine, and contains numerous extremely fine fibres and spindle-shaped cells, probably nerve-fibres and cells; 6, the muscular layer; 7, the endothelium. These observations were made on *Actinia mesembryanthemum*, Gosse. Only spirit-specimens were at command, so that nothing can be stated upon various points, such as the position of the pigment which these eyes have during life. M. Rötteken has found the same cones and lenses in the tips of the tentacles of *Actinia cereus*, Ellis & Sol.; and he believes that their diffusion among the Actiniæ is very general.

Fig. 4.

With regard to the musculature, he has made out the following facts. Three body-layers may be distinguished—the ectothelium, the muscular layer, and the endothelium. In the foot-plate and in the body-wall there are exclusively annular fibres, in the septa longitudinal fibres, and in very limited spots radial fibres, and in the tentacles longitudinal fibres externally and annular fibres within. In a great number of Actiniæ the annular fibres are aggregated beneath the peristome into a strong annular muscle, which is either completely imbedded in the body-wall as a *diffused* annular muscle, or projects inwards into the chambers as a ridge, forming a *prominent* annular muscle. The peristome possesses radial and annular fibres, the stomachal tube an inner and an outer layer of longitudinal fibres, whilst an intermediate layer of annular fibres occurred only in a very limited space at the mouth. The muscular layer consists of the sarcolemma, the fibrillæ, and an interfibrillar layer containing nuclei. The sarcolemma, which forms the principal mass of the body of the Actinia, is called *connective tissue* by Kölliker. Fundamentally these designations do not contradict each other; but the term sarcolemma must be preferred, because, on the one hand, cells could only be detected in it in rare instances, and, on the other, it enters most intimately into the structure of the muscles. This layer is always characterized by its rapid and deep coloration in solution of carmine; it is either homogeneous or fibrous, and frequently includes fine horny spicula. The fibrillar substance consists of long prismatic or cylindrical fibres. These three members of the muscular layer are variously combined in the different Actiniæ, and, indeed, in such a manner that we can distinguish three grades of histological development. In the lowest grade the sarcolemma is bounded by a straight line on the side of the fibrillar layer, the fibrillar prisms are placed upon it (when seen in transverse section) in a straight line; the interfibrillar substance is in contact with the ectothelium and endothelium: the linear boundary between the thelial and interfibrillar layers is, indeed, always rendered distinct by an accumulation of dark granules; but it is impossible to detect a limiting membrane. In the second grade the boundary-line of the sarcolemma towards the fibrillar layer is more or less deeply undulated; the fibrillar prisms follow this line; and the limit of the interfibrillar layer towards the thelial structures remains rectilinear. In the third grade the summits of the undulations unite, and we have a sarcolemma-layer which is rectilinearly bounded towards the ectothelium and endothelium, and encloses cylindrical muscular primitive bundles consisting of a fibrillar cortical substance and an interfibrillar central substance. The first grade occurs frequently in the inner tentacular layer, the second in the outer tentacular layer of *Actinia nivea*, Less., and *A. effœta*, and almost always in the muscles of the vanes, the third always in the diffused annular muscle of the body-wall, and on those points of it where the septa are attached, and also in the outer tentacular layer of *Tealia crassicornis*.

LV.—*On the Development of* Echinorhynchus gigas. By Prof. A. Schneider*.

The ova of this worm are scattered upon the ground by the pigs. Here they are eaten by the larvæ of *Melolontha vulgaris*, and thus arrive at their further development. The ova burst in the stomach of the larva; and the embryos contained in them can then penetrate, by means of their spines, through the intestine into the body-cavity of the larva; here they become developed, and again reach the intestine of the pig by the agency of the larva.

The larvæ infested with *Echinorhynchi* live on until their metamorphosis into cockchafers. As the thorax of the cockchafer is not unfrequently eaten by man, we can understand that *Echinorhynchus gigas* may also get into the intestine of man. It has once been found in that situation by Lambl. I have never succeeded in procuring the development of the embryos of *Echinorhynchus gigas* either in the larvæ of *Tenebrio molitor* or in *Asellus aquaticus*.

When the embryos have arrived at the body-cavity of the larvæ of *Melolontha*, they remain for some days unaltered and capable of motion; they then become rigid, acquire an oval form, and envelope themselves in a finely cellular cyst, which is formed of the connective tissue of the larva. The skin of the embryo, with its circlet of spines at the anterior extremity, continues at first to be the skin of the growing larva; and it is only at a later period, when the formation of the hooks commences, that it is thrown off, when it forms a second cystic envelope.

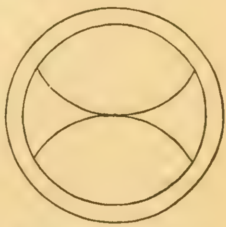
The considerable size and perfect transparency of the larva of *Echinorhynchus gigas* permits its development to be more accurately traced than in other *Echinorhynchi*, the development of which was first investigated by Leuckart and afterwards by Greef. Here only those facts can be given which are intelligible without figures.

* Translated by W. S. Dallas, F.L.S., from the 'Sitzungsbericht der Oberhessischen Gesellschaft für Natur- und Heilkunde,' March 8, 1871.

The embryo, or, rather, the larva proceeding from it, divides very soon into two layers, a thick dermal layer and an inner cell-mass, from which the other organs originate. The dermal layer is characterized by very large spherical nuclei with nuclear corpuscles: these at first lie irregularly scattered, but they then arrange themselves in the following manner:—At the cephalic extremity a band of six nuclei is formed, between which the six foremost hooks protrude. A second band, of about fourteen nuclei, is formed at the place where the lemnisci are produced. The nuclei of this band become the nuclei of the lemnisci: while the latter grow inwards as two processes of the skin, the nuclei gradually pass into them. Of the remaining nuclei the hindmost four, with their nuclear corpuscles, increase considerably in length, and accompany the lateral lines of the body on each side as four cords. In the mature state they attain nearly the whole length of the body, and are probably the longest nuclei known.

Between the lemniscal band and the anterior extremities of these four nuclei, a considerable number of nuclei are rather irregularly placed; these also increase in length, but in a much less degree. All these long nuclei, as also their nuclear corpuscles, give off short acute diverticula on both sides. These large, long nuclei are still found in the mature examples. Without the history of the development, their morphological signification could hardly be guessed.

Both the ovaries and the testes are produced extraordinarily early. The former are two bodies, each composed of about four cells, and are both situated at the same place. Each testis is connected by a cord, consisting of a series of cells (afterwards the efferent duct), with the well-known muscular vas deferens. The ovaries are from the first destitute of this or any similar connexion. While the testes grow rapidly by cell-multiplication, the ovaries remain unaltered, and probably fall away from the so-called ligament very early (when the total length of the animal is 5 millims.). I have been unable to ascertain the subsequent fate of the ovaries.



The nature of the so-called "ligamentum suspensorium" has hitherto been entirely mistaken. In the transverse section of the mature female, and indeed almost throughout the whole length from the anterior end of the uterine bell to the insertion of the retractores proboscidis, the ligament shows in the manner represented in the figure. It consists of fine membranes which, as may be seen, bound two sacs (a dorsal and a ventral) attached to the body, and are in contact and united in the middle. Anteriorly the two sacs communicate, and their membranes separate entirely from the walls; they form a point like a nightcap, which finally advances to the proboscis. Posteriorly the conditions are more complicated, but an arrangement is made by which both sacs communicate with the uterine bell. These sacs alone contain the ova and free-swimming ovaria. The two lateral three-cornered spaces are to be regarded as the body-cavity. Where the two sacs are attached in the middle of the body, there is a finely granular cord, which, in the young state, contains a series of very fine large nuclei. This cellular cord is called the ligamentum in many *Echinorhynchi*, and has been interpreted as the ovary by several observers. I shall hereafter endeavour to show that it rather represents the intestine. In *Echinorhynchus gigas* the nuclei of the cord ultimately become completely obliterated, whilst in other species they persist. The males possess a similar arrangement; but I shall not enter upon that. The analogy between the male and female sexual organs is nearly complete; but as the comparative size of the individual parts is very different, it becomes difficult to establish this, or to make it clear without a considerable number of figures.

The hooks grow outwards from the innermost layer of the proboscis. When they are already formed and calcified, they are still covered by a thin membranous layer, which they afterwards cut through so as to become perfectly free. It is only then that the proboscis becomes inverted.

Any one who goes thoroughly into the anatomy of the *Echinorhynchi* will find how difficult it is to compare the structure of their body with that of any other animal. This is not due to deficient knowledge of their structure, but probably rather to the fact that we require to know a series of other animals which constitutes their connexion with allied forms. Perhaps, indeed, the *Echinorhynchi* are not simple, but double animals—in this fashion, that the proboscidal apparatus represents one, and the so-called sexual organ the other animal, whilst the body-envelope is common to both. Both animals are mouthless, and each of them is modified for a special purpose. Similar conditions, as is well known, occur among the Bryozoa. The developmental history is exceedingly favourable to this supposition; but its more exact demonstration I must leave for a detailed memoir.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

May 4, 1871.—Sir Philip Grey-Egerton, Bart., Vice-President, in the Chair.

"On the Structure and Affinities of *Guynia annulata*, Dunc., with Remarks upon the persistence of Palæozoic Types of Madreporaria." By P. Martin Duncan, M.B. Lond., F.R.S., Professor of Geology in King's College, London.

The dredging-expedition which searched the sea-floor in the track of the Gulf-stream of 1868, yielded, amongst other interesting Madreporaria, a form which has been described by Count Pourtales under the name of *Haplophyllia paradoxa*, and which was decided by him to belong to the section Rugosa.

The last expedition of the 'Porcupine,' under the supervision of Dr. Carpenter, F.R.S., and Mr. J. Gwyn Jeffreys, F.R.S., obtained, off the Adventure Bank in the Mediterranean, many specimens of a coral which has very remarkable structures and affinities. The species is described under the name of *Guynia annulata*, Dunc. The necessity of including it amongst the Rugosa and in the same family, the *Cyathoxonidæ*, as *Haplophyllia paradoxa* is shown.

Having this proof of the persistence of the rugose type from the Palæozoic seas to the present, the affinities of some so-called anomalous genera of Midtertiary and Secondary deposits are critically examined. The Australian tertiary genus *Conosmilia*, three of whose species have strong structural resemblance to the Rugosa, is determined to be allied to the *Stauridæ*, and especially to the Permian genus *Polycœlia*. The Secondary and Tertiary genera with hexameral, octomeral, or tetrameral and decameral septal arrangements are noticed, and the rugose characteristics of many lower Liassic and Rhætic species are examined.

The impossibility of maintaining the distinctness of the Palæozoic and Neozoic coral-faunas is asserted; and it is attempted to prove that whilst some rugose types have persisted, hexameral types have originated from others, and have occasionally reverted to the original tetrameral or octomeral types, and that the species of corals with the confused and irregular septal members so characteristic of the lowest Neozoic strata descended from those Rugosa which have an indefinite arrangement of the septa.

The relation between the Australian Tertiary and recent faunas, and those of the later Palæozoic and early Neozoic in Europe, is noticed, and also the long-continued biological alliances between the coral-faunas of the two sides of the Atlantic Ocean.

MISCELLANEOUS.

Discovery of the Animal of the Spongiadæ *confirmed.* By H. J. Carter, F.R.S. &c.

My dear Dr. Francis,

Just a line to tell you what you will be glad to learn, viz. that I have confirmed all that Prof. James-Clark, of Boston, has stated about the sponge-cell, and much more too.

It is, after all, only what was published and illustrated in the 'Annals' in 1857. Indeed I am astonished now at the accuracy and detail of that paper ("Ultimate Structure of Spongilla" &c.), now *all* confirmed by an examination of a *marine* calcareous sponge.

I have not only fed the sponge with indigo, and examined all at the moment, but the sponge so fed was put into spirit directly afterwards, and *now* shows all the cells (monociliated) with the *cilium attached and the indigo still in the cells.*

This, I think, will break down Häckel's hypothesis, which is as imaginative and incorrect as it is beautiful.

His "Magosphæra," too, is figured in the 'Annals' (1856), and described *in extenso* as the amœboid cell which inhabits the mucus of the cells or internodes of the Bombay great *Nitella.*

But there are no people in England, if on the Continent, who seem to be able to show this, if even they be cognizant of it.

Ex oriente lux used to be the old phrase; the light is now being *reflected* back from America. It is from there that we must expect novelties now.

Yours &c.,
H. J. Carter.

"The Cottage," Budleigh-Salterton,
May 22, 1871.

On Testudo Phayrei *and* Scapia Falconeri. By Dr. J. E. Gray, F.R.S. &c.

Dr. J. Anderson read a communication to the Zoological Society on the 2nd of May, accompanied by "some drawings of and notes on the original specimen of *Testudo Phayrei*, Blyth, in the Indian Museum. Having examined the skull in the British Museum upon which *Scapia Falconeri*, Gray, has been based, and re-examined the small example of *Testudo Phayrei* at Calcutta, Dr. Anderson had come to the conclusion that Mr. Theobald's account of the history was strictly accurate."

Taught by former experience, I have consulted Dr. Anderson's original paper, and find,—1st, that the official minute above copied is inaccurate in most of the statements it contains. Dr. Anderson states first that the sternum shows that the animal is a *Testudo*, and the figures only refer to this part, and consequently both Mr. Blyth and Mr. Theobald were wrong, according to him, in referring it to the genus *Manouria*; secondly, that Mr. Theobald has falsely described the state of the specimen in the Indian Museum, in his printed catalogue of that collection; and, thirdly, the almost incredible statement* that Mr. Theobald referred the two original specimens of *T. Phayrei* in the catalogue above mentioned to two different genera. "The perfect typical one" he confounded with the common *Testudo indica*; and the smaller carapace, wanting a few shields and having no other bones, he referred to *Manouria emys*. This specimen, being without the head, can give no authority for Mr. Theobald's assertions about the skull in the Museum.

The paper contains no attempt to prove that the head of the perfect specimen is like the skull I described, much less to identify it as being the same species; and this is the first step that is wanting to support their hypothesis. Indeed, unless we are to believe that Mr. Theobald is a much more untrustworthy observer than I am inclined to think, his having placed the imperfect specimen of *Testudo Phayrei* as a specimen, with a short broad-headed *Testudo indica* goes far to disprove its being the same as the long narrow-headed *Scapia*.

The various statements on the minor points given about that specimen by Messrs. Blyth, Theobald, Blanford, and Anderson are so conflicting, and sometimes absolutely contradictory, that one can draw no conclusion from them. It is quite a mystery to me why Mr. Blyth, Mr. Theobald, and their friends are so anxious to prove their improbable hypothesis, which would only throw discredit on the two former. If I erred in considering the skull, which I had received without habitat or history, to belong to a new species, I had compared it with all the skulls of the large tortoises I knew, and believing, on the authority of Mr. Blyth and Mr. Theobald, that *Testudo Phayrei* (which I had not) was the same as *Manouria* (which I had, and which differed from the skull under examination), I took all the proper precautions before describing it as new; indeed, if I erred, I only did so in putting too much faith in my friends and fellow-labourers.

1. I did not suspect, and I do not now believe, that Dr. Falconer had a skull in his possession that belonged to the Indian Museum, knowing as I do that those he did borrow were returned by his brother at his death. 2. I never suspected that Mr. Blyth, the paid curator of the museum, would allow a skull to be removed from the collection without informing the officers of the institution and taking a receipt for it; but the then secretary informed me that no acknowledgment of the kind was to be found in any of their journals. 3. I did not suspect that Mr. Blyth did not know the species which he had named *Testudo Phayrei* when he stated that *Manouria emys* was the same species. 4. I did not suspect that Mr. Theobald's accuracy was not to be trusted when he placed the specimens and bones of *T. Phayrei* in the Indian Museum under the name of *Manouria emys* in the catalogue of the reptiles of that collection. But it appears that I should have suspected and believed all these circumstances, in order to escape making the mistake which I am

* I see Mr. Theobald acknowledges this mistake, and refers it to "culpable haste" (Proc. Zool. Soc. 1870, p. 675).

accused of having made; and I would rather repeat the error than be so suspicious and incredulous of the accuracy and trustworthiness of my fellow-labourers in science; and I hope some unprejudiced Indian zoologist will kindly examine and compare the head of *T. Phayrei* with the figure of the skull, or send to the British Museum, that we may make actual comparison, and I should be very glad to adopt the result.

Note on the Habitat of Diadema octocula. By A. G. Butler, F.L.S. &c.

In the 'Annals and Magazine of Natural History' for Jan. 1869 (p. 19, pl. 9. fig. 5) I described and figured a new species of *Diadema* under the name of *D. octocula*: the locality, roughly scribbled on a label attached to the insect, appeared to be "Island of Toloya or Tologa;" and though this locality was new to me and I could not discover it on any map, I supposed it possible that it might be the name of some obscure islet, and therefore published it as "Island of Tologa."

Subsequently, in a paper on the genus *Diadema* in the 'Trans. Entomological Society,' Mr. Wallace suggested that the correct locality might be Gilolo; he, moreover, differed from me respecting the sex of the insect, which, notwithstanding its female aspect, he stated to be a male.

In the 'Stettiner Entomologische Zeitung' for January to March 1869 (p. 71. n. 16, pl. 4. fig. 17), Dr. Herrich-Schäffer described and figured a new *Diadema* under the name of *D. formosa* *; it differs from my *D. octocula* only in its smaller size, more slender body, and in the presence of three marginal spots towards the apex of the front wings, and can therefore scarcely be a different species; it may, I think, be the male of my insect. The habitat given is "Vanua Valava."

Whilst examining some of the smaller Crustacea in the British-Museum collection, I have stumbled upon a small crab bearing a label with the locality "Totoya, Fiji Islands," which, I think, must be the correct reading of the habitat attached to the type of *D. octocula*.

Note on Chlamyphorus truncatus. By Dr. J. E. Gray, F.R.S. &c.

Mr. Edward Gerrard, jun., has lately procured for the Museum a specimen, in spirits, of the Pichiacoo from Mendoza. He has pointed out to me that they vary in the extent of the attachment of the dorsal shield to the middle of the back. In one specimen it is attached along the whole length of the dorsal line; in the one in the Museum it is only attached in two places, about a quarter of an inch long—one over the shoulder and the other in the middle of the back.

* This species seems to have been overlooked by Mr. Wallace.

On the Development of the Leaves of the Sarraceniæ. By M. H. Baillon.

The exceptionally formed leaves borne by the *Sarraceniæ* are well known as regards their external configuration and the long horn-shaped bag which forms their principal part; the lid, of variable form, which surmounts, and even the sort of projecting ridge which extends throughout the length of their inner margin, have been well distinguished. But botanists are not agreed as to the interpretation of these different regions of the leaf. The most generally accepted opinion upon this point is that put forward by A. Saint-Hilaire and M. Duchartre, amongst others. The former (Morphol. Végét. p. 142) supposes the winged margins of the petiole of *Citrus hystrix* or of *Dionæa* approximated and amalgamated, and says that we shall then have the leaf of *Sarracenia*, formed of an elongated urn (the true petiole) and a lid (the true leaf); and the second of these authors likewise says (Elém. de Bot. p. 308) that the ascidium of these plants is generally regarded as formed by the petiole, and their posterior lip or operculum as representing the limb.

Organogenetic observations alone could show how much of these interpretations was to be admitted. We have therefore studied the development of the leaves in *S. purpurea*, which is frequently cultivated in this country. In their earliest stage these leaves are represented by small mamillæ, the surface of which is at first convex. A little later the base of these organs becomes slightly dilated, and concave within: this is the first rudiment of the sheath, a portion of the leaf which, as we shall see, has nothing to do with the cavity of the pitcher of the *Sarracenia*. This vaginal portion, which will subsequently acquire a considerable development, behaves here in the same way as in all plants in which it exists, and has no influence upon the composition of the pitcher. The first indication of the latter is a small depression, a sort of pit, at first very slightly marked, which is produced at the top and a little on the inside of the cone which represents the young leaf. This depression is really due only to an inequality of development in the various portions of the apex of the leaf; and the inequality occurs rather late towards the apex of a leaf of which the petiolar and vaginal portions already exist. In this respect the leaves of the *Sarraceniæ* behave nearly like those of the Nymphæaceæ, with which they have so many other analogies.

At this age the young leaves of the *Sarraceniæ* have the same appearance as those of *Nepenthes*, but for a very different reason, if we admit, with Dr. J. D. Hooker, that the pitchers of the latter are the result of the great development of a gland. Here it is certainly the upper surface of the limb that is at this period reduced to a pit; and this depression is lined with an epidermis which is the upper epidermis of the leaf, which is developed in proportion as the pit becomes larger, and which subsequently even becomes covered with hairs, the secreting faculty of which has been noticed by many observers. The more the pit becomes hollowed out, the more does the limb of the leaf acquire the appearance of certain peltate leaves, such as those of *Nelumbo*, which is nearly allied to *Sarracenia*. The large and shallow cone which is formed by the limb of the leaf in *Nelumbo* becomes, in *Sarracenia*, deeper and narrower, so as finally to present the form of a long obconical cornet. Simultaneously with this change of form, the portion of the leaf which is called the lid becomes marked off, no doubt in a variable manner in the different species. We know that there are peltate leaves of which the margin of the limb is not entire, but cut into crenulations and lobes, and that sometimes these lobes are unequal, the terminal median one being perhaps more developed than the others. This is one of the causes of the petiole not being inserted in the centre of the peltate limb, but nearer to its base, which is most commonly more or less deeply emarginate-cordate. In the leaf of *Sarracenia* we might expect from the first to see an analogous phenomenon produced, because the pit is surrounded by a border which is thicker above than at the sides and below. This inequality only becomes more strongly marked with age; and it is the upper margin that increases most rapidly, afterwards becoming slightly constricted at its base. This is the origin of the lid and of the more or less distinct lateral projections which often accompany it; these are consequently not a limb, but the unequal lobes of a limb which existed before them.

The signification of that sort of vertical keel which runs along the inner border of the pitcher remains to be explained. This organ exists, usually in a rudimentary state, in a great number of peltate leaves. In these leaves we often observe a nervure or projecting crest, which stretches, on the lower surface of the limb, from the insertion of the petiole to the bottom of the sinus presented by the base of the limb. The crest of the leaves of *Sarracenia* appears to us to be nothing but an exaggeration of this very part; and its vertical direction is merely the consequence of the extreme depth acquired by the immoderately peltate limb of the leaf of *Sarracenia*. —*Comptes Rendus*, Nov. 7, 1870, p. 630.

Note on the Malar Bone in the Skulls of Manidæ. By Dr. J. E. Gray, F.R.S. &c.

The skulls of *Manis* which have been described and figured, and all the specimens that I have hitherto seen in different museums, have a very imperfect zygomatic arch, caused by the absence of the malar bone. Indeed Mr. Flower, in his admirable 'Introduction to the Osteology of the Mammalia' (p. 206), describing the skull of *Manis*, observes:—"There is no distinction between the orbit and the temporal fossa, which forms a small oval depression near the middle of the side of the skull. There are short zygomatic processes on the maxilla and squamosal, owing to the absence of the malar."

Mr. Swinhoe, early last year, brought me for examination some skulls of *Manis* from Amoy and Formosa, along with the skulls of a new deer and hare. I observed that some of the skulls of *Manis* had a perfect zygomatic arch, which I had not before seen; but I was suffering too much pain at the time to pay more attention to the subject, observing that most likely the skull belonged to *Manis Dalmanni*, and that it might be distinct from *M. Hodgsoni*, with which I had hitherto united it.

Mr. Swinhoe left his specimens at the British Museum; and I have no doubt that the four from Amoy, which are of different ages, are the skulls of the family of five which he purchased in Amoy in June 1867, described in the 'Proceedings of the Zoological Society' for 1870, p. 650, and that the one from Formosa, which is of a larger size, is the male specimen described in the same place, and that the observation of Mr. Swinhoe, that "the Amoy and Formosan adult skulls both have complete malar arches; but in the skulls of the Amoy young ones these gape apart, the unossified cartilage having been cleaned away," is the true explanation of the absence of the malar, which most probably is present in all the species of the genus.

On Marine Bryozoa. By Prof. E. Claparède.

In the first Number of vol. xxi. of Siebold und Kölliker's 'Zeitschrift,' Claparède, who, with the exception of Nitzsche, is the only writer who has studied the Bryozoa since the publication of the capital papers of Smitt, gives us most interesting contributions to their history. While on the main points he completely agrees with the views taken by Smitt of the polymorphism of the species, their mode of budding, and general embryonic development, yet in some points not satisfactorily determined by Smitt, such as the relations of the various cells (zoœcia) to one another, the nature of Smitt's "mörka kroppar," dark bodies, and "fett kroppar," he has new observations differing somewhat from those of Smitt. The most interesting facts are those concerning a sort of retrograde development, a resorption of the digestive cavity in the older cells, the gradual disappearance of the lophophore, resulting in cells usually considered as dead, but in reality having latent life, and where alone the fatty bodies of Smitt, which play such an important part in the embryology of Bryozoa, are developed. These cells apparently pass through stages identical with those produced by budding at the youngest extremity of the colony, with the difference that in one case the cell is immature, while in the other it is fully developed. The resorption is frequently accompanied by peculiar changes in these cells, and is confined to the older portions of the Bryozoan colony in which the lateral connexion between the cells for exchange of fluids between the cells provided with digestive cavities and those cells containing latent life is very strikingly shown, thus forming a complete circulation between the most distant parts of the colony. He also confirms the nature of the colonial nervous system, first traced by Fritz Müller, and shows its existence among the Chilostomata, where it had only been traced by Smitt before. Claparède closes this interesting paper by giving us the complete development of *Bugula*, with larger, more accurate, and at the same time more intelligible figures than we have had of the early development of any one species of marine Bryozoa thus far. He has, however, not been able to decide positively the nature of the ova, said in one case to owe their origin to a sexual process, and in the other cases to point to the existence of parthenogenesis among Bryozoa under certain circumstances. Claparède has not confirmed the observations of Schneider on the development of *Membranipora*; but from what Nitzsche has observed of the early stages of *Bugula*, he appears to have seen the same retrograde development in the youngest stages of its larva which Schneider observed in *Cyphonautes* during its development into *Membranipora*.—*Silliman's American Journal*, May 1871.

On the Order of Development of the Dentition of Sloths (Bradypus). By Dr. J. E. Gray, F.R.S. &c.

The skull of the two-toed Sloth (*Cholœpus*) is distinguished from that of the three-toed Sloths (*Bradypus* and *Arctopithecus*) by having the intermaxillary bone moderately developed, forming the front edge to the jaw; whereas in the latter two genera it is rudimentary, free, and very commonly lost in preparing the specimen. But the development of the teeth, which I believe has not hitherto been observed, differs more. In *Cholœpus* the front grinders in both jaws are much larger than the others, subtriangular, with bevelled edges, by their rubbing against each other, like the canines of pigs; they are developed at the same time as the other grinders, or, indeed, rather before; for they are of considerable size when the other grinders are small and rudimentary. The front ones of the upper jaw are separated from the others by a considerable space; and the lower one is considerably behind the produced front edge of the lower jaw, and separated from the other grinders by a moderate space. In the three-toed Sloths, on the contrary, the grinders are all regularly placed, the front lower one being transversely compressed and truncated. The front upper grinder is always smaller than the rest, cylindrical, and it is developed much later than the others. There is a specimen in the British Museum of a young skull of *Arctopithecus*, which has all the grinders in the upper and lower jaws well developed, but the upper front grinders are small, rudimentary, cylindrical, conical at the tip; and, on comparing other young skulls, it is evident that these teeth are gradually developed as the animal increases in age, and never attain the same size as the others.

Note on Asaphus platycephalus. By J. D. Dana.

The closing remark in my paper on page 368 will have to be cancelled if the species there referred to *Asaphus platycephalus* is identical with the *Asaphus platycephalus* (*A.* (*Isotelus*) *gigas*) of Trenton, the latter (as Mr. Billings writes the author) often occurring, in New York, rolled into a ball.—*Silliman's American Journal*, May 1871.

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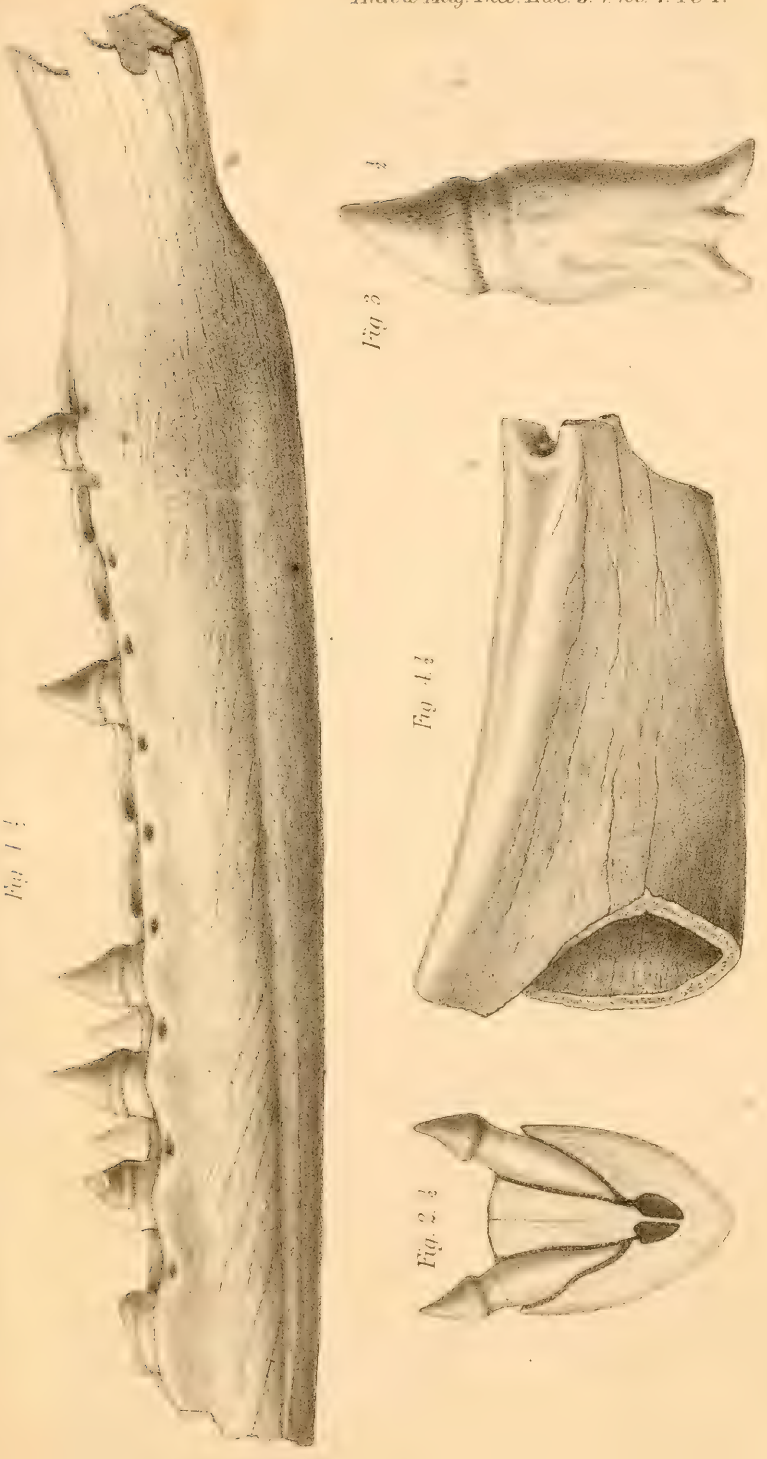
PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.



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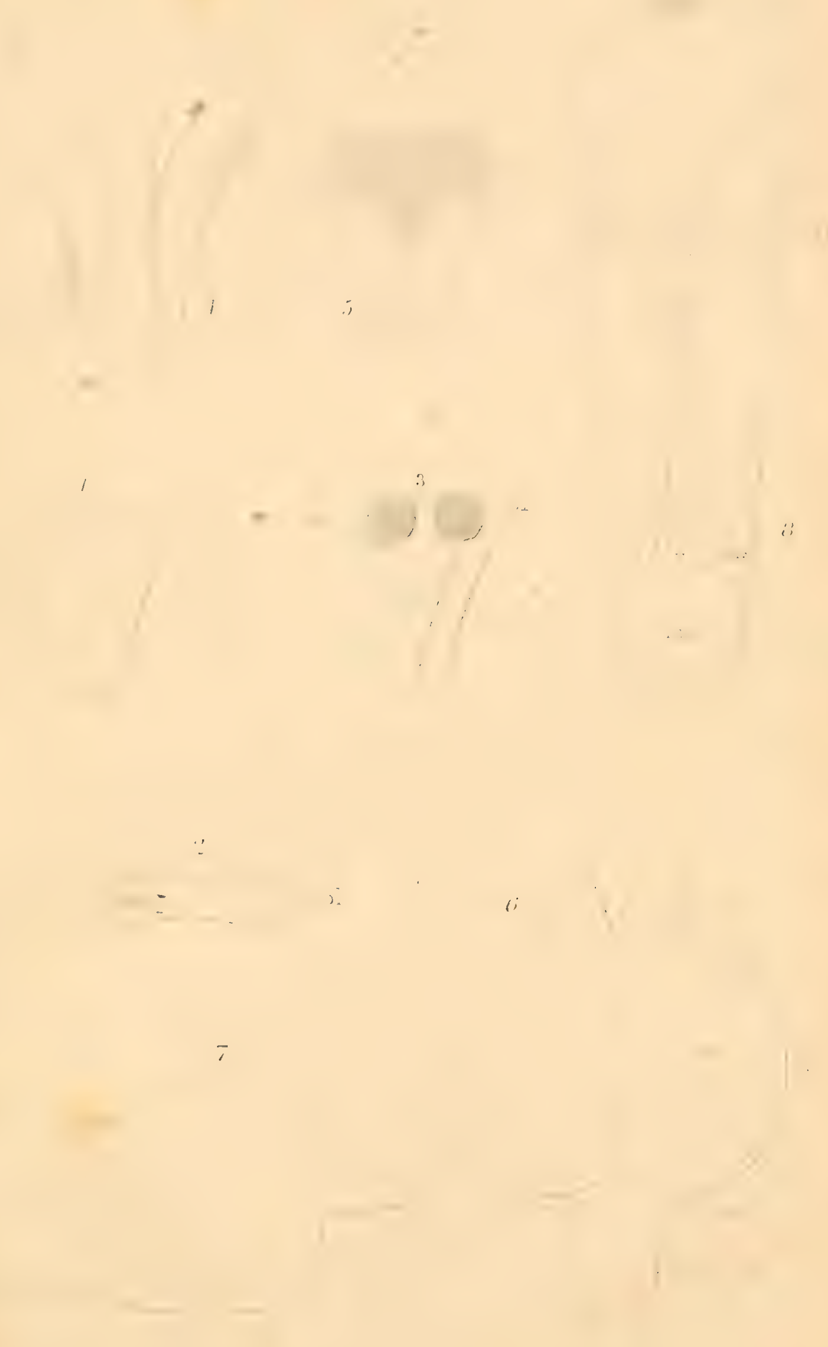

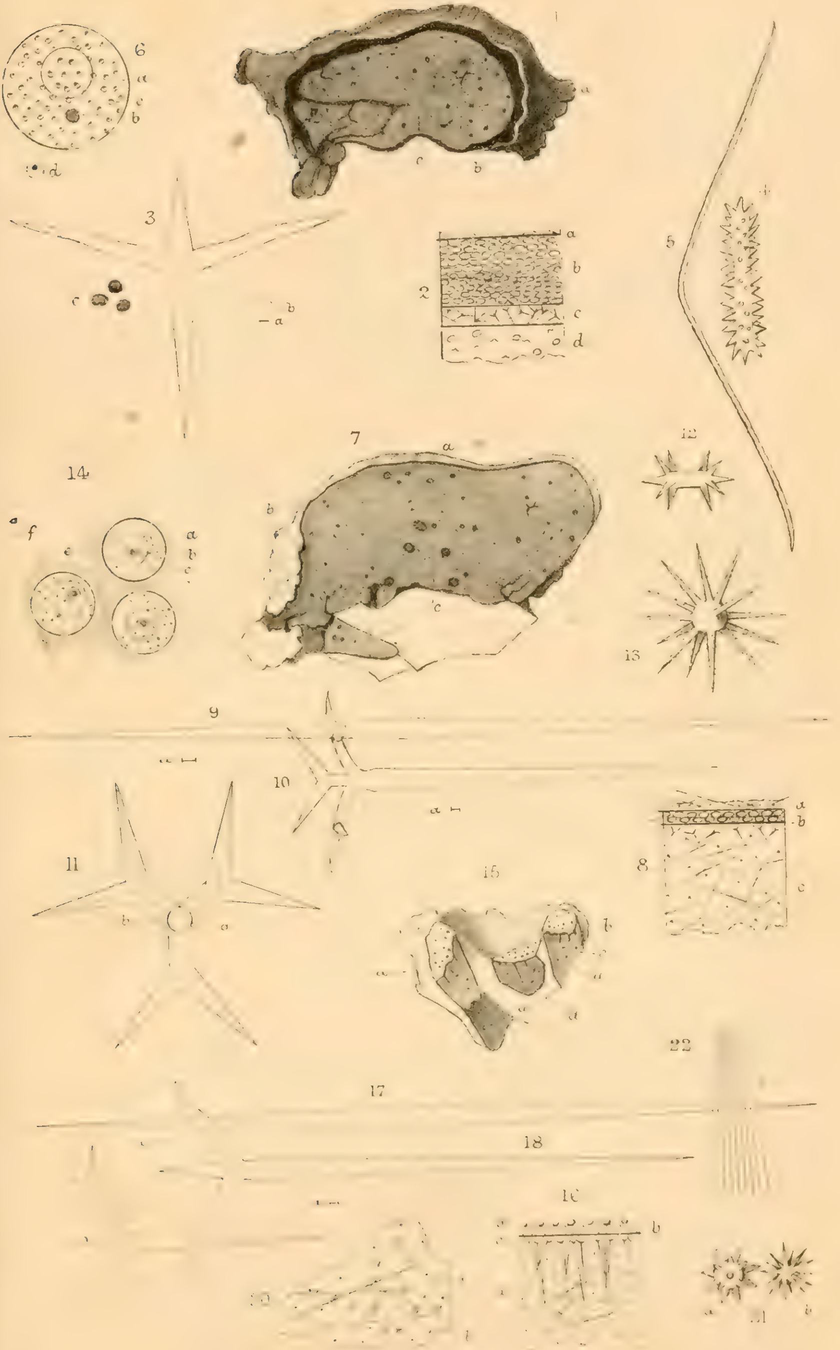

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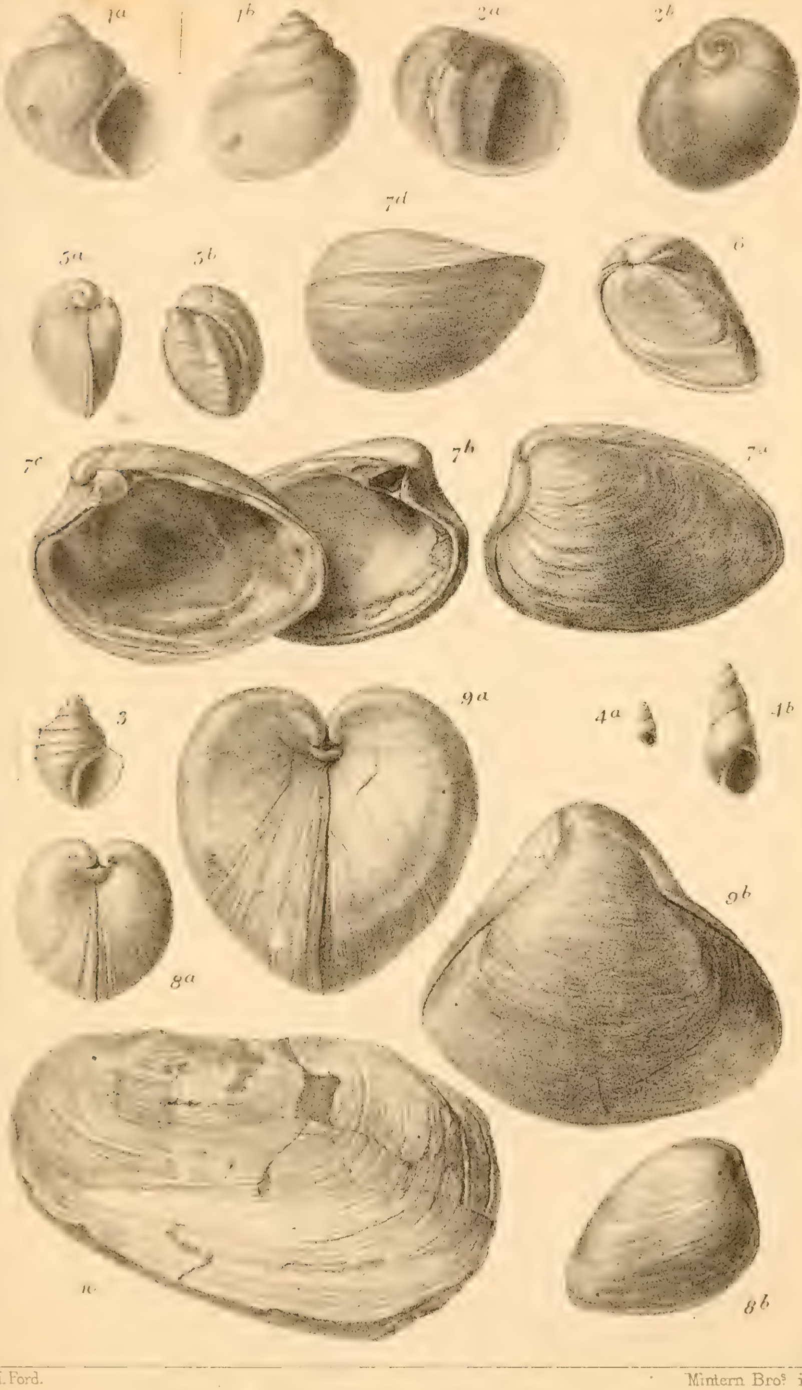

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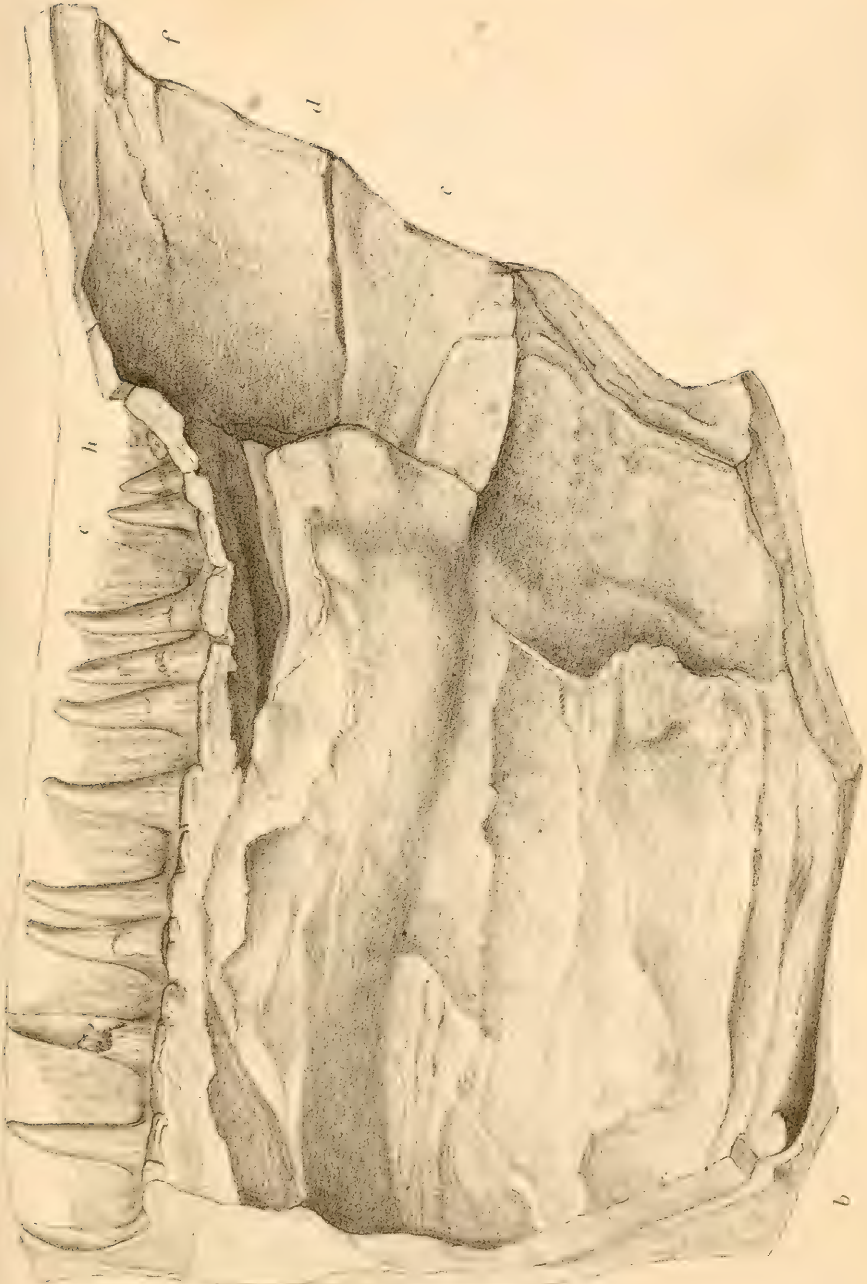

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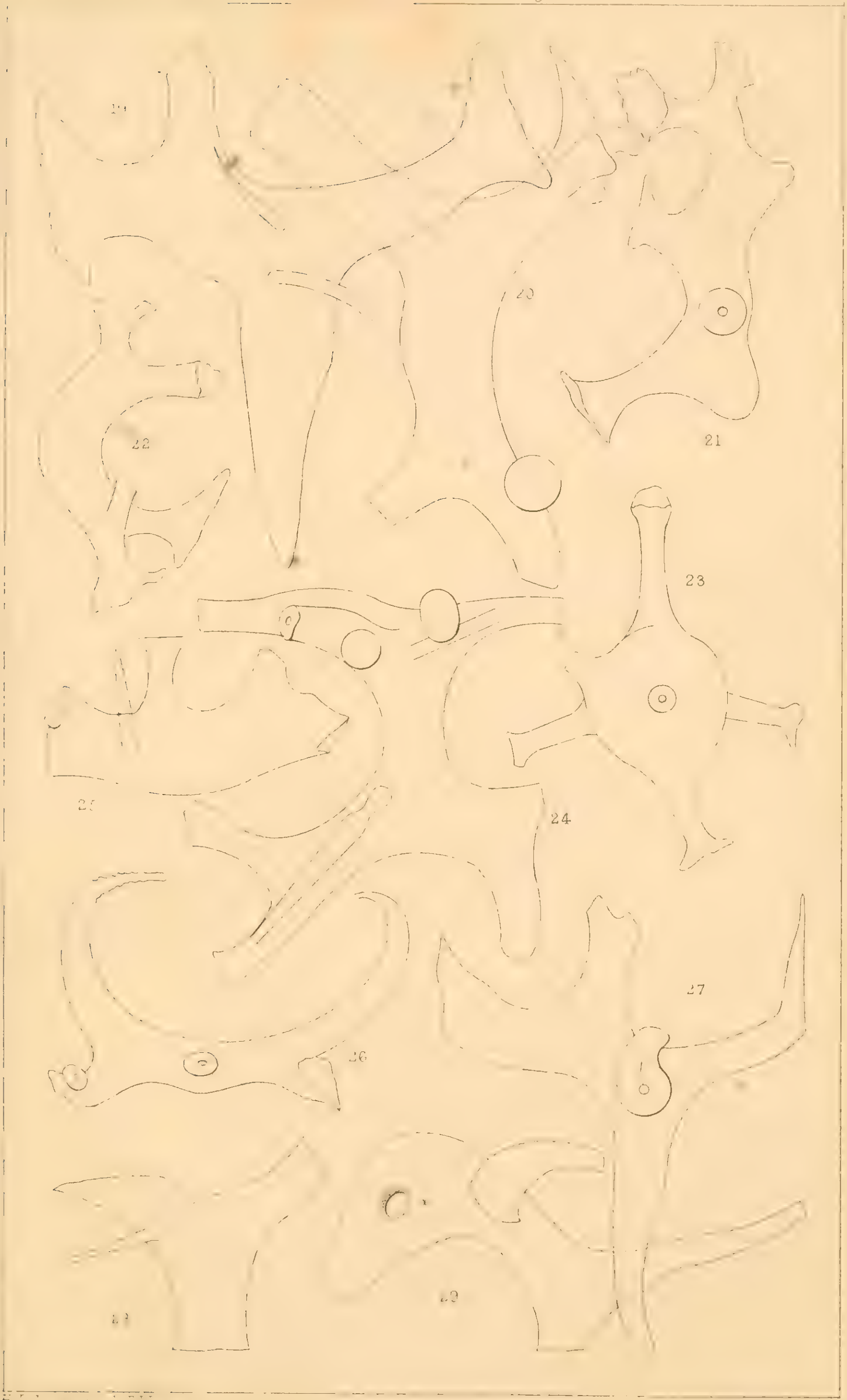

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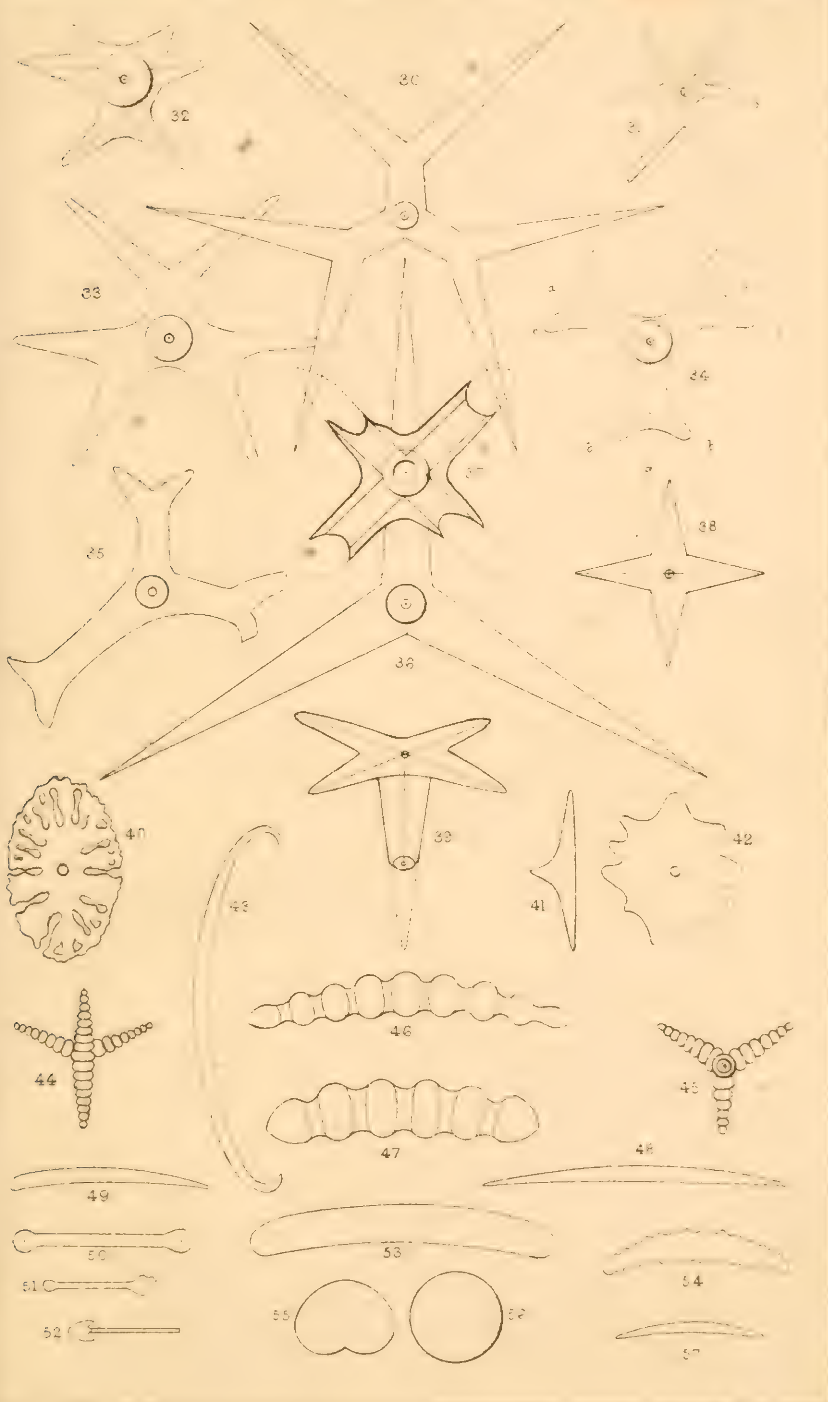

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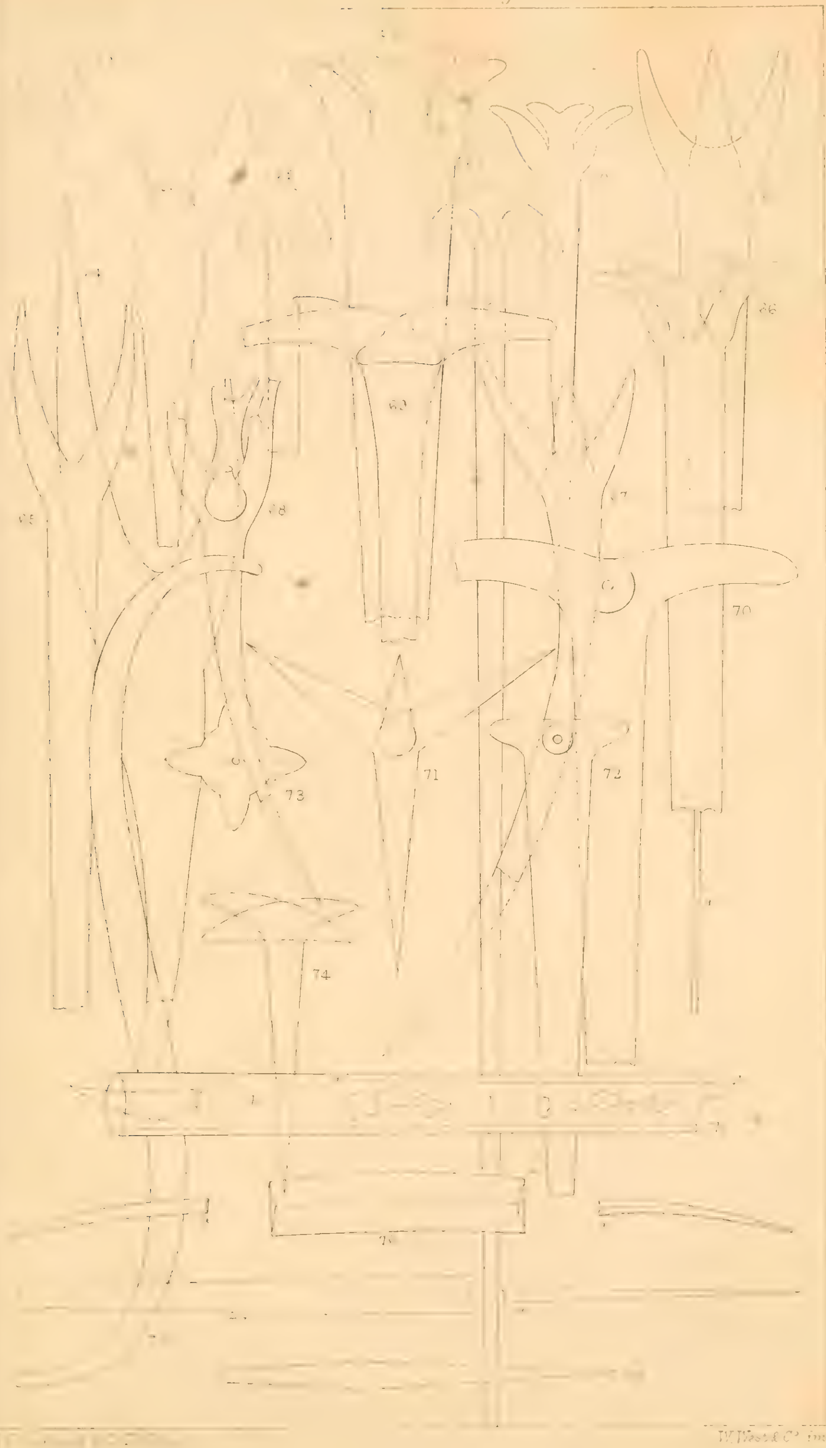

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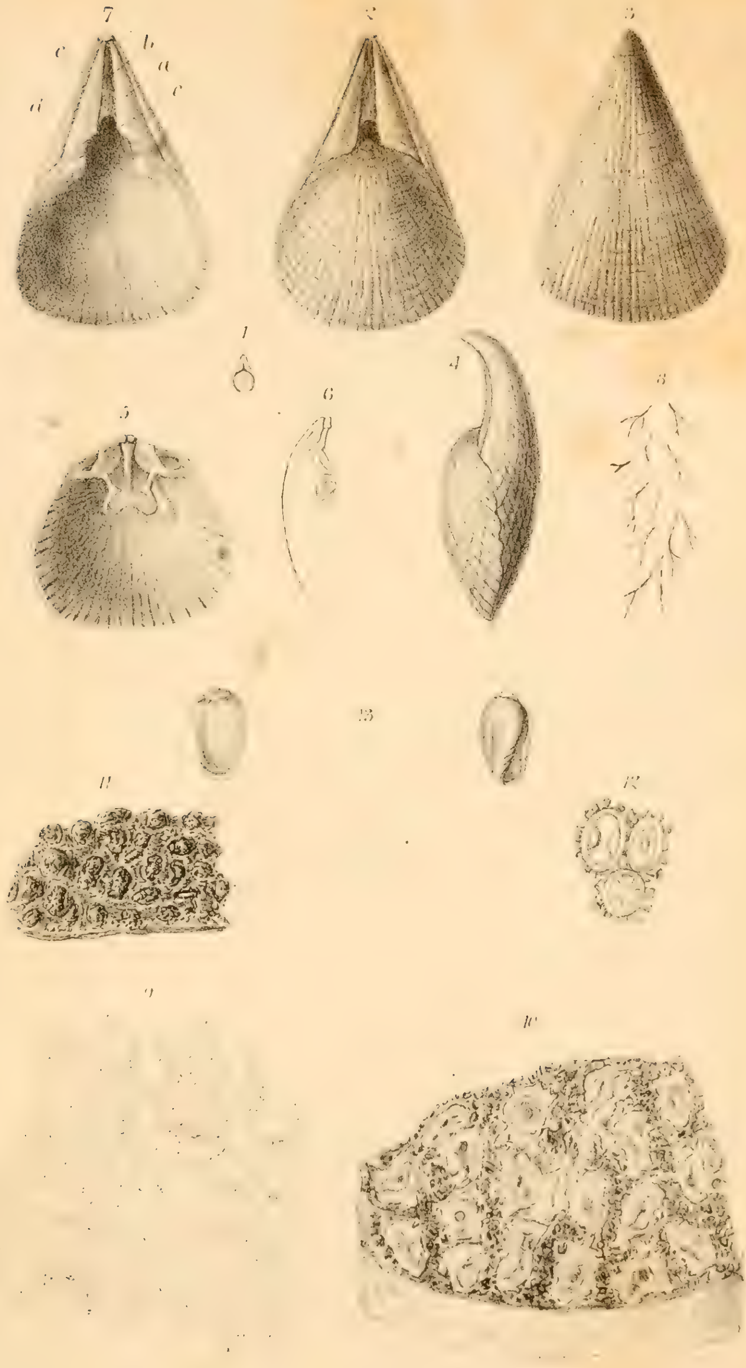

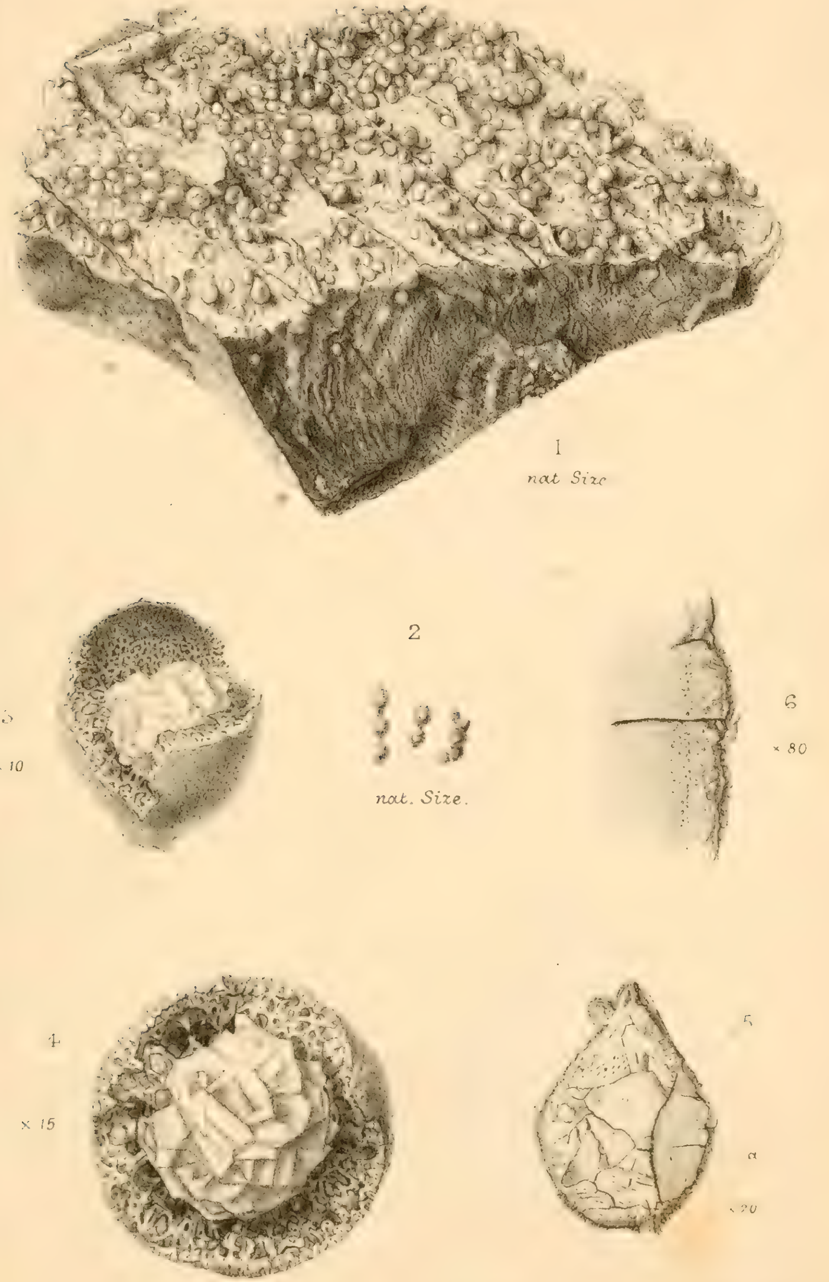

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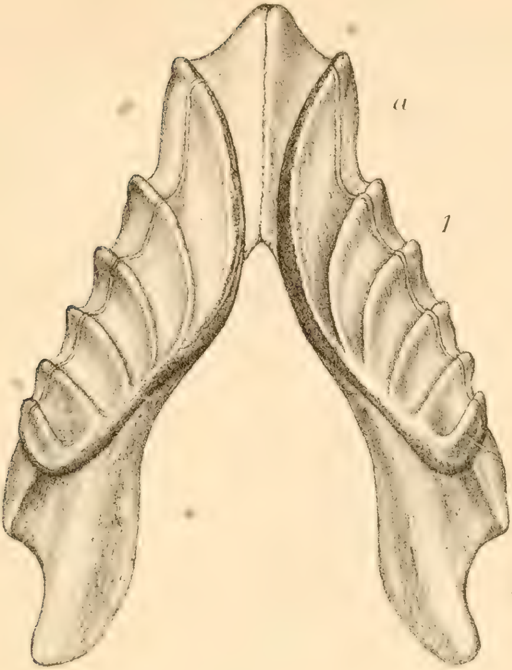

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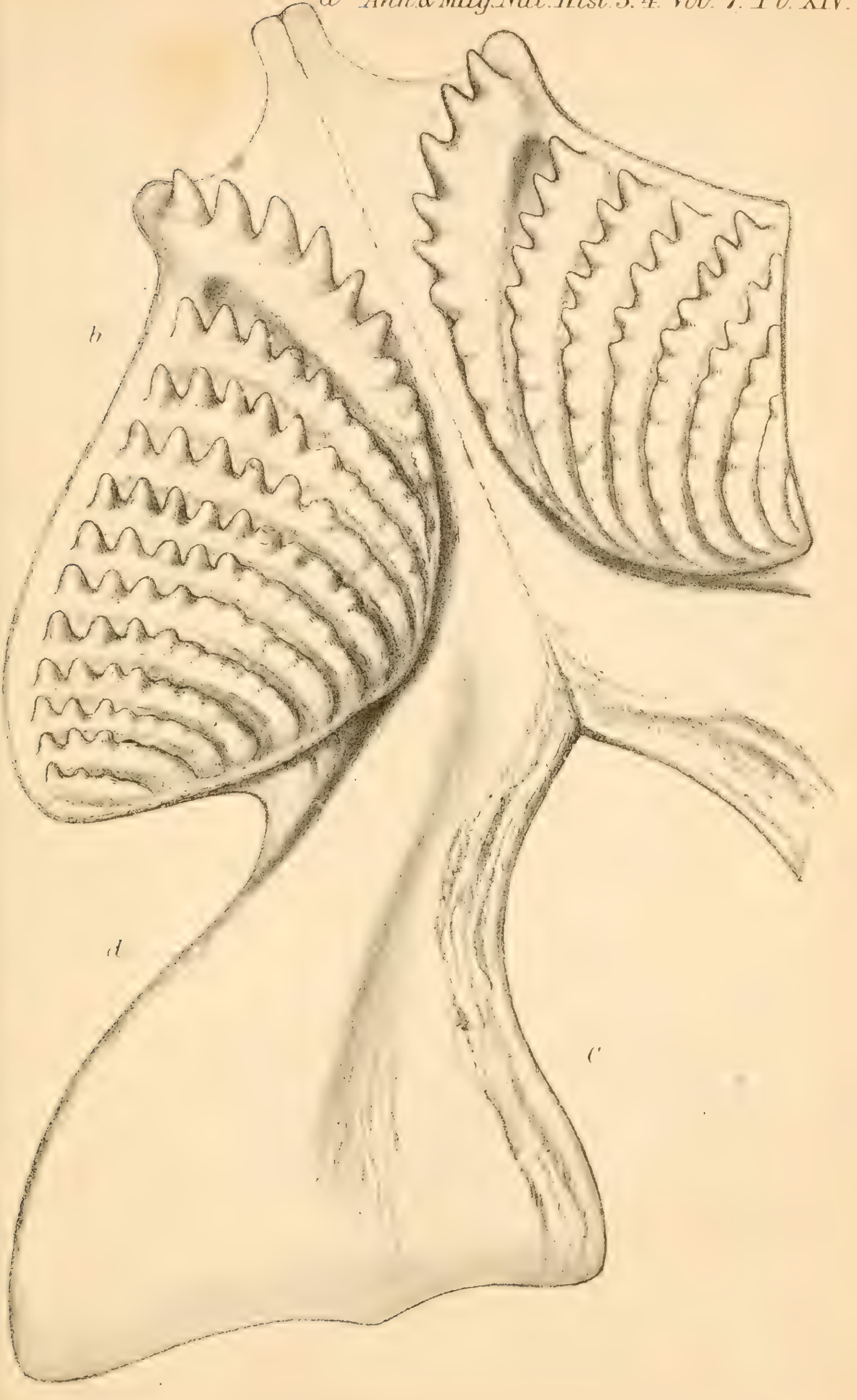

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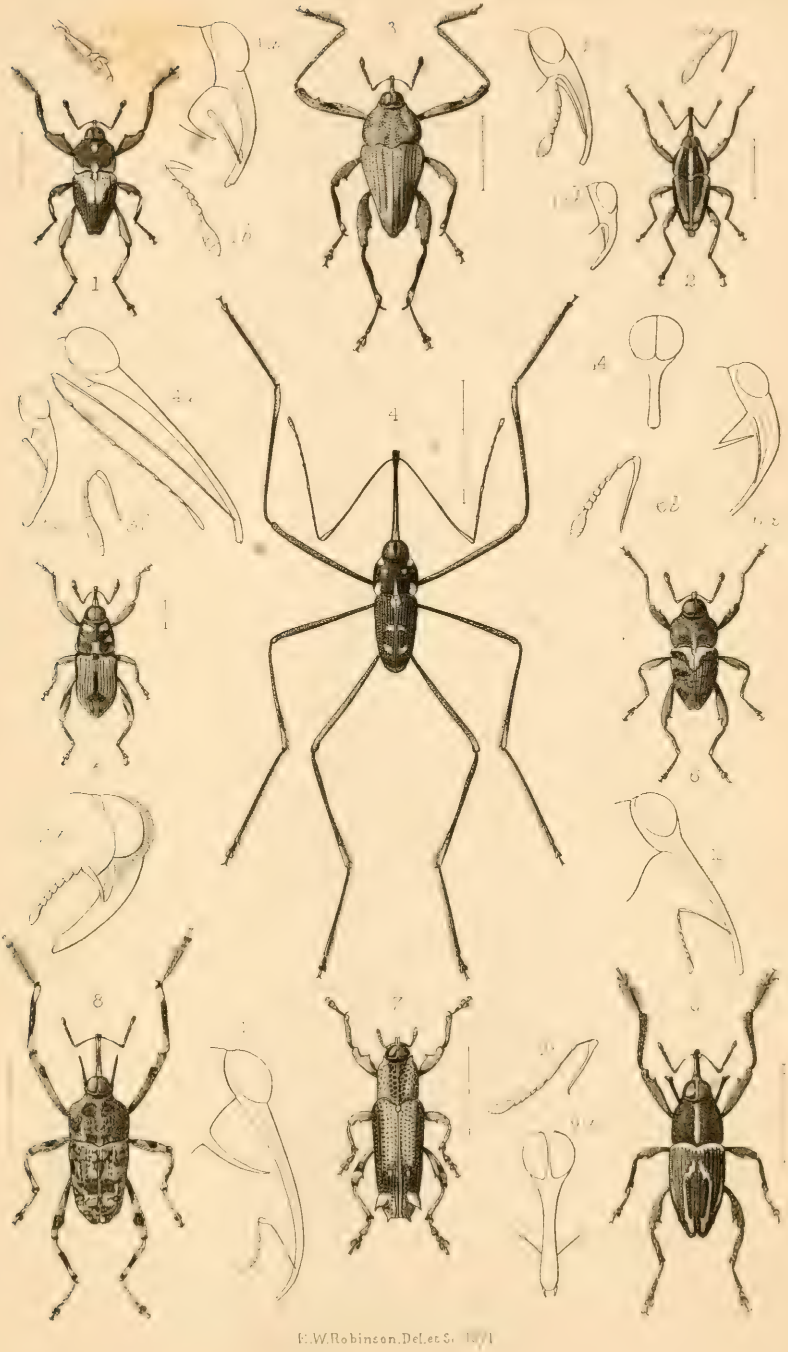

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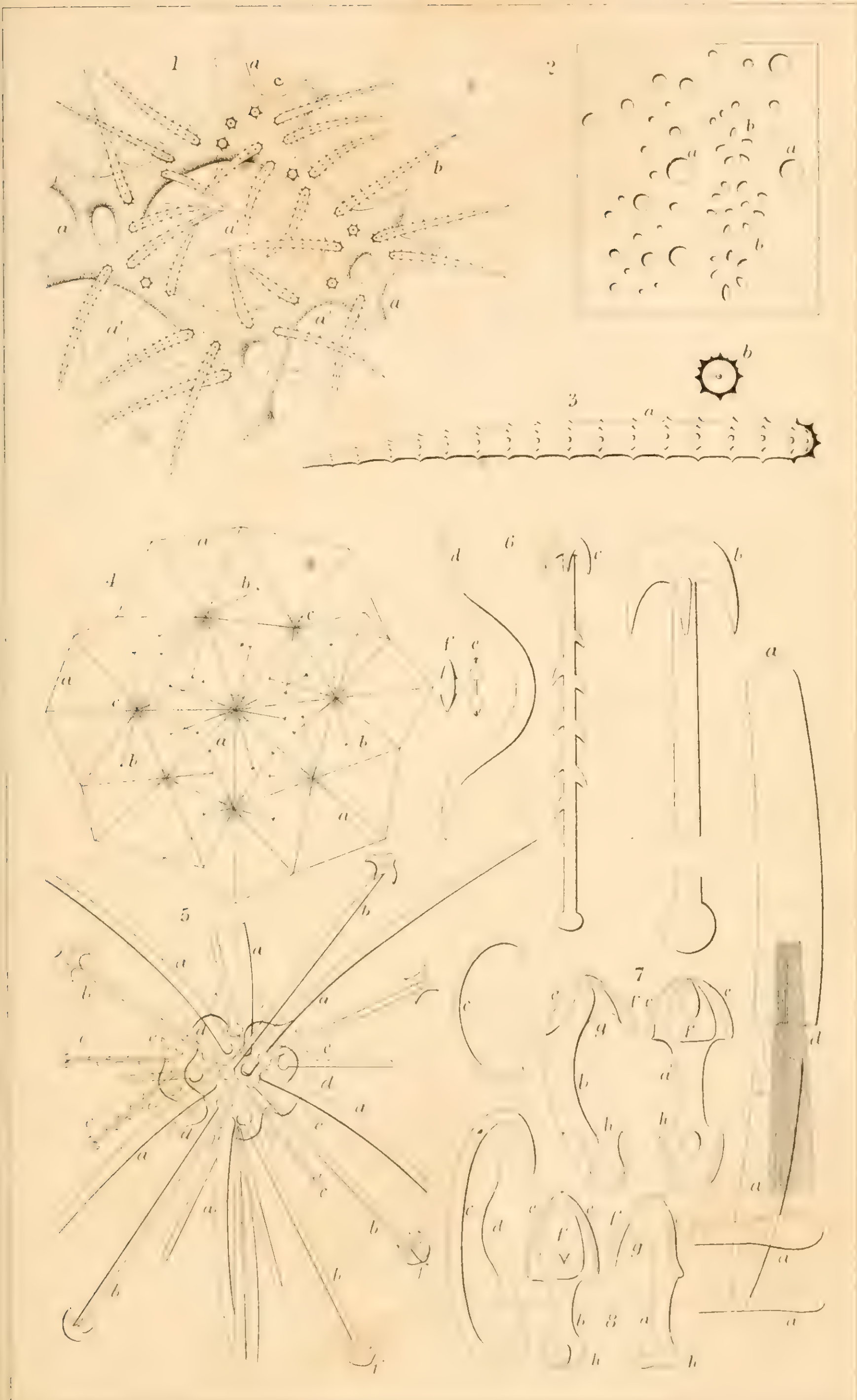

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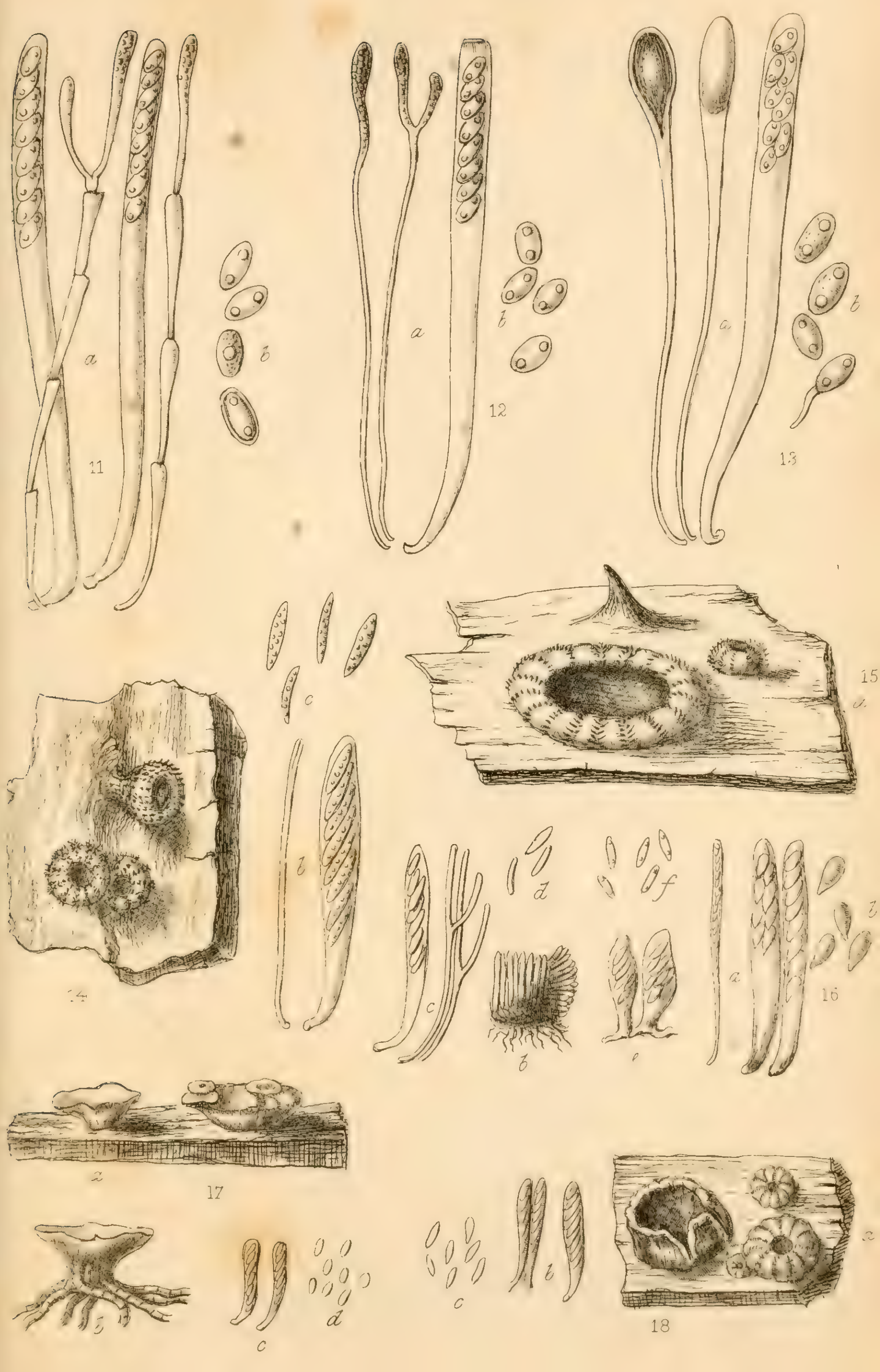
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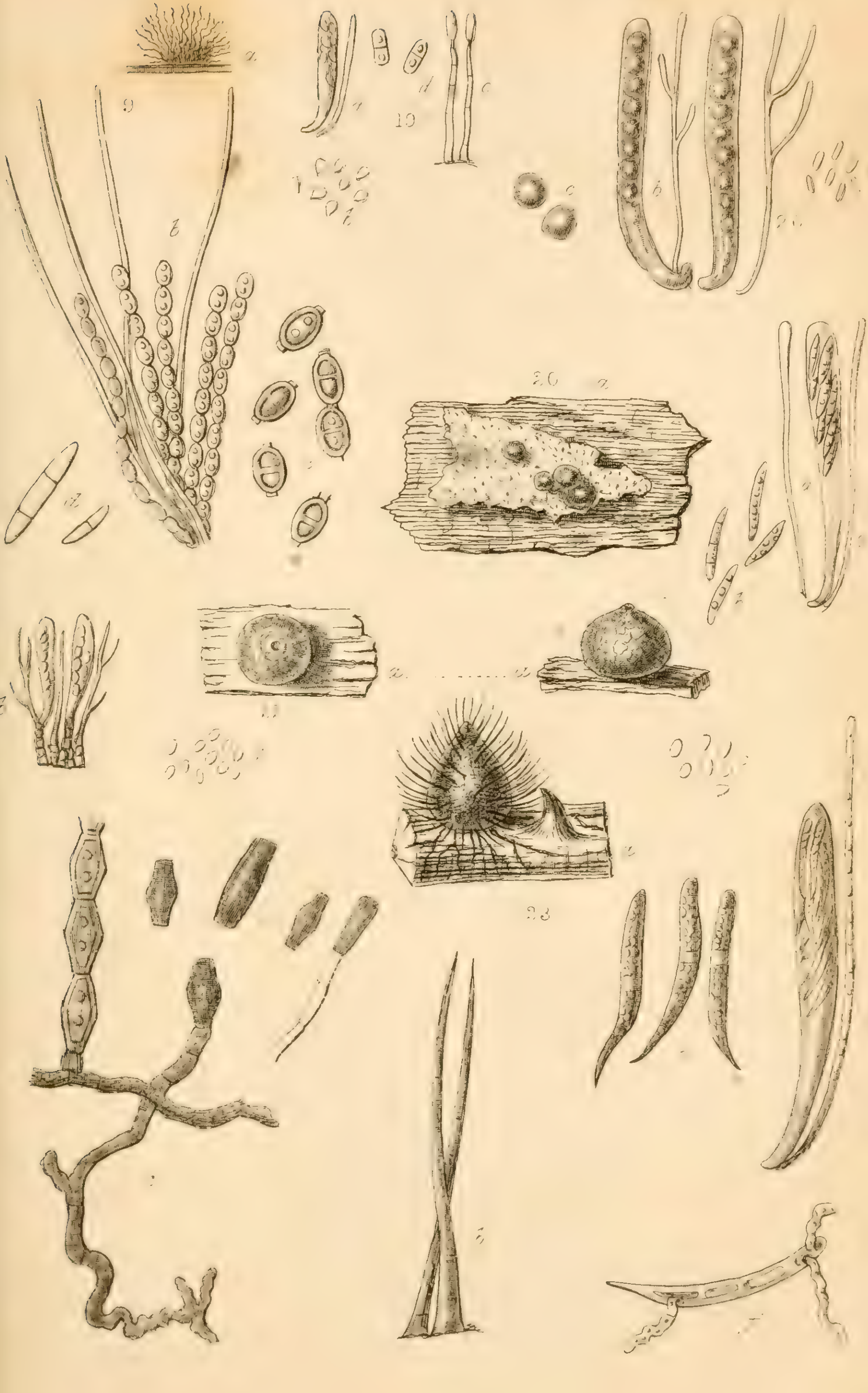

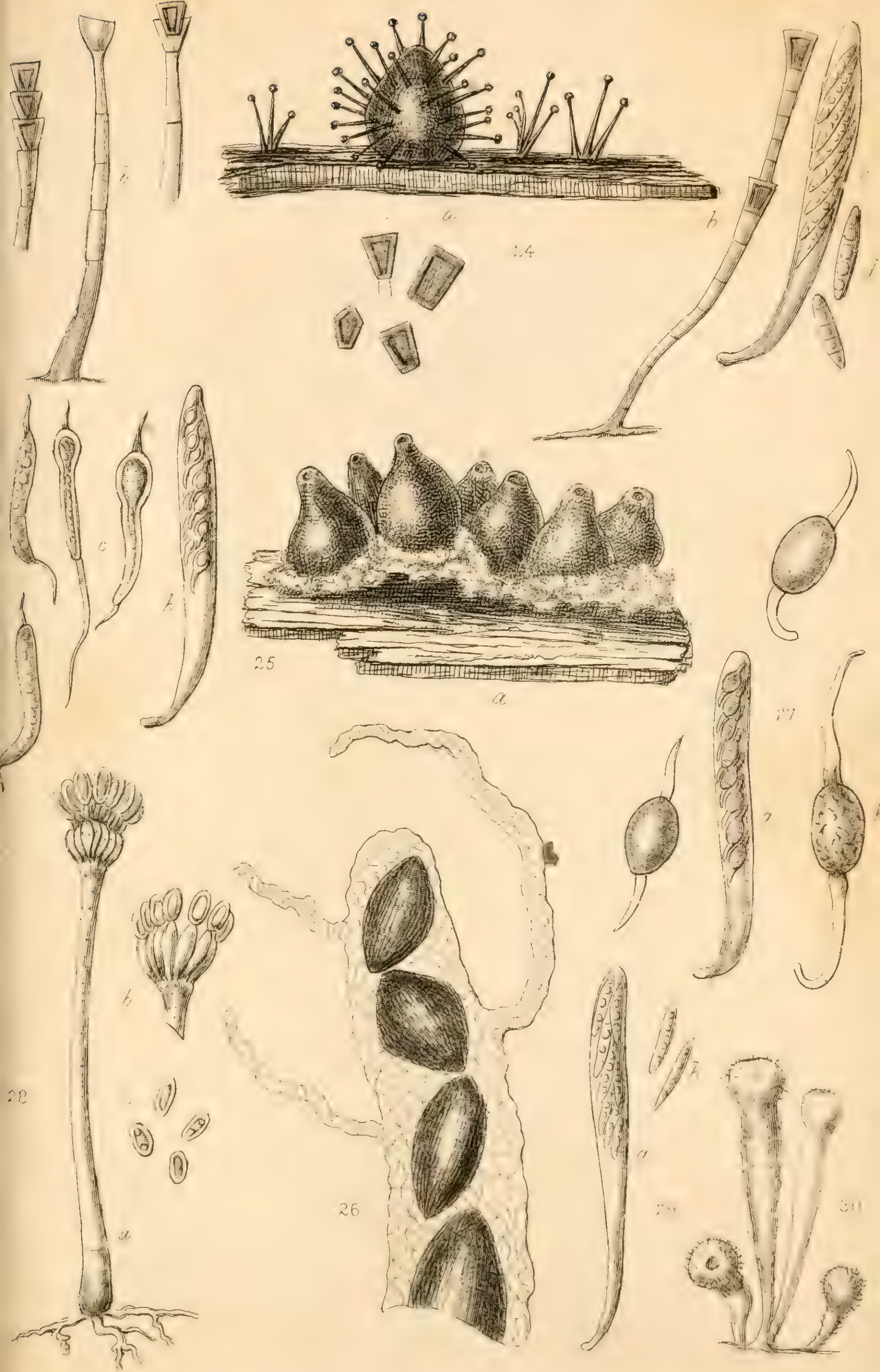
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