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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"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. 61. JANUARY 1873.

I.—*Transformation of an entire Shell into Chitinous Structure by the Polype* Hydractinia, *with short Descriptions of the Polypidoms of five other Species.* By H. J. Carter, F.R.S. &c.

[Plate I.]

All who are acquainted with the Spongiadæ know that there are certain species which enter the substance of shells and there grow to such an extent that finally the whole shell which they inhabit may become absorbed or destroyed, and the sponge itself, thus left alone, become unattached; after which it may still go on increasing in size until, drifted about by the currents in the sea, it may at last in some storm be thrown ashore upon the beach. *Cliona celata*, which attacks the oyster-shell, is one of these, and after having absorbed the whole valve grows into a shapeless mass, which is brought up by the trawl- or dredge-net, or cast ashore, as before stated, in which condition it has been called "*Raphyrus Griffithsii*" by Dr. Bowerbank. *Halichondria suberea*, Johnst., is a species which attacks univalve shells—but often retains more or less of the outward form of the shell, and almost always that of the internal cavity; for a hermit crab (*Pagurus*) generally inhabits the latter, and so prevents the sponge from encroaching in this direction. Hence, if the outward form of the shell is lost, the internal one is, for the most part, so perfectly preserved that there is no difficulty whatever in concluding that it was once a Gasteropodous shell, although not a particle of the calcareous matter may remain, and the whole be transformed into sponge-structure.

The same thing, *mutatis mutandis*, may take place with the flexible polype called *Hydractinia*, which for the most part also forms a parasitic crust on univalve shells.

Thus in the British Museum there is a specimen of *Hydractinia echinata* covering a whelk-shell (*Buccinum undatum*) both inside and out; and the same was tenanted by a *Pagurus*, now dead *in situ*; while the horny skeleton or incrustation of the polype, having shrunk by contraction on drying, has become cracked about the lip, and the pieces so curled up that their edges have become exposed, and thus show that, although the outer part presents its natural dark amber-colour, the inner one becomes gradually whiter, until it appears to differ very little from the shell itself.

Carrying on our examination with a simple lens, we observe that the pieces have brought away with them a portion of the shell-substance on which the crust grew; and when both their lower side and the corresponding surface of the shell are respectively examined, it will be found that the former presents a surface of whitish crystalline matter punctated by amber-coloured points, which are connected above with the horny structure of the *Hydractinia*, while the surface of the shell opposite presents nothing of the kind, and is therefore uniformly white,—thus showing that the horny or chitinous incrustation has brought away with it just so much of the shell-substance as the horny portion of the polype had penetrated.

Hydractinia echinata is so common on our coast that it does not seem necessary for me to describe here more than the part immediately connected with our subject, viz. the polypidom, which includes the transformation of the substance of the shell into the horny structure of the *Hydractinia*. For the rest I refer the reader to the ample descriptions, illustrations, &c. contained in Mr. Hincks's 'History of the British Hydroid Zoophytes,' vol. i. p. 19 &c., and vol. ii. pl. 4 (1868).

The skeleton or polypidom of *Hydractinia* consists of a clathrate mass of horny solid fibre (I use the word "horny" here synonymously with "chitinous," as the most expressive term, although chemically not so correct as the latter), which spreads horizontally in a thin layer over the shell on which the polype may be growing, rising above into a forest of pyramidal serrated spines, averaging about one sixteenth of an inch high, and descending below by simple advancement of the clathrate fibre into the shell-substance, as before mentioned.

The insterstices of the clathrate network are filled by the granular plasma called "cœnosarc;" and the external parts of the skeleton serve to support the polype-mass; all of which, being extremely delicate, fail, after being once dried, to present under any circumstances a recognizable form.

If we now, with a very sharp and thin knife, cut off vertically a slice of the dried curled-up crust above mentioned (Pl. I. fig. 8) and place it under a microscope, we may see the white crystalline shell-substance (*d d*) gradually decreasing upwards among the interstices of the chitinous network, until it gives place entirely to the dark amber-colour of the latter and its granular plasma (*c*, figs. 8 & 9); while in the opposite direction the white substance increases to the confines of the lowermost layer of the network, until it can hardly be distinguished from the substance of the shell itself (fig. 8, *g*).

Again, if we put a similar slice (fig. 9) into dilute nitric acid, we shall not only observe an effervescence, but when this slice is placed under the microscope we may also observe that the whole of the white crystalline substance has disappeared (fig. 9, *d d*), leaving nothing but the clathrate fibre of the skeleton (fig. 9, *e*), of which the increasing thinness, pale colour, and wide interstices towards the shell evince its young or progressive stage of development.

It thus appears evident that *Hydractinia echinata* transforms the calcareous shell on which it may be growing into its own horn-like skeleton.

We have now to prove this more satisfactorily; and this can be done by another specimen in the British Museum, where the *whole* of the shell has become transformed into the horn-like skeleton of a *Hydractinia.*

The shell thus transformed was somewhat less in size than a *Buccinum*, but of a totally different family, as may be seen by the form of the aperture, which resembles that of some turbinated shell, though of course the species is now undeterminable, at least to one possessing such a limited knowledge of conchology as myself (fig. 1, *a*, *b*). Nor is the *Hydractinia* the same specifically as *H. echinata*; for all the spines are smooth (fig. 3), and not, as in the latter, serrated (fig. 4). Hence there is here a marked difference between the two polypes, although in every other respect the skeleton-mass or polypidom, which is the only part left in the transformed shell, is almost identical with that of *Hydractinia echinata*.

As the transformed shell now exists, it is empty and entirely composed of parallel layers of clathrate chitinous fibre (fig. 2, *a*, *b*). The internal cavity is smooth, and the columella preserved; so that we may fairly infer that the shell had been originally tenanted by a *Pagurus*, which had remained there until the whole of the shell had become transformed into the chitinous skeleton of a *Hydractinia*, when, probably finding it too light for its purpose, the *Pagurus* betook itself to a heavier habitation.

Although the internal surface of the transformed shell remains smooth and perfect (fig. 2, *a*, *b*), the external surface has become changed into the peculiar growth of the *Hydractinia*, which presents a more or less irregularly tubercled appearance, each tubercle of which, being more or less separate from the rest and varying in size and shape, consists of a little monticule of clathrate fibre involving one or more of the smooth erect spines which characterize the species (fig. 1, *a*, *d*); whereas in *Hydractinia echinata* there are no such tubercles, the surface being for the most part even and equally spined throughout.

So much, then, for the internal and external surfaces respectively of the transformation; we have now to go to the layers of which it is composed. And these together present a thickness varying with that of the original shell, being in the section (which was made for the purpose, and forms part of the illustrations, fig. 2) 4-12ths of an inch thick at the base, and 2-12ths in the parietes. Moreover these layers show, by the presence of smooth spines upon them here and there (fig. 2, *d d*), that the growth of the *Hydractinia* had been outwards as well as inwards or towards the shell. Nor does it seem quite clear how much of the shell has been absorbed by the layer of the *Hydractinia* which lined its cavity (fig. 2, *e e*), since in the specimen of *Hydractinia echinata* before me the polype-crust, although smoothed by the *Pagurus* internally, covers the cavity as well as the exterior of the shell. At the same time, in the transformation, the presence and direction of the spines on its layers (fig. 2, *c c*) point out, to a certain extent, the limit of the crust vertically, leaving about one third of the thickness of the transformation inside it for what may have been effected by the lower part of the outer crust and that lining the cavity respectively. In this case the original shell could not have been very thick.

A microscopic examination of the structure gives the same results, minus the soft substance and presence of calcareous matter, as that of *Hydractinia echinata*; and thus it is satisfactorily proved that this kind of polype can effect a change in the composition of a shell analogous to that produced by the sponges mentioned.

This is a point of interest to know, inasmuch as it bears on fossilized as well as recent structure, and therefore every clathrate structure of this kind in a fossil shell must not be too hastily set down as sponge-transformation.

The transformed shell bears the museum no. "2461," which appears to me to be preceded by a P; and the former shows that it must have been in the museum for many years, since for upwards of twenty this kind of numbering has been discontinued.

In its maximum measurements it is about two inches long from apex to base, two inches broad, *i. e.* from left to right side, and one inch thick.

The outer layer is rendered more or less green by the presence of the gonidia and thallus of a lichen, which here and there appears in little groups of gymnocarpous apothecia all over the surface. So it is just possible that, after the comparatively heavy calcareous matter of the shell had been replaced by the lighter chitinous structure, the *Pagurus*, as before stated, left his habitation; and the latter, having floated into an estuary, may have been left on its banks, where its surface became in time grown over by this lichen, and where, probably, it was found, unless all this took place on the sea-shore, or the *Pagurus* carried the transformed shell inland, as they appear to do in the island of Cuba (Sir C. Lyell, Princip. Geol. vol. ii. 1872).

The largest apothecia are about 1-48th of an inch in diameter, and more or less circular, the thalamium dark brown, and exciple white; the spores ellipsoid, generally eight in the theca, but varying in number, and for the most part confusedly arranged.

My attention was first called to the specimen of *Hydractinia echinata* above mentioned from its likeness to the figures of the sponge named "*Terpios echinata*" by De Fonbressin et Michelotti ('Spongiaires de la Mer Caraïbe,' p. 102, pl. xxiv. figs. 4 & 5, Haarlem, 1864). And then, when I observed coupled with it in the museum another shell like it, but *entirely* transformed into horny structure, I began to think that the skeleton of *Hydractinia echinata* must be a sponge, not being aware at the time that any organism but a sponge could effect such a transformation, and observing microscopically that the horny substance was formed of concentric layers. However, placing the specimens before my friend Mr. Parfitt for his opinion as to the habitat and species of the lichen, this intelligent naturalist immediately recognized *Hydractinia echinata*, and handed out from his cabinet a specimen dredged up off the Otter-mouth, close to the place where I am living. The nature of the organism on the whelk-shell thus having become known to me, that of the organism which had transformed the other shell still remained enigmatical, but was subsequently worked out in the way above mentioned.

It would appear from a section of the crust that the polypidom of *Hydractinia echinata* is formed of horizontal layers (figs. 8 & 9), each of which is marked by a row of knots (*e*, figs. 8 & 9), which indicate the points of union of the clathrate chitinous fibre, corresponding to the knots in network; and, judging from a microscopic examination of the part advancing into the shell, it would also seem that these knots first appear in the form of separate cells (fig. 7, *d d*), which, generating concentric layers of chitine around them, may be termed "horn-cells." The horn-cell then sends off two sets of branches, one of which (fig. 7, *e e*) becomes the clathrate chitinous fibre, which is solid and formed of concentric layers, and the other set (fig. 7, *f f*) spread out into a chitinous membrane (fig. 7, *g*) on the same plane as the horn-cells, which membrane thus acts as a framework to the whole. These horn-cells appear as dark points in the last layer of shell-substance that is about to be absorbed, and which remains adherent to the contracted and curled-up fragments of the dried and thus broken-up polypidom, as above mentioned (fig. 5, *a*; fig. 8, *g*). The chitinous membrane therefore lies above this (fig. 6, *b*; fig. 8, *f*). But if a fragment of these two layers, viz. the chitinous and calcareous ones (which are of course *very* thin, but can be occasionally picked off together), be mounted in Canada balsam, it will be observed that the calcareous layer, which is the undermost, presents a worm-eaten appearance (fig. 7, *i*), as if it had been subjected to the dissolving influence of a surface formed of pseudopodial villi, about 1-6000th inch in diameter.

In the layer lining the cavity of the wholly transformed shell (fig. 2, *e e*), treated in a similar manner, we have the same characters, minus, of course, the calcareous layer, as in fig. 9, *g*,—that is to say, the chitinous membrane alone, in which are set the horn-cells and their clathrate structure, as in *a*, figs. 6 & 7.

How the absorption of the shell-substance is effected in *Hydractinia* is unknown to me; but (referring to like phenomena) when we observe that the protoplasm of the plant-cell can, as required, work its way through the thick cellulose cell (as in *Spirogyra* under conjugation), that the tender Amœba-like entophyte *Pythium* (also an inhabitant of the cell of *Spirogyra*) will do the same thing, &c., that the excavating sponges, whose sarcode is equally soft and delicate, will do the same in the oyster-shell as well as in limestone rock, it does not appear strange that the cœnosarc of *Hydractinia* should be able to perforate a whelk-shell under similar circumstances.

Also, when it is observed that, in the excavations made by *Cliona celata* in the concretionary limestone formed and found about the rocks of the New Red Sandstone on the shore here, the siliceous grains which are mixed up with it still project above the otherwise smooth surface of the excavation, it does seem (as my friend Mr. Parfitt has sagaciously observed) that these excavations are produced by an "acid or erosive agent" of a chemical rather than of a physical nature, which, not being able to dissolve the silex, thus leaves the grains of sand projecting into the excavation (Parfitt on the boring of Mollusks, &c., Trans. Devon. Assoc. for Advancement of Science, 1871).

May we not assume, then, that this process is one of animal chemistry like that of digestion (wherein the gastric juice will dissolve calcareous matter, but fails to affect a piece of glass)?—the action in *Hydractinia* being produced not by cells but by the intercellular sarcode, which, like that of the sponge, can prolong itself into villous pseudopodial processes (fig. 7, *c*, *i*), which possibly may be the pioneers of all vital changes of this kind, in exercising on their confines that catalytic power of which life alone is capable.

Indeed Professor Allman has long since demonstrated the existence of sarcode among the Hydroid polypes, which, to use his own words, "comports itself exactly like the pseudopodia of an *Amœba*, which it also resembles in structure" ('Annals,' 1864, vol. xiii. p. 204); so that the worm-eaten appearance presented by the lowermost layer of the crust of *Hydractinia echinata* (that is, in the calcareous surface of the shell just about to become transformed) may be produced, as before stated, by a villous layer of minute pseudopodial prolongations from the cœnosarc.

Lastly, as regards the power of animal chemistry in these operations, which is chemistry directed by an unknown agent, as the production of alcohol by the yeast-plant, &c., it signifies that there is an instinctive power acting here, which is far beyond any possessed by the highest cerebrated being, if I may use the expression.

When I observe the delicate mycelium of a minute fungus growing or creeping (for the terms are synonymous here) through the hard crystalline layers of the shell of a *Buccinum*—when I observe on the surface of a lancet which has been carefully protected by a layer of animal fat a similar kind of mycelium, which has wriggled its way not only over but *in* the surface of the polished blade by oxidation of the iron in its course, so as to leave a rusty image of itself—and when I observe a plant-like form of glauconite in the substance of an agate which has been formed in a geode of an igneous rock, so much like a Conferva that it might easily pass for one if not otherwise understood, to say nothing of the dendritic markings of rocks, &c.,—these facts, taken in connexion, seem to signify not only that the law of form is the same both in the vegetable and mineral kingdoms at least (for the glauconite form in this respect is almost typically that of a Conferva), but that *vital* influence also is the *primum mobile* in all—that indomitable power which rules the world independently of man!

Having ascertained that the transformed shell, which had been thrown in among the sponges, had been produced by a polype and not by a sponge, I turned my attention to certain branched organisms, or rather their skeletons, which had also been placed among the sponges, and had therefore come before me for examination, when, noticing that they also possessed a clathrate chitinous structure closely allied to that of the polypidom of *Hydractinia* (fig. 9), while the characteristic feature of most sponges, viz. the branched system of canals terminating externally in large outlets or oscula, was absent from them, I submitted to microscopical examination a portion of the stem of a beautiful form from New Zealand, which had been presented to the museum by Sir G. Grey; and I found not only that it was identical with the structure of the polypidom of *Hydractinia*, but that attached to its fibre internally, where the water had failed to destroy the whole of the soft parts with which the clathrate structure had originally been filled and covered, a few thread-cells still remained. I then sought for the hydrothecæ, and found them also.

Next I took portions from two other species, which came from the Cape of Good Hope—and obtained similar results, so satisfactorily that in many of the thread-cells their contents had become half extruded.

Finally I examined the two species from Australia which Dr. J. E. Gray, under the family name of "Ceratelladæ," had described and figured provisionally as sponges in the 'Proceedings of the Zoological Society' for November 26th, 1868 (p. 575), designated respectively *Ceratella fusca* and *Dehitella atrorubens*; and here, again, I met with similar results.

Hence it becomes necessary for me briefly to describe all these polypidoms, beginning with that of the transformed shell, in order that henceforth they may be relegated to their proper place. Were they possessed of their soft parts, and perfect as the *Hydractinia* of our own shores when carefully dredged up from its natural abode can only be, I should have proposed their being handed over to some one more conversant than myself with this department of zoology: but who can say when perfect specimens of the polypidoms of these species, with all their soft parts recognizable, may be similarly taken, when those we have come from foreign shores, where they have apparently been washed about in the surf for years before they were picked up for preservation? Meanwhile, as the description of a polypidom alone is comparatively easy, as it may be a long while before the soft parts can be obtained, and as it is desirable at once to separate these skeletons from the sponge-structures which I am examining, it is hoped that the following diagnoses may not be unacceptable.

Hydractinia levispina, n. sp. (Pl. I. fig. 1, *a*, *b*.)

Zoophyte incrusting and eroding univalve shells. Polypidom formed of clathrate, subrectangularly meshed chitinous fibre (as in fig. 9), solid, concentrically laminated, surmounted by smooth, erect, conical spines (figs. 3 & 1, *b*, *e*), grouped together in the midst of proliferous tubercles (fig. 1, *d*, *e*), scattered more or less over the surface. Increasing by layers, so as finally to absorb the whole of the shell on which it grows (fig. 2, *a*, *b*). Height of transformed shell 2 inches from apex to base; extreme breadth, viz. from left side to margin of outer lip, $1\frac{1}{2}$ inch. Spine variable, about 1-30th inch high by 1-60th inch diameter at the base.

Hab. Unknown.

Loc. Unknown.

Obs. This specimen, which is in the British Museum, bears the number "2461," which mode of marking, as before stated, shows that it has been there for a very long time; the number also appears to be preceded by a "P." There is no further history attached to it than that which its own structure reveals. It evidently grew on a shell a little less in size than a *Buccinum*, but of a totally different species, as the margin of the aperture is continuous like that of the Turbinidæ. While there it gradually transformed the whole of the shell into its own chitinous polypidom; meanwhile a *Pagurus* or hermit crab inhabited the interior and so preserved the form of this part. Subsequently it probably got into some tidal estuary, where, having been left high and dry on its banks, a gymnospermous lichen took up its habitation on its surface, and, spreading its thallus throughout the external layer of the imperishable chitine, at last threw up the groups of shield-like conceptacles (apothecia) now scattered over the greater part of the shell-like polypidom. Of course this might also have taken place on the sea-shore, or the *Pagurus* itself might have carried it inland.

Hydractinia levispina differs from *H. echinata* in the tubercled state of its surface, but especially in the smoothness of its spines (fig. 3); the latter possesses a more or less even surface with serrated spines (fig. 4).

Ceratella fusca,

Gray, Proc. Zool. Soc. Nov. 26, 1868, p. 579, fig. 2.

"Coral expanded, fan-shaped, forming an oblong frond; branches divergent from the base, with numerous lateral, subalternate, subdichotomous branches; similar but smaller lateral branches.

"*Hab.* Australia, New South Wales, at the head of Bondy Bay."

Dehitella atrorubens,

Gray, Proc. Zool. Soc. Nov. 26, 1868, p. 579, fig. 1.

"Sponge or coral dichotomously branched, expanded, growing in a large tuft from a broad, tortuous, creeping base, of a dark brown colour, and uniform hard rigid substance. Stem hard, cylindrical, opake, smooth; branches and branchlets tapering to a point, cylindrical, covered with tufts of projecting horny spines on every side; those on the branches often placed in sharp-edged, narrow, transverse ridges; those of the upper branches and branchlets close but isolated, and divergent from the surface at nearly right angles.

"This genus is distinguishable from *Ceratella* by the greater thickness and cylindrical form of the stem, by the more tufted and irregular manner of growth, and by the tufts of spicules (oscules or cells) being more abundant and equally dispersed on all sides of the branches and branchlets."

The above descriptions are copied from Dr. J. E. Gray's excellent account of these two organisms, published in the 'Proc. Zool. Soc.' for November 26, 1868 (p. 575), to which the reader is referred for more extended descriptions of them, and for equally excellent illustrations, which, being almost typical forms of the following species from the Cape of Good Hope, will, until the latter are also illustrated, very well serve for their identification.

It will be observed that Dr. Gray was by no means satisfied that they belonged to the Spongiadæ, and therefore only provisionally placed them among the sponges. Had he been aware of what I have above stated, his views probably would have been different, and the real nature of these organisms would have been then told by him at once; and but for his encouragement now, it would most probably have never been elucidated by myself.

Ceratella procumbens, n. sp.

Zoophyte procumbent, compressed, thickly branched on the same plane; the larger stems chiefly on one (the lower) side.

hard, flexible, of an ochre-brown colour, tinged here and there with purple. Trunk short, solid, compact, compressed vertically, soon dividing irregularly or subdichotomously into round branches, which are confined to the lower surface, ending in branchlets with subclavate ends, that appear on the upper or opposite side, not reuniting or anastomosing. Hydrotheca consisting of a little semitubular plate, extending outwards and forwards from the side of the stem on the proximal border of an aperture in the latter; scattered thickly over all the branches, but most prominent on the branchlets; frequently represented by the little hole alone in the stem where the projecting portion has been worn off; scanty on the lower side of the main stems. *Minute structure*: composed of clathrate chitinous fibre throughout, whose meshes are subrectangular; hydrotheca formed of the semitubular scoop-like plate mentioned, supported on its proximal side by an extension of the clathrate structure of the stem, and bordering the little hole also above mentioned, which extends into the centre of the stem; surface of the larger stems bluntly microspined. Size of largest specimen 11 inches long by 5 inches broad, and about 1 inch thick, or vertically.

Hab. Marine; procumbent.

Loc. Cape of Good Hope and Port Natal.

Obs. There are five specimens of this species in the British Museum, viz. one with no. 67. 3. 22. 1, and "Cape of Good Hope" written on it, and the others ticketed no. 72. 8. 1. 1, and "Port Natal." Friction among the sand and waves has worn down some of them so much as to leave nothing but the foramina in the stems; whereby the most worn might be looked upon as a different species, did not the gradation from the more perfect ones point out that this is not the case, and thus that they all belong to one and the same species. Some parts still retain a purple colour both externally and internally, showing that, as with the other species in some parts also, this has for the most part been washed out, and that the brown colour has been derived from the chitinous fibre alone. In most of the specimens thread-cells are numerous in the clathrate tissue, especially towards the centre of the stems, where they can not only be distinguished by their subconical form from other globular and nucleated cells present (which appear like ova), but, by the addition of liquor potassæ, may be made to extrude the thick portion of the thread. Their procumbent habit has been inferred from the main stem and its branches being flattened on one side, while the branches and hydrothecæ are chiefly on the other—much in the form of a wall fruit-tree, viz. with a flat back.

Ceratella spinosa, n. sp.

Zoophyte procumbent, thickly branched, hard, flexible, of a dark rich red-purple colour. Main branches round, brownish, covered with small, smooth, often subspatulate, erect spines. Stem dividing subdichotomously into purple branchlets, which terminate in abruptly pointed extremities. Hydrothecæ the same as in the foregoing species; most prominent over the round branchlets, to which they give, *en profil*, a serrated, somewhat Sertularian, appearance, the teeth of which are inclined forwards. *Minute structure*: main stems composed of clathrate chitinous fibre, of which the meshes are more or less oblong, passing into prominent longitudinal lines on the branchlets, where they terminate on the backs of the semi-tubular plates which respectively form the floors of the hydrothecæ, to which they thus give support. Size of specimen, which is merely a branch, $4\frac{1}{2}$ inches long by 2 broad.

Hab. Marine; procumbent.

Loc. Port Natal.

Obs. The spines on the surface distinguish this from the foregoing species, add to which its longer and more pointed branches, longitudinally ridged clathrate fibre, and rich red-purple colour. It bears the no. "72. 8. 1. 17, from Port Natal."

In Dr. Gray's two Australian species there are no actual spines independently of the projecting portion of clathrate structure on the proximal sides of the hydrothecæ, and the "spinulose" little knobs on the surface of *Ceratella fusca*.

The hydrotheca in *Dehitella atrorubens* is formed of a simple scoop-like projection of the subrectangular clathrate structure of the stem, stopped at the bottom by a septum of the same; there is no decided hole there larger than the diameter of the common mesh, for the cœnosarc of the interior to communicate with the sarcode of the polype, as in the Cape species; while in *Ceratella fusca*, which is almost as delicate in its branches as a *Sertularia*, and not unlike it in the alternate, but here spiral not opposite, position of its hydrothecæ, the latter are formed by a projection of the clathrate tissue in the shape of a clam-shell, whose ribs, extended beyond the margin, end respectively in an inflated tubercle of the same kind as that which characterizes the surface of the stem, rising up like little knobs on the knots of the clathrate network, to which Dr. Gray (*l. c.*) has appropriately applied the term "spinulose;" the bottom of the hydrotheca is filled up with a clathrate septum, in which there is no decided hole present as in the foregoing species; and in this way both of these from Australia differ from those of the Cape of Good Hope.

Chitina ericopsis, n. gen. et sp.

Zoophyte erect, bushy, fragili-flexible, fawn-coloured. Trunk long, hard, irregularly round, composed of many stems united clathrately and obliquely into a cord-like bundle, which divides and subdivides irregularly into branches, that again unite with each in substance (anastomose) when in contact, and finally form a straggling bushy head. Hydrotheca long, clathrate, tubular, terminating the ends of the branchlets or prolonged from some of the proliferous tubercles which beset the surface of the trunk and larger stems. *Minute structure*: composed of clathrate chitinous fibre throughout, whose meshwork is subrectangular and massive in the stems, where there is no difference between the centre and circumference, with the exception that the fibre is stouter in the former or oldest part; hydrotheca composed of several longitudinal fibres or ridges latticе-worked together transversely into a tubular form, somewhat contracted at the extremity, in the centre of which is an aperture of the meshwork a little larger than the rest. Height of specimens about 14 inches, trunk about 1 inch in diameter; hydrotheca averaging 1-3rd of an inch long by 1-60th of an inch in its broadest part, and the aperture 1-90th of an inch in diameter.

Hab. Marine; erect.

Loc. New Zealand.

Obs. There are several specimens of this beautiful polypidom in the British Museum; one of which (bearing the no. 57. 1. 2. 36) was presented by Dr. Sinclair, and the rest by Sir G. Grey; all from New Zealand. From their worn state they appear to have been long subjected to the friction of the waves and beach before they were picked up for preservation. Hardly any of the hydrothecæ on them are perfect; and it is only by looking carefully over the specimens that one can be found answering the description above given; and then it requires to be viewed with an inch compound power "end on" (as it is termed) to see the aperture at the extremity; the least inclination to one side will bring the surrounding network into focus, and thus defeat the object of the observer. In some the dried remains of the polype are still present, which mark the position of the tubular cavity. Conical ovoid thread-cells may be seen in the clathrate structure of the polypidom, which hang about the fibre in a dried fleshy substance that appears also to be the remains of the cœnosarc; and on some of the larger stems there are little superficial holes, which appear to be the remains of canals through which the cœnosarc was continued into the cavities of the hydrothecæ respectively, now worn off. The specimen differs so markedly from all the rest in its erect habit, and in the form and position of its hydrothecæ, that it must be considered the type of a new genus, to which I have given the name of *Chitina* and designated the species *ericopsis*, from its being so much like the stems of the common heather here used for making brooms.

These species may be provisionally tabulated thus:—

Family **Hydractiniidæ.**

Incrusting species:—
Hydractinia echinata.
H. levispina.

Branched procumbent species:—
Ceratella fusca, Gray.
Dehitella atrorubens, Gray.
Ceratella procumbens, n. sp.
C. spinosa, n. sp.

Branched erect species:—
Chitina ericopsis, n. g. et sp.

In this way I hope to get rid of them from among the Spongiadæ, and to bring them to the notice of those who have specially devoted their attention to the Hydroid Zoophytes.

EXPLANATION OF PLATE I.

Fig. 1. Upper and lower surfaces respectively of a turbinated (?) shell *wholly* transformed into clathrate chitinous fibre structure by *Hydractinia levispina* (n. sp.): *a*, upperside; *b*, lower side; *c*, smooth area on the latter, produced by friction during the time the shell was tenanted by a *Pagurus*; *d*, tubercular excrescences of the chitinous structure involving one or more spines, which the dark points (*e*) are intended to represent; *ff*, line of section. Natural size.

Fig. 2. Section of the same through the line *ff*, fig. 1, showing that the columella and every particle of the original shell-substance has been replaced by the chitinous structure: *a*, right side; *b*, left side; *c c*, layer surmounted by spines (*d d*) projecting *outwards*; *e e*, surface-layer of the cavity. Natural size.

Fig. 3. *Hydractinia levispina*, n. sp., spine of, with portion of subjacent clathrate structure at its base, showing that it is merely a conical form of the latter; magnified. Real length of spine about 1-30th inch, diameter of base of spine 1-60th inch. To contrast with the serrated form of the following figure.

Fig. 4. *Hydractinia echinata*, spine of, about the same size as the foregoing. To contrast with fig. 3.

Fig. 5. The same, incrusting *Buccinum undatum*, which contains the remains of a *Pagurus*. Magnified portion of lower surface of a fragment of the crust, raised by contraction and fracture from the inner surface of the outer lip close to the canal, showing that it is composed of calcareous matter, through which points of the superincumbent chitinous structure (*a a*) project. Horizontal view.

Fig. 6. The same, with the calcareous matter removed by acid, showing that the "points" of the superincumbent chitinous structure are the knots of the network, and continuous with or set in a chitinous expansion or chitinous membraniform layer: *a*, chitinous network; *b*, chitinous membrane. Horizontal view.

Fig. 7. The same portion much more magnified, showing:—*a*, chitinous structure and membrane, from which the calcareous matter has been removed by acid, = fig. 6; *b*, where the former is still covered by the calcareous layer, = fig. 5; *c*, where the calcareous layer alone remains; *d d*, points or knots (originally horn-cells) in which the branches (*e e*) arise that form the network; *f f*, branches which are continuous with, and probably form by expansion, the chitinous membrane; *g*, points which project through the calcareous layer; *h* (= fig. 5), peculiar worm-eaten appearance of the calcareous layer, as if produced by a villous surface of pseudopodia in connexion with the cœnosarc (*i*). Horizontal view.

Fig. 8. The same. Thin *vertical* section of same fragment of crust, much magnified, showing that the cœnosarc of the lower interstices of the chitinous structure is charged with white calcareous matter; the latter is here represented by the dark shade: *a*, free surface formed of aborted or ill-developed spines, from being in contact with the *Pagurus*; *b*, surface next the shell; *c*, older chitinous structure without calcareous matter; *e*, incised knots of the chitinous network, showing that the latter is formed in layers; *f*, chitinous membrane or layer, &c., = fig. 6 & fig. 7, *a*; *g*, calcareous layer, = fig. 5 & fig. 7, *b*. Diagram.

Fig. 9. The same. Similar portion, from which the calcareous matter has been removed by acid: *a*, free surface; *b*, surface next the shell; *c*, older chitinous network, now much thickened; *d*, interstices of lower part emptied of their calcareous material by the acid; *e*, chitinous network of the same, much thinner in fibre than that above it, from being younger and therefore presenting wider interstices; *f*, chitinous membrane or layer; *g*, points of chitinous structure projecting through calcareous layer, = fig. 5 & fig. 7, *c*, the latter now removed by the acid. Diagram.

II.—*On a new Species of* Nettapus (*Cotton-Teal*) *from the River Yangtsze, China.* By R. Swinhoe, H.M. Consul at Ningpo.

In the Abbé Armand David's "Catalogue d'Oiseaux de Chine," published in the 'Bulletin' of the 'Nouvelles Archives du Muséum d'Histoire Naturelle de Paris,' t. viii. (1871), is entered, under number 442, *Nettapus coromandelianus*, Scop., as occurring on the Yangtsze. In 1869 I spent some months of the early year on the Yangtsze and did not notice this bird; I therefore made inquiries of my friends at Kiukiang and Chinkiang as to whether they had seen such a bird. Mr. Russell (son of the 'Times' correspondent) said that last spring he had noticed a pair of such birds as I described perch on the yard-arm of a gun-boat lying off the settlement, but that he was not allowed to shoot them. Mr. Kopsch, Commissioner of Customs at

Kiukiang, gave me a more particular account of the species: he said that in spring they are frequently seen perching on the roof-tops of the houses in the place, that they were somewhat tame, and that in summer he noticed a female and two or three young ones paddling about in the patch of water behind their houses; he further stated that they were called by the French priests there the "Canard d'été," and by the Chinese Yew Ya. He was fortunate enough to procure two couples on the 25th of September, and has sent me a male and two females. What surprises me is the appearance of the male bird of this trio, which, otherwise attired in the garb of a male, has the neck and upper breast marked as in the female, and wanting the pectoral collar. Can the species have a winter dress different from that of summer? if so, it would scarcely begin to acquire it in September. I think, however, that the peculiarity is due to its partially assuming after nidification the plumage of the female, a strong *anatine* character, which shows its affinity with the true ducks rather than with the geese. I would dedicate this interesting novelty to Mr. Kopsch, who has taken much pains to procure me specimens.

Nettapus Kopschii, n. sp.

Male. Crown of the head, upper back, and scapulars brown, reflecting purple and green. (In a spring specimen in the collection of Père Heude at Shanghai the eyebrow, nape, throat, cheeks, and lower neck were white, the back of the neck dingy, with a collar on the lower neck, about a quarter of an inch broad, of deep iridescent brown.) Our specimen has the white markings dingy, the back of the neck brownish, the upper back finely mottled with whitish, the lower neck and upper breast waved with brown, each feather having two or three concentric semicircles of wavy brown. These are the feminine peculiarities it acquires after breeding; but the markings are dingier and not so well-defined as in the female.

The rest of his dress, which I will now describe, is as in spring. Back deep glossy green; tertiaries like scapulars, but reflecting a brighter green; coverts and secondaries deep duck-green; primaries black, reflecting deep green; a broad bar of white extends across the middle of the primaries, broadly tipping the secondaries and edging the tertiaries; upper tail-coverts yellowish grey, with brown stems; tail of twelve feathers, angular at tips, 2·8 inches long, the outer quill ·7 inch shorter than the longest, greyish brown with green gloss; under-parts dingy white, the feathers being brownish on their concealed parts; flanks light liver-brown; under tail-coverts pure white; axillaries and dark parts of underwing deep black.

Male: length $11\frac{1}{2}$, wing 6 inches. Female: length 13, wing 6·5, tail 3·2 inches.

The female has whitish eyebrows meeting at the occiput; her cheeks and throat are whitish; her neck all round and upper breast are beautifully waved with blackish brown; her upper parts are liver-brown, with a faint sheen of purple or or green according to the fall of light; her upper tail-coverts are lighter and mottled; her secondary coverts are lightly tipped with whitish; her secondaries broadly tipped, her tertiaries edged, and a few of her inner primaries marked near their tips with whitish; her tail is coloured as her back; and her underparts are dingy white, the feathers being brownish at their hidden portions; axillaries and underwings light liver-brown. The soft parts I will leave till I get fresh specimens; they have changed much in colour in the dry skins before me. The birds were extremely fat.

III.—*On* Berardius *and other Ziphioid Whales.* By Dr. J. E. Gray, F.R.S. &c.

Professor Flower has given an admirable description and figures of the skeleton of *Berardius Arnouxi* sent to England by Dr. Haast and purchased for the Museum of the Royal College of Surgeons. It is very pleasant to see these excellent and beautifully illustrated essays on the skeleton of Cetacea, which Professor Flower is now publishing in the 'Transactions of the Zoological Society.'

Professor Flower makes some observations on the other ziphioid whales.

I. He observes that the small skull in the Museum at Wellington, described and figured in the 'Trans. New-Zeal. Inst.' as the young of the *Berardius Arnouxi*, and which I have called *Berardius Hectori*, belongs to a different section of the group (Trans. Z. S. vol. viii. p. 216)—which must be stated on the authority of Dr. Hector's figure, for the skull has not been seen in Europe; and he speaks of it under the genus *Mesoplodon*, observing ("from the conformation of the skull") that the position of the teeth on the side of the jaw is of "little importance as a generic character." I think zoologists will prefer to take their characters from the position of the teeth rather than from a small modification in the form of the bones of which the skull is composed, which no doubt varies more or less in every species. At any rate, this is either a *Berardius* with the bones of which the skull is composed more like in shape to those of the skull of *Mesoplodon*, or a *Mesoplodon* with the teeth of a *Berardius*.

It makes very little difference which we choose; perhaps some day it will be a genus; but zoologists and comparative anatomists, or rather osteologists, look at these things with very different eyes: the one only knows the structure of a very limited number of animals; and the other has to arrange and classify all that come under his or others' observation.

I always understood the name *Mesodon* or *Mesoplodon* was given to the genus because the teeth were more or less in the middle of the side of the jaw, which is the case in all the species; but if *Berardius Hectori* be referred to it, this species will be the ziphioid whale with the teeth in the middle of the side of the jaw, with its teeth at the end of the jaw. To be sure there are examples of such nomenclature as *Chrysanthemum* (the golden flower) *leucanthemum* (with white flowers); but it is quoted as an example to be avoided.

II. Speaking of *Petrorhynchus capensis*, he observes:—"A skull of this animal has been brought from the Cape of Good Hope, of which an excellent description has been published by Professor van Beneden, under the name of *Ziphius indicus*;" and he goes on to complain that I retain the name of *Petrorhynchus capensis*, "although its specific identity with the last-named previously described specimen is admitted" by myself.

However good may be M. van Beneden's "description," his figure is most inaccurate, both in form, proportion, and detail; and I could not have believed that it belonged to the same species, or, scarcely, genus, until M. van Beneden sent me a cast of the beak of his specimen. I do not see how we can use the name *indicus* for a species which has only been found in the seas around the Cape of Good Hope. The Indian zoologists object to our giving the name of India to the whole of Hindostan; but what would they say if we used *indicus* for a species only found in Africa? I believe that the name *indicus* was given under the belief that it was not a native of Africa, but only "brought from the Cape" as an *entrepôt*. I have a further objection: I am informed that in the Indian seas a species of the genus is found which, from the description I have received of it, is distinct.

Professor Flower says that the skeleton of the "*Hyperoodon de Corse*" of Doumet is preserved at Cette, and that the skull is figured by M. Gervais in the 'Ostéographie des Cétacés,' t. 21. f. 8, 9, which certainly is called "*Ziphius de Corse*;" but I was not quite sure that they were from M. Doumet's specimen. Mr. Flower, I suppose, has private information on this head from M. Gervais, as M. Gervais's text of these plates has not been published yet.

I also observe that Duvernoy gave the name of "*Hyperoodon Gervaisii*" and Fischer's "*Ziphius Gervaisii*" to the skull in the Paris Museum, from the Hérault, which I proposed, in the 'Annals,' 1872, x. p. 469, should be called *Epiodon Heraultii*, but which I gladly change to that of *Epiodon Gervaisii*. I see Professor Flower erroneously refers to 'Ostéogr. Cét.' t. 21. f. 1–6 for this specimen; it should be f. 1–4.

Mr. Krefft, some time ago, sent me a photograph of the skeleton of a ziphioid whale which is in the Museum of Sydney, and was obtained from an animal stranded in Little Bay, about six miles from Sydney, which he marked as *Mesoplodon longirostris*, Krefft. It appears to be, from the scale appended, 18 feet long. The angle and symphysis of the lower jaw appears to be rather elongate and attenuated in front; and the beak is about twice and a half the length of the brain-cavity, measuring from the notch; and the head is one fifth of the entire length. The photograph does not show any teeth; and the skull resembles that of the figure of *Berardius Hectori*; but the beak is rather longer in proportion to the size of the head.

In the 'Annals and Magazine of Natural History, 1871,' vii. p. 368, I published a note which I had received and the figure from the photograph of a tooth which Mr. Krefft sent to me, as "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*." He says, "We have the entire skeleton;" so that there can be no doubt of its being the same as the one he named, but did not describe or publish, as *Mesoplodon longirostris*, which Professor Flower thinks is closely allied to, if not identical with, *Ziphius Layardi*. The form and surface of the tooth which is figured from Mr. Krefft's photograph appeared to me so unlike that of any other ziphioid whale known that I regarded it as indicating a new genus, which I proposed to call *Callidon*.

Dr. Krefft explains that the tooth is not visible from without; it is imbedded in the mandible, and the tip is bent towards the margin. It is as unlike the strap-shaped tooth of *Ziphius Layardi* as it is possible to be; and as *longirostris* has not been published, I propose to call it *Callidon Güntheri*.

The skeleton seems, from the photograph, to be one of the most perfect known.

IV.—*On the Peregrine Falcon from Sardinia.* By R. Bowdler Sharpe, F.L.S., F.Z.S., &c., Senior Assistant, Zoological Department, British Museum.

For the last two years I have been endeavouring to show that, owing to the insulated position of our native land, a tendency to vary from the continental forms exhibits itself more or less in all our resident birds; and that this will be found to be more and more the case I am firmly convinced, if ornithologists will view the matter calmly and endeavour to get together good series for comparison. Great difficulty exists to some minds in believing that our insular forms do really vary; and this scepticism is the more curious because, if we had been considering the avifauna of some distant land, every one would have *expected*, rather than otherwise, that an island lying off the coast of a large continent would possess a more or less modified fauna: but the difficulty consists in recognizing the fact after it has been ignored for nearly a century by every English writer on birds; and I have been called to task by several ornithological friends because, as I contend, I refuse to disbelieve the evidence of my own eyesight, which proves to me the distinctness of some of the British birds from their continental relations. What I do maintain is, that ornithologists commit an error in applying to our English birds the titles which Linnæus bestowed upon his *Swedish* species. Whether the birds which I have from time to time named with Mr. Dresser will ultimately be recognized as distinct species, or will merely be considered climatic races or subspecies, the future will decide; but as long as those differences exist it will be wrong to affix "Linnæus" as the namer of birds he never saw.

It is with regard to the differences exhibited in a like degree by the avifauna of Sardinia that I have been led to make the above remarks; and I believe that the latter island will be found to contain a modified fauna from that of the mainland. We know that it contains a species of Warbler almost, if not quite, peculiar to itself. So nearly does *Sylvia melanocephala* resemble the true *Melizophilus sardus* in some of its plumages, that I have reason to believe that it has often been mistaken for it. I myself have never seen an example of the latter bird from any other locality but Sardinia; nor do I know any one else who has done so. Until the fact of its wandering is clearly proved, therefore, I think we may look upon *S. sarda* as peculiar to the island of Sardinia; and we may expect from this to find other modifications in its avifauna. My friend Mr. A. Basil Brooke has lately lent me two

Falcons from Sardinia which can hardly be any thing but a new species; for they differ from every other Peregrine which I have ever seen from Europe, and more closely approach the southern forms *F. melanogenys* and *F. nigriceps*. The Sardinian birds, however, differ from these as well as the common Peregrine in the very strongly marked oval or tear-shaped spots on the chest, and the very broad and closely marked bars on the breast. They approach *F. melanogenys* in having a greater extent of black on the ear-coverts, which nearly meets the cheek-stripe along the whole of its length. Both specimens are fully adult females, and agree entirely; they were shot by Mr. Brooke in April 1869 and April 1871 respectively. I have no doubt that the characters above mentioned will be found to be constant, and therefore propose to describe the Sardinian bird as

Falco Brookei, sp. n.

F. similis *F. peregrino*, sed statura paullo minore, facie laterali tota nigricante, et pectore latissime nigro transfasciato distinguendus.

Hab. Sardinia (*A. B. Brooke*).

Mr. Brooke has very kindly presented one of the typical specimens to the national collection; so that the species can be examined by any one visiting the British Museum. The measurements of *F. Brookei* (in skin) as compared with *F. peregrinus* are as follows:—

	Long. tot.	culm.	alæ.	caudæ.	tarsi.
F. peregrinus, ♀ ad.....	19·0	1·45	13·8	7·6	2·15
F. Brookei, ♀ ad.......	17·0	1·35	13·5	7·0	2·00

V.—*Notes on the Longicorn Coleoptera of Tropical America.* By H. W. Bates, Esq., F.L.S.

Subfamily Rhinotraginæ.

The "*groupes*," corresponding to our subfamilies, under which Lacordaire classed the genera of Longicorns, and of which he established about eighty in the family Cerambycidæ alone, are seldom distinguished by definite group-characters. The rule seems to be that in each "groupe" modifications of form appear which do not occur in the same conjunction in any other; but every single modification is liable to disappear in some members of the "groupe." Thus there is a looseness and uncertainty of definition in the classification of this family which cannot be agreeable to rigid systematists; but they are inevitable, and the more attentively the Longicorns are studied the more hopeless rigid definitions of genera and subfamilies appear.

The *Rhinotraginæ* are a subfamily of the same section of the Cerambycidæ to which the familiar genera *Callichroma*, *Necydalis*, &c. belong, *i. e.* having finely faceted eyes. They are remarkable for the very general abbreviation of the elytra in the species, and the mimetic resemblances that many of them bear to wasps, bees, Ichneumonidæ, and so forth—a resemblance which is much aided by the subrudimentary condition of the elytra and the prevailing style of coloration. In the imago state they frequent flowers, in company with the Hymenoptera many of them resemble, and are very nimble fliers, probably in consequence of the abbreviation of the elytra and great development of the membranous wings. An almost universal character of the group is the large volume of the eyes, especially of the lower lobes, which in the males nearly meet in front: this forms the nearest approach to an exclusive character of the group; but it disappears in some few species. The head, too, is very generally elongated below the eyes, forming a muzzle; but this character exists in several other subfamilies of Cerambycidæ. The palpi are short, and their terminal joints nearly cylindrical or cylindric-ovate, truncated at the apex. The antennæ are almost always more or less serrated from the sixth joint; and the third to sixth joints are furnished with setæ on their outer sides. The thorax is cylindrical or ovate, always unarmed at the sides. The prosternum forms a distinct, though narrow, level plate between the anterior coxæ; and the episterna of the metasternum are always triangular and very broad in front. The anterior coxæ are generally obliquely exserted; but this is an inconstant character.

In deciding whether a Cerambycid with finely faceted eyes belongs to this group or not, the characters chiefly to be looked to are (1) the volume of the lower lobe of the eyes and the extent to which this has become frontal, (2) the presence of a distinct prosternal process, and (3) the prolongation of the head below the eyes. Species in which the eyes are lateral and the prosternal process narrow or obsolete are either *Necydalinæ* or *Molorchinæ*. The abbreviation of the elytra is not an essential character. The triangular shape of the metasternal episterna ought, however, I think, to be considered a *sine quâ non*; this would exclude *Trichomesia*, an Australian genus which Lacordaire places in the "groupe," and which is the only form in it not belonging to Tropical America.

Although so forbidding to the pure systematist, the *Rhinotraginæ* are full of interest to the general naturalist, on account of their mimetic disguises and the beautiful illustrations they offer of the mode in which divergent modifications occur in nature. For example, it is most instructive to observe, in forms so very closely allied, that whilst some species have rudimentary elytra, ample wings, and wasp-like bodies, or bee-like hind tibiæ (such as many of the species of *Odontocera*, *Charis*, and *Tomopterus*), others have elytra developed to the opposite extreme, and, aided by colours and facies, become the mimetic analogues of various Coleoptera—such as *Oxylymma* (resembling Galerucidæ), *Æchmutes* (resembling Lycidæ), and *Erythroplatys* (resembling Hispidæ). The lesson plainly taught here, to those who believe in the origin of species by natural variation and selection, is that the *Rhinotraginæ* have varied in many directions, and that, a protective disguise of one kind or other being necessary to the species, the variations have been gradually drawn out in many different directions, according as they resembled some object at hand which it was advantageous to resemble. In the present stage it cannot be said that the species are remarkable for variability in the parts of their structure involved in the adaptations here mentioned: but they are generally insects of great rarity; and wherever a large number of examples are at hand (e. g. *Acyphoderes aurulentus*, *femoratus*, and *hirtipes*, *Ommata* (*Agaone*) *notabilis*), there is a large amount of variation in general form and colour. If, however, we look at the differences between very closely allied species the most abrupt changes are seen—such, for instance, as those between *Odontocera fasciata* (resembling a wasp) and *O. compressipes* (resembling a bee, with pollen-gathering apparatus to the hind tibiæ). In fact the abruptness with which important parts of structure change from species to species renders the definition of genera impossible in this group; almost every species offers structural characters sufficient in amount to render generic separation plausible.

Genus Oxylymma, Pascoe.

Pascoe, Trans. Ent. Soc. ser. 2, v. p. 21; Lacord. Genera, vol. viii. p. 500.

1. *Oxylymma lepida*, Pascoe, *l. c.* p. 22, pl. ii. f. 3.

Ega, Amazons.

2. *Oxylymma telephorina*, Bates.

Oxylymma telephorina, Bates, Trans. Ent. Soc. 1870, p. 316.

Ega, Amazons.

3. *Oxylymma gibbicollis*, n. sp.

O. flavo-testacea, erecte pilosa; occipite, articulis antennarum 2°–5^um vittaque angusta laterali et suturali elytrorum, et metasterno, nigris; thorace antice valde convexo, postice abrupte depresso, rufo, maculis fuscis. Long. 4 lin.

Bahia (*coll. W. W. Saunders*).

Head with much-elongated muzzle, testaceous yellow, shining; occiput and neck black. Antennæ with basal and fifth and sixth joints yellowish, streaked with black exteriorly, second to fourth joints shining black, rest yellowish. Thorax strongly rounded on the sides, disk anteriorly gibbous, base strongly depressed and constricted; reddish, with four dusky triangular spots on the anterior part, which spots have numerous large circular punctures, the rest of the surface being smooth. Elytra depressed, pale yellow, clothed with long, erect, pale hairs, apex briefly sinuate-truncate, with acute angles to the truncature; surface closely punctured. Body beneath and legs waxy yellow, shining; metasternum black.

This species has a close resemblance to a species of *Diabrotica* (fam. Galerucidæ).

Genus Rhinotragus, Germar.

Germar, Ins. Sp. Nov. p. 513; Lacord. Genera, vol. viii. p. 500.

1. *Rhinotragus dorsiger*, Germar, *l. c.*

Var. *Rhinotragus marginatus*, Perty, Del. An. Art. Bras. p. 94, t. 19. f. 1.

R. anceps, Newm. Ent. Mag. v. p. 495.

S. Brazil.

R. marginatus is considered a distinct species by some entomologists.

2. *Rhinotragus apicalis*, Guérin-Méneville.

Rhinotragus apicalis, Guérin-Ménev. Icon. R. A. p. 236.

Bolivia. Prov. Paraná, Brazil.

3. *Rhinotragus analis*, Serville.

Rhinotragus analis, Serv. Ann. Soc. Ent. Fr. 1833, p. 550.

S. Brazil.

4. *Rhinotragus festivus*, Perty.

Rhinotragus festivus, Perty, Del. An. Art. p. 94, t. 19. f. 2.
R. suturalis, Serv. Ann. Soc. Fr. 1833, p. 550.

S. Brazil.

5. *Rhinotragus trilineatus*, White.

Rhinotragus trilineatus, White, Cat. Long. Col. Brit. Mus. p.

R. Amazons.

Genus ERYTHROPLATYS, White.

White, Cat. Long. Col. Brit. Mus. p. 201.

1. *Erythroplatys corallifer*, White, *l. c.* p. 202, pl. v. f. 2.

Santarem, Amazons, on flowers. Resembles to deception the Hispid *Cephalodonta spinipes.*

2. *Erythroplatys rugosus*, Lucas.

Rhinotragus rugosus, Lucas, Voyage de Castelnau, Entomologie, p. 182, pl. xii. f. 7.

Interior of Brazil.

3. ?*Erythroplatys Lucasii*, Thomson.

Rhinotragus Lucasii, Thoms. Classif. des Céramb. p. 178.

Interior of Guiana.

Genus ÆCHMUTES, Bates.

Bates, Entom. Monthly Mag. iv. p. 23 (1867).
Syn. *Ornistomus*, Thoms. Syst. Ceramb. p. 166 (1864).

The differences between these two genera are too small to warrant their separation. Thomson's genus is not mentioned in Lacordaire's great work; but there can be no doubt that this is its right place, and not in the neighbourhood of *Pteroplatus*, with which it was possibly confounded by Lacordaire. The species of the genera here united, although differing very greatly in size and in the form of the apex of the elytra, both resemble the Lycidæ. I hesitate to admit M. Thomson's name, as it may prove, when its faulty grammatical construction is corrected (as it is sure to be by subsequent authors), to have been already employed in zoology.

1. *Æchmutes bicinctus*, Thomson.

Ornistomus bicinctus, Thoms., *l. c.* p. 167.

S. Brazil.

2. *Æchmutes lycoides*, Bates.

Æchmutes lycoides, Bates, Trans. Ent. Soc. 1870, p. 332.

Ega, Amazons.

Genus OREGOSTOMA, Serville.

Serv. Ann. Soc. Fr. 1833, p. 551; Lacord. Genera, vol. viii. p. 501.

1. *Oregostoma rubricorne*, Serv. *l. c.*

Rhinotragus coccineus, Guérin-Ménev. Icon. R. A., Ins. pl. 44. f. 7.

S. Brazil.

2. *Oregostoma luridum*, Klug.

Stenopterus luridus, Klug, Entom. Bras. Spec. alter. p. 470, pl. 44. f. 3.

S. Brazil.

Genus Ommata, White.

White, Long. Col. Brit. Mus. p. 194; Lacord. Genera, vol. viii. p. 502.

White founded the genus *Ommata* on a species from Venezuela, distinguished by its very long antennæ, thickened and not serrated towards the apex; with this character are associated vitreous narrowed elytra and tufted hind tibiæ. Lacordaire considers these features of less generic importance than the normal relative forms of the metasternum and abdomen and the exserted anterior coxæ. In these latter points White's insect agrees with a large number of species of the most diversified forms and colours; and an examination of very copious material has not yielded me any more definite generic distinctions than those mentioned by Lacordaire. It is true that the type, *Ommata elegans*, and a second species that may be associated with it, *O. Maia* of Newman, differ from all the other *Ommatæ* (sensu Lacord.) in their vitreous elytral surface; but *O. clavicornis* and some other species with opaque elytra come very close to *O. Maia*, and the genus would have to be split up into a large number of smaller genera if *Ommata* were to be restricted to the two species here named. The genus comprehends a series of species which for the most part are at once distinguishable by their facies from *Odontocera*; and in cases of doubt I have treated the opaque and punctured elytra as a differential character.

The genus *Agaone*, Pascoe, which I formerly adopted, I find on the examination of further material to be quite untenable; or if it be maintained, it must be restricted to the typical species, *A. notabilis*.

I. *Legs long and slender; middle femora gradually and moderately clavate.*

A. *Elytra entire or nearly so.* (Phœnissa.)

1. *Ommata* (*Phœnissa*) *nigripes*, Serville.

Oregostoma nigripes, Serv. Ann. Soc. Ent. Fr. 1833, p. 552.

S. Brazil.

2. *Ommata* (*Phœnissa*) *bipartita*, n. sp.

O. nigripede gracilior, thorace magis cylindrico, elytrorum plus quam dimidio apicali nigro; nigra, thorace et fere dimidio basali elytrorum coccineis. Long. $4\frac{1}{2}$–$5\frac{1}{2}$ lin. ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Very closely allied to *O. nigripes* (Serv.). Smaller and narrower, thorax narrower and more regularly cylindrical, the black portion of the elytra extending rather more than halfway towards the base. The head is coarsely scabrous-punctate as in *O. nigripes*; the antennæ are very slightly thickened towards the tips, with the third to fifth joints linear and the following moderately serrate. The thorax and elytra are closely reticulate-punctate, the latter more deeply so than in *O. nigripes*; they are slightly narrowed in the middle, and reach the apex of the abdomen, with the tips broadly and obliquely truncate and the sutural angle briefly spinose. The abdomen is dark blue and shining.

3. *Ommata* (*Phœnissa*) *punicea*, Newman.

Rhinotragus puniceus, Newm. Entom. Mag. v. p. 495.

S. Brazil.

There are many examples in the British-Museum collection, all distinguished from *O. nigripes* by their slenderer shape and two small black spots placed transversely on the disk of the thorax.

4. *Ommata* (*Phœnissa*?) *discoidea*, Serville.

Oregostoma discoidea, Serv. Ann. Soc. Ent. Fr. 1833, p. 552.

S. Brazil.

A A. *Elytra moderately narrowed posteriorly.*

a. *Elytra scarcely abbreviated, apex truncated.* (Chrysaëthe.)

5. *Ommata atrata*, Bates.

Ommata atrata, Bates, Trans. Ent. Soc. 1872, p. 184.

S. Brazil.

6. *Ommata asperiventris*, Bates.

Ommata asperiventris, Bates, Trans. Ent. Soc. 1872, p. 184.

S. Brazil.

7. *Ommata cyanipennis*, Bates.

Ommata cyanipennis, Bates, Trans. Ent. Soc. 1872, p. 184.

Chontales, Nicaragua.

8. *Ommata aurata*, Bates.

Ommata aurata, Bates, Trans. Ent. Soc. 1870, p. 320.

R. Amazons.

9. *Ommata smaragdina*, Bates.

Ommata smaragdina, Bates, Trans. Ent. Soc. 1870, p. 320.

R. Amazons.

10. *Ommata Beltiana*, Bates.

Ommata Beltiana, Bates, Trans. Ent. Soc. 1872, p. 184.

Chontales, Nicaragua.

aa. *Elytra narrowed and rounded at the tip; antennæ elongated and thickened at apex, not serrated.*

* *Elytra shining or vitreous.* (Ommata, *typical.*)

The elytra have an elevated line along their posterior part, parallel to the outer margin.

11. *Ommata elegans*, White.

Ommata elegans, White, Cat. Long. Col. Brit. Mus. p. 194, pl. v. f. 6.

Venezuela.

12. *Ommata Maia*, Newman.

Odontocera Maia, Newman, Entomologist, p. 92.

Rio Janeiro, Brazil. Not uncommon in collections.

I have seen a third species of this group in Dr. Baden's collection, in which the antennæ are half as long again as the body; but the specimen is in too imperfect a state for description.

** *Elytra opaque.* (Rhopalessa.)

13. *Ommata clavicornis*, n. sp.

O. gracilis, nigra, longe erecte pubescens, thorace (marginibus antico et postico nigris exceptis) sanguineo, breviter cylindrico, polito, plagiatim punctato; elytris integris, crebre punctatis; antennis elongatis, articulis 3^{o}–6^{um} linearibus, 9^{o}–11^{um} valde dilatatis, leviter serratis. Long. 4 lin. ♀.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

Allied to the typical species, *O. elegans*, in the form of the antennæ, but differing in the elytra being very nearly entire and without vitreous polish on their surface. The head has a short muzzle, the eyes (female) widely distant, and the forehead coarsely but sparsely punctured, with silvery pubescence. The sixth to eighth antennal joints are pale at the base. The thorax is short, smoothly convex and shining, with moderately small punctures in patches. The elytra are very little narrowed, and reach to the middle of the pygidium, their apex being very obtusely truncated, and their surface closely punctate-rugose and clothed with curled whitish hairs. The under surface is clothed with similar hairs. The legs are slender, the thighs somewhat suddenly clavate, and the hind legs distinctly elongated; their colour is pitchy, with the base of the hind thighs pale testaceous.

14. *Ommata tenuis*, Burmeister.

Rhinotragus tenuis, Burmeister, Stettin. ent. Zeit. 1865, p. 173.

Paraná.

Burmeister describes the antennæ as strongly thickened at the tip and the elytra punctured and opaque. As he does not mention the form of the elytra, and places the species in *Rhinotragus*, it is to be inferred they are subentire and perhaps truncated.

II. *Legs slender; middle femora abruptly but not very broadly clavate; elytra with sides subparallel, apex truncated.* (Eclipta.)

A. *Elytra abbreviated.*

15. *Ommata Eirene*, Newman.

Odontocera Eirene, Newman, Entomologist, p. 92.

S. Brazil.

The elytra reach the middle of the third abdominal segment, and are obtusely truncated; the antennæ are thickened and serrate from the seventh joint.

There is a sexual difference in coloration. The female, described by Newman, has unicolorous greenish-black elytra and white hind tarsi; the male has a pale testaceous vitta near the suture, extending from the base to two thirds the length of the elytra, and the hind tarsi are black with cinereous hairs.

16. *Ommata castanea*, n. sp.

O. linearis, breviter pubescens, antennis basi pedibusque nigris; elytris abbreviatis ad suturam dehiscentibus. Long. 5 lin. ♀.

Prov. Rio Janeiro, Brazil (*coll. Dr. Baden and H. W. Bates*).

Head thickly punctured, except the lower part of the forehead; muzzle elongated, not narrowed. Antennæ (female) three fourths the length of the body, thickened but scarcely serrate towards the tips, joints 3 to 6 linear; basal joints black, apical pale tawny. Thorax elongate cylindrical, densely reticulate-punctate. Elytra considerably narrowed from near the base, but parallel afterwards to the apex, which is truncated and scarcely reaches the base of the penultimate ventral segment; they are widely divergent at the suture. The legs are black, the hind pair much elongated, with distinctly clavate femora.

17. *Ommata thoracica*, n. sp.

O. elongata, angusta, plumbeo-nigra, cano breviter pubescens, thorace angusto, rufo, crebre reticulato-punctato; elytris paulo abbreviatis, apice recte truncatis. Long. $4\frac{1}{2}$ lin. ♀.

Prov. Paraná et Novo Friburg, Rio Janeiro (*coll. W. W. Saunders, Dr. Baden, and H. W. Bates*).

A slender, narrow species, with elytra very moderately narrowed and parallel from a little beyond the base, and reaching a little beyond the base of the penultimate segment, their apices sharply truncate, and their suture slightly gaping. Head rugose-punctate, with much-elongated muzzle. Antennæ (female) two thirds the length of the body, black; third to sixth joints linear, but rather short and stout, the following a little thickened and but slightly serrated. Thorax elongate, convex, uneven; surface entirely covered with shallow circular pits, leaving narrow reticulated interstices. Elytra closely punctured. Legs rather slender, shining black; thighs somewhat abruptly clavate, hind legs elongated.

I have seen this species labelled *O. collaris* of Serv.; but Serville says this species has the elytra "acuminées postérieurement," which character applies neither to this nor the following similarly coloured species.

18. *Ommata flavicollis*, n. sp.

O. postice angustata, nigra, thorace flavo-aurantiaco, opaco, haud distincte punctato; elytris abbreviatis, versus apicem paulo angustatis, apice truncatis. Long. 4 lin. ♂ ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Closely allied to the preceding, but the antennæ shorter and the elytra not reaching the apex of the antepenultimate ventral segment. Head coarsely punctured; muzzle much elongated; eyes (male) almost contiguous, (female) separated by only a short distance. Antennæ scarcely two thirds the length of the body; third to sixth joints linear but rather thick, and fifth and sixth a little widened at apex; they are black, but in the male the seventh to eleventh joints are pale at the base. Thorax opaque, orange-yellow, without visible punctuation. Elytra very closely subconfluent-punctate. The legs are moderately slender, the thighs elongate-clavate.

19. *Ommata Eunomia*, Newman.

Odontocera Eunomia, Newman, Entomologist, p. 92.

S. Brazil.

Described by Newman from a single specimen. In colours the species is variable—the upper surface of the thorax being either wholly black, slightly embrowned in the centre, or wholly fulvous; and the yellow vitta of the elytra sometimes extends to the suture, and is sometimes confined to the disk, or wholly wanting. Throughout all the varieties, however, the front of the head, the four anterior femora, and the basal half of the hind pair are bright fulvous. The elytra scarcely pass the base of the antepenultimate segment, and are sharply sinuate-truncate at the apex. The antennæ have the third to sixth joints linear; and the rest are not thickened, and only slightly serrated. The thorax is somewhat irregularly reticulate-punctate. The elytra are closely punctate and obscured by soft incumbent silky pile.

20. *Ommata brachialis*, n. sp.

O. gracilis, fusco-nigra, infra dense cano pubescens; femoribus anticis fulvis, femoribus posticis basi albo-testaceis. Long. 3–4 lin. ♂.

Prov. Rio Janeiro, Brazil (*coll. Dr. Baden and H. W. Bates*).

Very closely allied to *O. Eunomia*. Elytra more elongate, passing the base of the penultimate segment, and obtusely (not sinuate) truncate at the apex. The head is wholly black; and the anterior thighs only are fulvous, the extreme base of the other pairs being whitish. The eyes (male) are separated by a narrow space on the forehead. The antennæ are three fourths the length of the body, and thickened towards the apex; they are dull black, with bases of seventh to eleventh joints fulvous; the third to fifth joints are long, slender, and linear. The thorax is narrow, and reticulate-punctate in three longitudinal patches, the interstices being scarcely punctured. The elytra are closely punctured. The legs are long, especially the hind pair, and the thighs distinctly clavate.

21. *Ommata monostigma*, Bates.

Agaone monostigma, Bates, Trans. Ent. Soc. 1869, p. 384.

Chontales, Nicaragua.

22. *Ommata liturifera*, n. sp.

O. linearis, angusta, fulvo-testacea; occipite lituraque magna prothoracis (H simulante) nigris; elytris paulo abbreviatis, late truncatis, crebre punctatis. Long. $2\frac{3}{4}$–4 lin. ♂ ♀.

Prov. Rio Janeiro, Brazil (*coll. Dr. Baden and H. W. Bates*).

Head tawny testaceous; occiput, and in female a frontal streak, black; coarsely punctured; muzzle moderately elongated, not narrowed; eyes in male contiguous in front, in female widely distant. Antennæ rather short, filiform, serrate, joints 3–5 linear; tawny testaceous, tips of joints brown. Thorax cylindrical, a little constricted in front and behind, very coarsely punctured; tawny, with two broad vittæ on the disk, joined in the middle by a fascia, black, a black vitta also on each flank. Elytra reaching to the middle of the penultimate ventral segment, moderately narrowed from near the base and parallel, apex sharply truncate; colour light tawny brown, thickly but separately punctured. Body beneath yellowish, breast and middle of abdomen black. Legs slender, thighs rather abruptly clavate, hind legs moderately elongate; testaceous yellow, femoral clava ringed with black, tibiæ and tarsi also black.

A A. *Elytra nearly reaching the tip of the abdomen.*

23. *Ommata prolixa*, n. sp.

O. elongata, angusta, setosa, testaceo-rufa; capite (epistomate excepto), maculis thoracis duabus dorsalibus alteraque utrinque elytrorum humerali, pectore et pedibus nigris, femoribus basi albo-testaceis; elytris pallide fuscis postice obscurioribus; antennis modice elongatis apice vix incrassatis, nigris, articulis basi pallidis; thorace antice angustato, supra inæquali, grosse disperse punctato; elytris subintegris, crebre punctatis, apice oblique truncatis. Long. 4 lin. ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders*).

Closely allied to *O. cribripennis*, but more elongated, especially the elytra. The eyes (female) are more distant on the forehead, and the space between them is wide, plane, and (like the rest of the head) coarsely punctured. The antennæ have the third to fifth joints linear, and the following very gradually thickened, but not produced, at their inner apical angles. The hind legs are very little elongated, and the thighs moderately clubbed.

24. *Ommata lanuginosa*, n. sp.

O. linearis, fulvo-testacea, aureo breviter pubescens, opaca; occipite, thoracis disco femoribusque (partim) nigris; antennis filiformibus, articulis 7^{o}–10^{um} vix serratis haud incrassatis; thorace cylindrico, supra longitudinaliter biimpresso, reticulato-punctato; elytris vix abbreviatis, acute truncatis, fulvo-fuscis, creberrime punctatis. Long. 4 lin. ♂.

Prov. Rio Janeiro (*coll. Dr. Baden*).

Opaque, clothed with a fine incumbent golden pile, short on the elytra, but longer and denser on the sides of the thorax, on the breast, and in the middle of the abdominal segments. The head is tawny testaceous, with the crown and occiput and part of the epistome black; the eyes (male) do not reach the median line; the muzzle is much elongated. The antennæ are dull tawny brown. The thorax is cylindrical, almost bisulcate along the disk, closely reticulate-punctate, with the whole disk dull black, and margins (like the under surface) tawny testaceous. The elytra reach the base of the terminal segment and are sharply sinuate-truncate; their surface is very regularly and closely punctured and opaque. The legs are moderately slender, the femora rather abruptly but not thickly clavate, and the first joint of the hind tarsi is equal in length to the remaining three; the femora and tibiæ are indistinctly clouded with blackish.

25. *Ommata cribripennis*, n. sp.

O. linearis, angusta, setosa, melleo-flava; occipite supra maculaque basali pronoti nigris; antennis apicem versus vix incrassatis, nigris, scapo infra articulisque 3^{o}–10^{um} basi melleo-flavis; elytris pallide fuscis, subintegris, crebre sed discrete grosse punctatis, apice oblique truncatis; pedibus posticis elongatis, femoribus omnibus clavatis. Long. 3 lin. ♂ ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Closely allied to *O.* (*Agaone*) *malthinoïdes* (Bates), but the elytra less attenuated than in that species; in fact these organs are entire, with the exception of the narrowness of the epipleuræ from a little beyond the base, and they leave only the tip of the pygidium exposed. The eyes of the male do not approach so closely on the forehead as in the allied species. The third to fifth antennal joints are linear, and the rest are only very slightly produced at their inner apical angles. The thorax is cylindrical and very coarsely, but irregularly and not closely, punctured. The legs are clear honey-yellow, with the exception of a brown spot at the apex of the hind femora.

26. *Ommata erythrodera*, n. sp.

O. clavicorni simillima, differt antennis brevibus gracilibus, articulis 6^{o}–11^{um} basi flavis. Linearis, fusco-nigra nitida, sparsim pubescens; thorace cylindrico, angusto, supra convexo, paulo inæquali, grossissime sparsim punctato, læte rufo nitido, marginibus anticis et posticis nigris; elytris vix abbreviatis, acute truncatis, nigro-fuscis, passim grosse regulariter punctatis, nitidis; femoribus sub-abrupte haud fortiter clavatis, basi albis. Long. 4 lin. ♀.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden*).

Deceptively similar to *O. clavicornis* in general form, colour, and in the form and proportions of the legs; but differs at once in the moderately short slender antennæ, ringed with pale testaceous at the base of joints 6 to 11; this character would bring it into a different genus were the antennæ taken as guides. The head is shining black, regularly punctured, with much longer muzzle than in *O. clavicornis* and not pubescent; the space between the eyes on the front (female) is quite plane and very moderate for this sex. The elytra reach beyond the base of the terminal segment and are broadly and subsinuately truncate; their surface is shining, free from incumbent pubescence, and covered with separate punctures decidedly larger than those of *O. clavicornis*; in shape they are parallel-sided from after the base. The underside of the body is shining black, scantily clothed with grey pubescence. The basal joint of the posterior tarsi is narrow, but shorter than the remaining joints taken together.

27. *Ommata vitticollis*, n. sp.

O. linearis, angusta, nigra; capite angusto, grosse punctato melleo-flavo; thorace elongato antice angustato, supra inæquali, grosse disperse ocellato-punctato, nigro, vitta dorsali et infra melleo-flavis; elytris subintegris, apice obtuse truncatis, passim crebre ocellato-punctatis. Long. $3\frac{1}{2}$ lin. ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Differs in form from the allied species, the head and thorax being small in proportion to the elytra, and the thorax narrowed anteriorly. The antennæ are three fourths the length of the body, and scarcely thickened towards the tips; the third to sixth joints are linear; they are black, with the exception of the pale bases of joints ninth to eleventh. The femora are distinctly clavate and the hind legs elongated, as in the typical forms of the genus.

28. *Ommata malthinoïdes*, Bates.

Agaone malthinoïdes, Bates, Trans. Ent. Soc. 1870, p. 319.

R. Amazons.

29. *Ommata ruficollis*, Bates.

Agaone ruficollis, Bates, Trans. Ent. Soc. 1870, p. 319.

R. Amazons.

30. *Ommata anoguttata*, n. sp.

O. elongato-linearis, supra plana, subtiliter pubescens, fusca, elytris apice macula transversa flava. Long. 5 lin. ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Head fulvo-testaceous, shining, thickly punctured, muzzle elongated; space between the eyes (female) in front moderate; occiput black. Antennæ more than three fourths the length of the body, slightly thickened and serrate towards the tips, joints three to five linear; colour pitchy testaceous, basal joints beneath paler. Thorax elongate cylindrical, disk with four tubercles and a median raised wheal, rest of surface ocellate-punctate, black above, central line and sides fulvous. Elytra elongate-linear and plane, leaving the pygidium uncovered, not dehiscent; apex truncate and tumid on the surface where lies the pale transverse spot; the surface rather finely and closely rugose-punctate, with soft, inclined, and curly pubescense; colour brown, suture paler. Body beneath dark brown, with golden pubescence; abdominal segments ringed with yellow. Legs tawny testaceous, base of thighs blackish; hind legs moderately elongated, thighs rather abruptly clavate.

31. *Ommata ægrota*, Bates.

Odontocera ægrota, Bates, Trans. Ent. Soc. 1872, p. 233.

Chontales, Nicaragua.

I described this species as an *Odontocera*, following Lacordaire's definition of the genus; but the closely punctured and non-vitreous elytra bring it within the genus *Ommata*, according to the classification here adopted.

32. *Ommata Xantho*, n. sp.

O. robustior, pallide flava; capite, elytris, tibiis, tarsis femoribusque supra nigris, fronte flava; antennis filiformibus, nigris, articulis 6^{o}–10^{um} basi pallidis; thorace lateribus paulo rotundatis, margine antico crasso, reticulato-punctato opaco; elytris subintegris reticulato-punctatis, apice oblique truncatis angulo exteriore longe spinoso; metasterno late nigro-fasciato; pedibus robustis, femoribus elongato-clavatis. Long. $4\frac{1}{2}$ lin. ♂.

Prov. Paraná, Brazil (*coll. W. W. Saunders*).

A robust species, with hind legs not disproportionately elongated, and filiform antennæ, of which the third to fifth joints are linear.

33. *Ommata pœcila*, n. sp.

O. linearis, pallide flava, thoracis macula dorsali, elytrorum macula quadrata humerali, fascia mediana alteraque apicali nigris; antennis elongatis, apice gradatim incrassatis, nigris, flavo annulatis; thorace cylindrico, convexo, crebre reticulato-punctato; elytris vix abbreviatis, basi excepta angustatis parallelis, apice oblique truncatis, dense reticulato-punctatis. Long. 4½ lin. ♂.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Linear, thorax and elytra closely covered with round punctures forming narrow reticulated interstices. Clear pale yellow, with an irregular spot on the disk of the thorax, a belt across the middle and apex of the elytra, and a square spot on the shoulder black. The antennæ (male) are nearly as long as the body and considerably thickened towards the apex, the third to fifth joints are linear; the colour is black, with the base of fourth to tenth joints and first to fourth joints beneath pale testaceous. Beneath there is a broad stripe on each side of the metasternum and across the abdomen, black. The legs have a streak on the upperside of the femoral clavæ, the apex of the tibiæ and the tarsi black; the hind legs are not elongated; all the femora are clavate, the anterior and middle pair more abruptly so than the posterior. The elytra are moderately narrowed from a little behind the base, and are thence parallel to the apex; they are not dehiscent at the suture; and the external angle of the apical truncature has a longish spine.

A variety occurs in which the middle and apical black fasciæ of the elytra and the humeral spots are united, and the head and whole apical half of the abdomen is black.

34. *Ommata fenestrata*, Lucas.

Oregostoma fenestratum, Lucas, Voyage de Castelnau, Ins. pl. 12. f. 8.

Interior of Brazil.

III. *Legs robust; middle femora abruptly and very thickly clavate; first joint of hind tarsi greatly elongated; elytra entire.* (Agaone, *Pascoe*).

35. *Ommata notabilis*, White.

Rhinotragus notabilis, White, Cat. Long. Col. Brit. Mus. p. 199.

R. Amazons.

Genus Odontocera, Serv.

Serv. Ann. Soc. Ent. Fr. 1833, p. 546; Lacord. Genera, vol. viii. p. 503.

I have nothing to add to the definition of this genus given by Lacordaire, except that I think it better to exclude every species which has not a vitreous surface to the elytra. This character, added to the enlarged metasternum, slender abdomen (often constricted at the base), subcylindrical or oval thorax, and elytra never much abbreviated or subulate, will distinguish *Odontocera* from all the allied genera. The antennæ vary in thickness and length; in most species they are short, thick, and strongly serrated from the sixth or fifth joint; but many have very slender, filiform antennæ. Some of these I formerly placed in the genus *Agaone*, notwithstanding the slender or constricted abdomen; but this course is the less admissible, as the type of the genus *Odontocera* (*O. vitrea* of Serville) is described as having slender antennæ.

I. *Antennæ elongate, slender.*

1. *Odontocera molorchoïdes*, White.

Rhinotragus molorchoïdes, White, Cat. Long. Col. Brit. Mus. p. 200.

R. Amazons.

2. *Odontocera vittipennis*, n. sp.

O. nigra, cano pubescens; thorace oblongo-ovato, rufo-aurantiaco, reticulato-punctato, opaco; elytris nigris, vitta albo-testacea, vitrea; tarsis posticis albis; antennis elongatis gracilibus, articulis a sexto leviter serratis basi flavo-testaceis. Long. 4 lin. ♂.

Brazil (*coll. W. W. Saunders*).

Head black, clothed with hoary pile; muzzle elongated; eyes (male) nearly touching the median line in front. Antennæ as long as the body, black; joints sixth to eleventh yellow at base, third to sixth linear, seventh to tenth elongate, moderately dilated and serrate at their apices. Thorax rather broader than the elytra, subovate, the sides being much rounded near the middle; the surface is opaque, covered with shallow round pits, and with the flanks light red. The elytra nearly reach the apex of the penultimate segment; they are subparallel from the middle, with tips obliquely and sharply truncated; their surface is very closely and coarsely punctured and deep black, except a narrow well-defined central vitta from the base to near the apex, which is whitish, faintly punctured, and shining. The legs are black, with the exception of the hind tarsi, which are white, and have their basal joint longer than the remaining three together, but not slender; the middle femora are abruptly and very broadly clavate; the hind legs greatly elongated, and their femora very gradually and moderately thickened. The under surface of the body is densely clothed with short hoary pile; the abdomen is moderately slender, and the anterior coxæ scarcely exserted.

3. *Odontocera clara*, n. sp.

O. valde elongata, nigra; thorace aurantiaco-flavo, pectore abdomineque cinereo-tomentosis; elytris disco omnino vitreo albotestaceo. Long. $5\frac{1}{2}$–$7\frac{1}{2}$ lin. ♂ ♀.

Chontales, Nicaragua (*coll. T. Belt and H. W. Bates*).

An elongate narrow species, similar in form to *O. chrysostetha*, but resembling *O. vittipennis* in colours. Head black, shining, scabrous-punctate; muzzle elongate and narrow. Antennæ long and filiform, moderately serrate from the sixth joint, shining black; extreme base of joints 7 to 11 pallid, especially in the male. Thorax long, cylindrical, gradually narrowed in front, orange-testaceous, moderately shining, closely subreticulate-punctate, with a short, smooth, raised dorsal line on the fore part of the disk. Elytra reaching to the middle of the fourth segment, moderately narrowed behind the base, thence parallel to the apex, which is sharply truncate, with the angles prominent; surface pallid brownish and glassy, faintly punctulate; margins (except the basal) narrowly black and coarsely punctured. Meso- and metasterna and abdomen black, clothed with a laid ashy pile; metasternum moderately voluminous, and abdomen linear, coarsely punctured. Legs much elongated, black, shining; all the femora rather gradually clavate; hind pair reaching the tip of the abdomen.

This is one of the latest discoveries of Mr. Thomas Belt.

4. *Odontocera colon*, Bates.

Agaone colon, Bates, Trans. Ent. Soc. 1870, p. 319.

R. Amazons.

5. *Odontocera monostigma*, Bates.

Agaone monostigma, Bates, Trans. Ent. Soc. 1869, p. 384.

Chontales, Nicaragua.

6. *Odontocera parallela*, White.

Odontocera parallela, White, Cat. Long. Col. Brit. Mus. p. 189.

R. Amazons.

7. *Odontocera mellea*, White.

Odontocera mellea, White, Cat. Long. Col. Brit. Mus. p. 188.

R. Amazons.

8. *Odontocera chrysostetha*, Bates.

Odontocera chrysostetha, Bates, Trans. Ent. Soc. 1870, p. 320.

R. Amazons.

9. *Odontocera vitrea*, Serville.

Odontocera vitrea, Serville, Ann. Ent. Soc. Fr. 1833, p. 547.

Cayenne.

Serville describes the antennæ in his *Odontoceræ* as "filiformes, presque setacées, 5 ou 6 articles en scie." His species would therefore come in the present section.

10. *Odontocera cylindrica*, Serv. *l. c.* p. 548.

Brazil.

It is not stated in the description that the elytra have vitreous disks; the position of the species is therefore doubtful.

II. *Antennæ more or less abbreviated and dilated.*

A. *Thorax narrow, cylindrical.*

a. *Disk of thorax even.*

* *Antennæ much thickened towards the apex.*

11. *Odontocera crocata*, n. sp.

O. gracillima, postice attenuata, fusco-niger; antennis, pedibus et elytris fulvo-croceis, his marginibus et apice late nigris, valde abbreviatis, apice late truncatis. Long. $3\frac{3}{4}$ lin. ♂.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

Head coarsely punctured; eyes voluminous, contiguous in front; muzzle moderate, narrow. Antennæ two thirds the length of the body, thickened towards the tip, saffron tawny; third to fifth joints slender, linear, seventh to tenth serrate. Thorax very narrow, cylindrical, with longitudinal patches of shallow circular punctures, the patches connected by transverse wrinkles. Elytra just passing the base of the antepenultimate segment, moderately narrowed from after the base, dehiscent at the suture, sharply and broadly truncated at the apex; surface moderately punctured, very sparsely so on the disk, which is shining. Body beneath rufous tawny; thorax, sides of breast, and belt across middle of abdomen black. Legs saffron tawny; hind pair elongated; thighs distinctly clavate. Metasternum (male) voluminous; abdomen slender, linear.

** *Antennæ robust, all joints thickened.*

12. *Odontocera sanguinolenta* (Dej.), n. sp.

O. elongata, robusta, sanguinea; capite, antennis, vitta thoracis lata dorsali pedibusque nigris; femoribus posticis annulo sanguineo;

elytris fere apicem abdominis attingentibus, angustis, testaceo-flavis, vitreis, marginibus nigris, apice macula oblonga læte flava. Long. 7–8 lin. ♂ ♀.

Rio Janeiro (*coll. W. W. Saunders, Dr. Baden, and H. W. Bates*).

An elongated and narrow but robust form. Head black, coarsely punctured. Antennæ about half the length of the body, stout, of equal thickness to the apex, third to fifth joints being much dilated, and the following serrated, dull black. Thorax elongated, cylindrical, closely punctured, sides broadly blood-red, the rest dull black. Scutellum white. Elytra reaching nearly the tip of the body, narrow, and nearly parallel from after the base; apex sharply truncated, with angles somewhat produced; surface shining, black, with a central vitta straw-colour and vitreous, the black borders coarsely punctured; an elongate spot brighter yellow at apex. Breast and abdomen sanguineous, the former black in the middle, the latter with margins of the segments black. Legs robust, black; hind femora with a blood-red ring, and gradually clavate.

13. *Odontocera apicalis*, Klug.

Stenopterus apicalis, Klug, Entom. Bras. Specim. alter. p. 54, t. xliv. f. 6.

Brazil.

Apparently allied to *O. sanguinolenta.*

aa. *Disk of thorax tuberculated.*

14. *Odontocera gracilis*, Klug.

Stenopterus gracilis, Klug, Entom. Bras. Spec. alt. p. 54, t. xliv. f. 7.
St. elegans, Guérin-Ménev. Icon. R. A. pl. 44. f. 9.

Brazil.

It has been suggested that this species should be excluded from the genus *Odontocera*, on account of its tubercled thorax, the great length of the peduncle of the hind femora, and other characters. Its peculiar facies and metallic colouring ill consort with the other congeners; but all its essential structural characters are shared in by one or other members of the genus. For instance, the tuberculated thorax is possessed in still higher development by *O. flavicauda*, which has nothing abnormal in its colouring, and quite moderately clavate and pedunculate hind femora.

15. *Odontocera flavicauda*, n. sp.

O. elongata, linearis, castaneo-rufa; capite, antennis basi pedibusque nigris; elytris pallide brunneis, vitreis, marginibus anguste nigris, apice flavis. Long. 5–6 lin. ♂ ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Elongate and narrow in form. Head coarsely punctured. Antennæ rather more than half the length of the body, not thickened, regularly serrate from the sixth joint; fifth also a little dilated at the apex; basal half black, apical half castaneous. Thorax rather short, cylindrical; surface with four tubercles and a central raised line; interstices with large, circular, scattered punctures. Elytra reaching nearly the base of the pygidium, moderately narrow and subparallel from a little beyond the base; apex broadly sinuate-truncate; surface glassy, although finely and sparsely punctured and setose; margins coarsely rugose-punctate and black; disk pale brown (palest near the base); apex with a longish yellow spot. Beneath shining chestnut-red; thorax blackish; Legs black; hind pair much elongated; thighs abruptly clavate. Abdomen of male slender and linear, of female subpetiolated.

AA. *Thorax subovate.*

a. *Hind legs elongate, slender; femora abruptly clavate.*

16. *Odontocera nigriclavis*, n. sp.

O. elongata, nigra; pedibus posticis (clava femorali scapoque tibiali nigris exceptis) et tarsis omnibus flavo-testaceis; vitta discoidali elytrorum albo-testacea, vitrea. Long. 5–6 lin. ♂ ♀.

Prov. Rio Janeiro and Paraná, Brazil (*coll. W. W. Saunders, Dr. Baden, and H. W. Bates*).

Closely allied to *O. dispar* (Bates), but having longer elytra, yellow tarsi, and female concolorous with the male, &c. Head with elongated muzzle. Antennæ half the length of the body, thickened from the fifth joint; black, bases of the joints testaceous tawny. Thorax elongate, gradually narrowed behind; surface longitudinally impressed, clothed with long hairs, and closely reticulate-punctate. Elytra reaching to middle of the third segment, nearly parallel from after the base, truncate at the apex, thickly punctured and black on the borders; disk occupied by a whitish vitreous vitta. Legs black; tarsi testaceous yellow; the hind legs moderately elongated; femora abruptly clavate; tibiæ with a dense brush of black hairs round the apical half; base of thighs and of tibiæ testaceous yellow.

17. *Odontocera pœcilopoda*, White.

Odontocera pœcilopoda, White, Cat. Long. Col. Brit. Mus. p. 191.

Amazons.

18. *Odontocera dispar*, Bates.

Odontocera dispar, Bates, Trans. Ent. Soc. 1870, p. 321.

Amazons.

19. *Odontocera aurocincta*, n. sp.

O. valde elongata, nigra; antennis, tibiis et tarsis fulvis; femoribus basi et tibiis posticis dimidio basali albo-testaceis; thorace breviter cylindrico-ovato, grosse punctato, tomento aureo marginato; elytris modice abbreviatis, angustis, apice obtuse truncatis, fulvo-testaceis, vitreis. Long. 7 lin. ♀.

Tehuantepec, Mexico (*coll. H. W. Bates*).

Closely allied to *O. nigriclavis*, but destitute of brush on the hind femora. Head coarsely punctured, black. The antennæ are tawny, moderately short, thickened towards the tips, serrate from the sixth joint. The elytra reach nearly to the middle of the third segment, and are much narrowed but not subuliform, being little dehiscent at the suture and truncated at the tip; they are unicolorous pale tawny brown, with the exception of a narrow blackish line along the anterior part of the suture and of the lateral margins. The underside of the body is closely punctured; it is black, becoming castaneous on the abdomen, the two basal segments of which have a broad pale testaceous belt. The hind legs are moderately elongated, and the femora somewhat strongly clavate. The metasternum is voluminous, and the abdomen very elongate and slender towards the base.

20. *Odontocera leucothea*, n. sp.

O. albicanti (Klug) simillima; differt elytrorum margine suturali late incurvo, maculaque triangulari circumscutellari nigra. Long. 7–9 lin. ♀.

Novo Friburg (Rio Janeiro); Minas Geraes and Paraná. (*coll. W. W. Saunders, Dr. Baden, and H. W. Bates*).

Deceptively similar to *O. albicans*, Klug (Entom. Bras. t. xliv. f. 5); colours the same, except a broad, triangular, black spot in the scutellar region. The silvery pile of the thorax, however, is concentrated in rounded spots, of which there are four (in quadrangle) on the disk, and others more irregular on the flanks; and there are slight differences in the distribution of colours on the antennæ and legs. The white ring of the antennæ in *O. albicans* embraces joints seventh to ninth; in *O. leucothea* joints sixth, seventh, and the apical half of the fifth. In the anterior legs the femora are chestnut-red, and the tibiæ and tarsi testaceous yellow (in *O. albicans* these colours are exactly reversed); the middle tibiæ and base of the femora are testaceous yellow. Notwithstanding this close general similarity, it is likely the two insects belong to different genera, the antennæ (according to Klug's figure) appearing to be simple, like the typical *Ommatæ*, and the elytra parallel. In *O. leucothea* the antennæ are serrate from the fifth joint, and the sutural margin of the elytra is strongly incurved from before the middle. The disk of the elytra is vitreous. The abdomen is red, and in the female vespiform.

I have seen four examples, all females, and exactly similar.

21. *Odontocera? albicans*, Klug.

Stenopterus albicans, Klug, Entom. Bras. Specim. alter. p. 53, t. xliv. f. 5.

Rio Janeiro.

aa. *Hind femora gradually thickened.*

22. *Odontocera hilaris*, n. sp.

O. nigra, thorace supra aurantiaco-rufo, elytrorum disco femoribusque posticis basi flavo-testaceis. Long. $4\frac{1}{2}$ lin. ♀.

Odontocera punctata, Bates, Trans. Ent. Soc. 1870, p. 323 (nec Klug).

R. Tapajos, Amazons (*coll. H. W. Bates*).

Short and rather robust. Head with broad and not very elongate muzzle; the eyes in the unique specimen approach tolerably near to the median line in front, and seem to show it to be a male; but the short and broad sessile abdomen is that of a female. The antennæ are short, thickened and serrated from the fifth joint. The thorax is strongly rounded on the sides and constricted at the base, the surface closely reticulate-punctate. The elytra reach nearly to the middle of the third segment, with the suture dehiscent only from the middle, rapidly narrowed but truncated at the apex; the margins are narrowly deep black, leaving the whole disk pallid and vitreous, without visible punctures, except at the base. The hind legs are greatly elongated, the femora very gradually clavate, the tarsi short and slender.

I had erroneously referred this species to *O. punctata* (Klug), with which it agrees in colour and general form; but *O. punctata* (of which I have now an example before me) has longer elytra, with their vitreous disks covered with strong dark punctures. The eyes in the female approach the median frontal line as closely as in *O. hilaris*; but the hind legs are short and wholly black.

23. *Odontocera punctata.*

Stenopterus punctatus, Klug, Entom. Bras. Spec. alt. p. 53, t. xliv. f. 4.

Bahia (*coll. Dr. Baden*).

Klug gives the locality as "Pará interior," which is probably an error.

24. *Odontocera ornaticollis.*

Odontocera ornaticollis, Bates, Trans. Ent. Soc. 1870, p. 323.

Tapajos, Amazons.

The abdomen in the male is very elongate, slender at the base, and slightly thickened and curved downwards at the tip.

25. *Odontocera petiolata*, n. sp.

O. elongata, fusco-nigra, pedibus fulvo-testaceis; elytris elongatis modice subuliformibus, apice subacute rotundatis, flavo-testaceis, vitreis, marginibus anguste rufo-castaneis, fasciaque curvata pone scutellum et vittula humerali nigris; abdomine utriusque sexus valde petiolato. Long. 4–7 lin. ♂ ♀.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

Head above and down the middle of the forehead black, the rest tawny testaceous; eyes in male not touching the median line of forehead, in female a little more distant. Antennæ short and stout, black; apex tawny. Thorax ovate, much narrowed behind and convex in front, densely pubescent, coarsely and closely punctured. Elytra reaching nearly to the apex of the penultimate segment, subulate, but not very narrow, parallel from after the base, obtusely pointed at the apex; the vitreous yellowish disk has a few very fine setiferous punctures; a black fascia curves near the base behind the scutellum, and joins on each side a short streak on the top of the shoulder; the margins elsewhere are narrowly castaneous. The legs are moderately stout; the hind thighs not clavate, but gradually and moderately thickened. The petiolated basal segment of the abdomen is partly yellow; the very convex metasternum and margins of the ventral segments are clothed with golden pile.

26. *Odontocera fasciata*, Newm.

Necydalis fasciata, Oliv. Ent. no. 74, p. 10, pl. i. f. 9.
Odontocera chrysozone, White, Cat. Long. Col. Brit. Mus. p. 192, pl. v. f. 5.

R. Amazons.

The abdomen is strongly vespiform, as in the two preceding species.

27. ? *Odontocera Dice*, Newm.

? *Odontocera Dice*, Newm. Entom. p. 91.

Rio Janeiro.

aaa. *Hind legs short and stout; femora thickly clavate.*

28. *Odontocera triliturata*, Bates.

Odontocera triliturata, Bates, Trans. Ent. Soc. 1870, p. 324.

R. Amazons.

29. *Odontocera compressipes*, White.

Odontocera compressipes, White, Cat. Long. Col. Brit. Mus. p. 191.

R. Amazons.

In this species the hind tibiæ are much dilated exteriorly near the apex and tufted with hairs, evidently an adaptation—the result, combined with colour and shape, being a close imitation of a common yellow species of *Melipona* bee.

30. *Odontocera furcifera*, Bates.

Odontocera furcifera, Bates, Trans. Ent. Soc. 1870, p. 323.

R. Tapajos, Amazons.

In this species the elytra are of the same form as in the typical *Acyphoderes*, *i. e.* subulate and pointed at the apex.

31. *Odontocera simplex*, White.

Odontocera simplex, White, Cat. Long. Col. Brit. Mus. p. 325.

R. Amazons.

32. *Odontocera bisulcata*, Bates.

Odontocera bisulcata, Bates, Trans. Ent. Soc. 1870, p. 326.

R. Tapajos, Amazons.

[To be continued.]

VI.—*Growth or Evolution of Structure in Seedlings.* By John C. Draper, M.D.*

The continuous absorption of oxygen and formation of carbonic acid is an essential condition of evolution of structure, both in plants and in animals.

The above proposition, so far as it relates to animals, will probably be admitted by all; the opposite opinion, however, is

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commonly held as regards plants. Yet we propose to show that in these organisms, as in animals, growth, as applied to evolution of structure or organization of material provided, is inseparably connected with oxidation.

The discussion of the proposition in question necessarily involves a preliminary review of the character of the gases exhaled from various plants. Commencing with the lower organisms, as Fungi, the uniform testimony is that these plants at all times expire carbonic acid, while it is chiefly in the higher plants, and especially in those which contain chlorophyl or green colouring-matter, that carbonic acid is absorbed and oxygen exhaled. The inquiry, then, in reality narrows itself down to the examination of the growth of chlorophyl-bearing plants.

Regarding these plants the statement is made and received that they change their action according as they are examined in the light or in the dark, exhaling oxygen under the first condition, and carbonic acid under the second. Various explanations of this change of action have been given, that generally accepted accounting for it on the hypothesis of the absorption of carbonic acid by the roots, and its exhalation by the leaves when light is no longer present.

The change, on the contrary, appears to arise out of the fact that two essentially different operations have been confounded, viz. the actual growth or evolution of structures in the plant, and the decomposition of carbonic acid by the leaves under the influence of the light, to provide the gum or other materials that are to be organized. These two factors are separated by Prof. J. W. Draper in his discussion of the conditions of growth in plants. We propose to show that, by adopting this proposition of two distinct operations in the higher plants, all the apparent discrepancies regarding the growth of these plants are explained.

The growth of seedlings in the dark offering conditions in which the act of growth or evolution of structure is accomplished without the collateral decomposition of carbonic acid, I arranged two series of experiments in which growth under this condition might be studied and compared with a similar growth in the light. That the experiments might continue over a sufficient period of time to furnish reliable comparative results, I selected peas as the subject of trial, since these seeds contain sufficient material to support the growth of seedlings for a couple of weeks.

To secure as far as possible uniformity of conditions between the dark and light series, and also to facilitate the separation, cleansing, and weighing of the roots, each pea was planted in a glass cylinder, 1 inch in diameter and 6 inches long. These cylinders were loosely closed below by a cork, and filled to within half an inch of the top with fine earth or vegetable mould. They were then placed erect in a covered tin box or tube-stand, in such a manner that the lower end dipped into water contained in the box, while the whole of the cylinder except the top was kept in the dark. Thus the first condition for germination, viz. darkness, was secured; the second, warmth, was supplied by the external temperature, which varied from 70° to 80° F.; while regularity and uniformity in the supply of moisture in both series was secured by having a box of cylinders or tubes for each and keeping the level of the water the same in both. The supply of oxygen was also equal and uniform, since the upper part of each tube presented a similar opening to the air.

Thus prepared, one box, containing five cylinders, was kept in a dark closet, while a second, similar in all respects, was placed in a window of the adjoining room, where it was exposed to direct sunlight five or six hours every day. To each tube a light wooden rod thirty inches in length was attached; and on this the growth of the seedling was marked every twelve hours. The hours selected were 7 A.M. and 7 P.M. I thus obtained the night and day, or dark and light growth of every seedling, as long as those in the dark grew. The seeds were planted on June 1st, and appeared above the ground on June 6th, when the measurements were commenced. In each series one seed failed to germinate; the record consequently is for four plants in each. The history of the evolution of structures is as follows:—

Evolution of structure in the dark.—In Table I. the seeds are designated as A, B, C, D; and each column shows the dates on which leaves and lateral growths appeared. These constitute periods in the development of the plants, which are indicated by the numbers 1, 2, 3, 4, 5, 6. The weight of each seed is given in milligrammes.

TABLE I.—*Seedlings grown in the dark.*

	A.	B.	C.	D.
Weight of seed....	431.	436.	456.	500.
Period 1	7th day.	7th day.	7th day.	7th day.
,, 2	8th ,,	9th ,,	9th ,,	8th ,,
,, 3	10th ,,	10th ,,	11th ,,	10th ,,
,, 4	12th ,,	12th ,,	13th ,,	12th ,,
,, 5	14th ,,	15th ,,	15th ,,	14th ,,
,, 6	17th ,,	18th ,,	18th ,,	17th ,,

A glance at the above shows the uniformity as regards time with which the structures were evolved in each plant. It also indicates for each plant an equality in the number of periods of evolution, viz. 6, notwithstanding the difference in the weights of the seeds, and suggests that the power of evolution of structure in seedlings resides in the germ alone.

The character of the evolution in the six periods shows a steady improvement or progression.

In the first, the growth consists of the formation close to the stem of two partially developed pale yellow leaves.

The second period is similar to the first, except that the leaves are a little larger.

The third presents a pair of small yellow leaves close to the main stem, from between which a lateral stem or twig about one inch long projects, and bears at its extremity a second pair of imperfectly developed yellow leaves, from between which a small tendril about a sixteenth of an inch long is given off.

The fourth resembles the third, the lateral twig being longer, and the tendril three times as long as in the third.

The fifth is like the fourth, except that the tendril bifurcates.

The sixth is similar to the fifth, except that the tendril trifurcates.

Stem, leaves, twigs, tendrils of various degrees of complexity, all are evolved by the force preexisting in the germ without the assistance of light.

Evolution of structure in the light.—

TABLE II.—*Seedlings grown in the light.*

	E.	F.	G.	H.
Weight of seed....	288.	426.	462.	544.
Period 1	..	6th day.	..	6th day.
„ 2	7th day.	7th „	7th day.	7th „
„ 3	8th „	8th „	8th „	9th „
„ 4	12th „	9th „	10th „	10th „
„ 5	15th „	11th „	14th „	12th „
„ 6	..	13th „	..	14th „

Table II. was obtained in the same manner as Table I., the columns representing the days on which lateral growths and leaves appeared. Though there is not the same uniformity as in Table I., the periods are identical in both as regards the visible character of the evolution. Nothing appears in the second that did not preexist in the first; and in the case of the seeds E and G the evolution is even deficient as regards the first and the sixth periods.

While the general character of the evolution in both series is similar, certain minor differences exist. In Table II. the leaves and tendrils are many times larger than in Table I., and they with the whole plant are of a bright green colour, instead of the sickly pale yellow of Table I.: but the light has not developed any new structure; it has only perfected those which preexisted, and converted other substances into chlorophyl, which is not an organized body.

Not only did the plants in the two series present similarities in evolution of structure, but the average weight of dry plant in each was very nearly the same; for

	mgr.			mgr.	
	455	of seeds in the dark	produced	184	of dry plant,
while	455	„ light	„	215	„ .

A comparison of the parts below the ground with those above (both being dried at 212° F.) shows that the proportion of root to total weight of plant was also nearly identical, being

25 of root for 100 of plant in the dark, and
23 „ 100 „ light.

The close similarity in the evolution of visible structure in the light and in the dark, the small difference in the total weights of the plants grown in the same time in both series, and the close approximation in the proportional weight of root to plant, all justify the conclusion that the growth in darkness and in light closely resemble each other, and that it is proper to reason, as regards the nature of the action, from the first to the second.

Another interesting fact which lends support to the opinion that the process of growth in seedlings developed in the dark is very similar to that occurring in those grown in the light, is the character of the excrements thrown out by the roots. It is well known that many plants so poison the soil that the same plants cannot be made to grow therein until the poisonous excretions from the roots of the first crop have been destroyed by oxidation. In the case of peas this poisoning of the soil takes place in a very marked manner; and I have found that in the pots in which peas have been grown in the dark, the soil is so poisoned by the excrements from the roots that a second crop fails to sprout. Does it not follow that since, in the two series with which I experimented, the excrements from the roots possessed the same poisoning action, the processes in the plants from which these excrements arose must have been similar?

There remains an important argument, concerning which nothing has thus far been said. It is to be derived from the consideration of the rate of growth in the light series during various periods of the day of twenty-four hours. If the evolution of structure in a plant in daylight is the result of the action of light, that evolution should occur entirely, or almost entirely, during the day. If, on the contrary, it is independent of the light, it should go on at a uniform rate as in plants in the dark.

For the elucidation of this portion of the subject, I present the following tables; the first of which shows the growth by night, 7 P.M. to 7 A.M., of the seedlings in the dark series, compared with their growth by day, 7 A.M. to 7 P.M. The measurements were taken from the sixth to the twentieth of the month, the day on which growth ceased in the dark series.

TABLE III.—*Seedlings grown in the dark.*

	Night growth.		Day growth.
No. 1......	$12\frac{3}{4}$ inches.		14 inches.
,, 2......	$13\frac{1}{4}$,,		13 ,,
,, 3......	$11\frac{3}{4}$,,		$11\frac{3}{8}$,,
,, 4......	$12\frac{5}{8}$,,		$11\frac{3}{8}$,,
Average..	$12\frac{5}{8}$,,	Average..	$12\frac{3}{8}$,,

The total day growth and night growth under these circumstances are nearly equal, though there is a slight excess in favour of the night, amounting, as the table shows, to $\frac{2}{8}$ of an inch in 12 inches.

In Table IV. the growth of the light series is given in the same manner, by day and by night, for the same time, viz. to June 20th. The thermometric and hygrometric conditions in both series were very similar, as indicated by the dry- and wet-bulb thermometers suspended in the vicinity of each set of tubes.

TABLE IV.—*Seedlings grown in the light.*

	Night growth.		Day growth.
No. 5......	$3\frac{1}{4}$ inches.		4 inches.
,, 6......	8 ,,		7 ,,
,, 7......	$5\frac{1}{4}$,,		$4\frac{1}{4}$,,
,, 8......	$9\frac{1}{2}$,,		$8\frac{1}{2}$,,
Average..	$6\frac{1}{2}$,,	Average..	6 ,,

In the average, and throughout the table, with a single exception, not only is the uniformity in the rate of growth during the day and night shown, but the slight excess of night growth found in the series kept in the dark is likewise copied. We must therefore accept the conclusion, that the act of growth or evolution of structure is independent of light, and that the manner of growth during the day is similar to that at night.

It will be noticed that the total average height attained in the light is only about half that in the dark series. The explanation of this we have already seen in the fact that in the former the leaves and tendrils were much larger than in the latter, while the dry weights were nearly the same. The material of the seed in the light series was consumed in extending these surfaces, while in the dark series it was spent in lengthening the stem.

Having established the continuous character of growth in seedlings, and the similarity of rate and nature of the process by night and by day, and admitting that night plants throw off carbonic acid, it is not improbable that this carbonic acid arises, not from mechanical absorption by the roots and vaporization by the leaves, but as a direct result or concomitant of the act or process of evolution of structure.

To put the matter in the clearest form, let us first understand what growth is. It appears in all cases to consist in the evolution or production of cells from those already existing. According as the circumstances under which the cells are produced vary, so does the tissue ultimately produced vary ; cells formed in woody fibre become wood; cells formed in muscle in their turn form muscles; but the starting-point of the process in every instance is the formation of new cells.

If, now, we examine the evolution of cells under the simplest conditions, as, for example, in the fermentation that attends the manufacture of alcohol, we find that with the evolution of the *Torula*-cells carbonic acid is produced. The two results are intimately connected; and it is proper to suppose that since the carbonic acid has arisen along with the new cells, the latter operation must in some way involve a process of oxidation. Accepting the hypothesis that oxidation is attendant on these processes of cell-growth under the simplest conditions, we pass to the examination of what occurs in the lower forms of vegetable organisms found in the air.

The fungi, and, indeed, all plants that are not green, with a few exceptions, exhale carbonic acid and never exhale oxygen. In this case, in which cell-production often occurs with such marvellous rapidity, the carbonic acid must have arisen as a consequent of the cell-growth. It is improbable that it has been absorbed by roots and exhaled from the structures, either in these plants or in those produced during fermentation. In the latter there never are any roots; and in the former, even where roots are present, they bear a small proportion to the whole plant. The quantity of moisture exhaled by such growths is also insignificant, and out of proportion to the carbonic acid evolved. We must therefore in this case decline to accept the root-absorption hypothesis, and admit that the carbonic acid has arisen as a result of the cell-growth in the plant.

Passing to the chlorophyl-bearing plants, we find that in the Phanerogamia it is only the green parts that at any time exhale oxygen, and then only under the influence of sunshine. The other parts of the plant above the ground that are not green, viz. the stem, twigs, flowers, &c., are at all times, day and night, exhaling carbonic acid. The whole history of the plant, from the time the seed is planted till its death, is a continuous story of oxidation, *except when sunlight is falling on the leaves.* The seed is put into the ground; and during germination oxygen is absorbed and carbonic acid exhaled. If the seedling is kept in the dark, oxygen is never exhaled, only carbonic acid, and the plant not only grows, but all visible structures, except flowers, are formed in a rudimentary condition. In the light, the growth during the night time is attended by the evolution of carbonic acid, while during the daytime the bark of the stem and branches is throwing off carbonic acid. When flowers and seeds form, the evolution of carbonic acid attending this highest act of which the plant is capable is often greater than that produced at any time in many animals.

Every thing in the history of plants therefore tends to show that the evolution of their structures is inseparably attended by the formation of carbonic acid; and it seems impossible, when we consider the evolution alone, to arrive at any other opinion than that already expressed—that *all living things, whether plant or animal, absorb oxygen and evolve carbonic acid, or some other oxidized substance, as an essential condition of the evolution of their structures.*

College of the City of New York,
Sept. 12th, 1872.

VII.—Sequoia *and its History.* By Professor ASA GRAY, President of the American Association for the Advancement of Science*.

THE session being now happily inaugurated, your presiding officer of the last year has only one duty to perform before he surrenders his chair to his successor. If allowed to borrow a simile from the language of my own profession, I might liken

* An address delivered at the meeting held at Dubuque, Iowa, August 1872.

the President of this association to a biennial plant. He flourishes for the year in which he comes into existence, and performs his appropriate functions as presiding officer; when the second year comes round, he is expected to blossom out in an address and disappear. Each president, as he retires, is naturally expected to contribute something from his own investigations or his own line of study, usually to discuss some particular scientific topic.

Now, although I have cultivated the field of North-American botany with some assiduity for more than forty years, have reviewed our vegetable hosts, and assigned to no small number of them their names and their place in the ranks, yet, so far as our own wide country is concerned, I have been to a great extent a closet botanist. Until this summer I had not seen the Mississippi, nor set foot upon a prairie.

To gratify a natural interest, and to gain some title for addressing a body of practical naturalists and explorers, I have made a pilgrimage across the continent. I have sought and viewed in their native haunts many a plant and flower which for me had long bloomed unseen, or only in the *hortus siccus*. I have been able to see for myself what species and what forms constitute the main features of the vegetation of each successive region, and record (as the vegetation unerringly does) the permanent characteristics of its climate.

Passing on from the eastern district, marked by its equably distributed rainfall, and therefore naturally forest-clad, I have seen the trees diminish in number, give place to wide prairies, restrict their growth to the borders of streams, and then disappear from the boundless drier plains, have seen grassy plains change into a brown and sere desert—desert in the common sense, but hardly anywhere botanically so,—have seen a fair growth of coniferous trees adorning the more favoured slopes of a mountain-range high enough to compel summer showers—have traversed that broad and bare elevated region shut off on both sides by high mountains from the moisture supplied by either ocean, and longitudinally intersected by sierras which seemingly remain as naked as they were born—and have reached at length the westward slopes of the high mountain-barrier which, refreshed by the Pacific, bears the noble forests of the Sierra Nevada and the coast-range, and among them trees which are the wonder of the world. As I stood in their shade in the groves of Mariposa and Calaveras, and again under the canopy of the commoner redwood, raised on columns of such majestic height and ample girth, it occurred to me that I could not do better than to share with you, upon this occasion, some of the thoughts which possessed my mind.

In their development they may, perhaps, lead us up to questions of considerable scientific interest.

I shall not detain you with any remarks (which would now be trite) upon the size or longevity of these far-famed Sequoia trees, or of the sugar-pines, incense-cedar, and firs associated with them, of which even the prodigious bulk of the dominating Sequoia does not sensibly diminish the grandeur. Although no account and no photographic representation of either species of the far-famed Sequoia trees give any adequate impression of their singular majesty, still less of their beauty, yet my interest in them did not culminate merely or mainly in considerations of their size and age. Other trees in other parts of the world may claim to be older ; certain Australian gum-trees (*Eucalypti*) are said to be taller. Some, we are told, rise so high that they might even cast a flicker of shadow upon the summit of the pyramid of Cheops ; yet the oldest of them doubtless grew from seed which was shed long after the names of the pyramid-builders had been forgotten. So far as we can judge from the actual counting of the layers of several trees, no Sequoia now alive can sensibly antedate the Christian era.

Nor was I much impressed with an attraction of man's adding. That the more remarkable of these trees should bear distinguishing appellations seems proper enough; but the tablets of personal names which are affixed to many of them in the most visited groves (as if the memory of more or less notable people of our day might be made more enduring by the juxtaposition) do suggest some incongruity. When we consider that a hand's breadth at the circumference of any one of the venerable trunks so placarded has recorded in annual lines the lifetime of the individual thus associated with it, one may question whether the next hand's breadth may not measure the fame of some of the names thus ticketed for adventitious immortality. Whether it be the man or the tree that is honoured in the connexion, probably either would live as long, in fact and in memory, without it.

One notable thing about these Sequoia trees is their *isolation.* Most of the trees associated with them are of peculiar species; and some of them are nearly as local. Yet every pine, fir, and cypress in California is in some sort familiar, because it has near relatives in other parts of the world; but the redwoods have none. The redwood (including in that name the two species of "big trees") belongs to the general cypress family, but is *sui generis.* Thus isolated systematically, and extremely isolated geographically, and so wonderful in size and port, they, more than other trees, suggest questions.

Were they created thus local and lonely, denizens of California only—one in limited numbers in a few choice spots on the Sierra Nevada, the other along the coast-range from the Bay of Monterey to the frontiers of Oregon? Are they veritable Melchizedecs, without pedigree or early relationship, and possibly fated to be without descent?

Or are they now coming upon the stage (or rather were they coming but for man's interference) to play a part in the future?

Or are they remnants, sole and scanty survivors of a race that has played a grander part in the past, but is now verging to extinction? Have they had a career? and can that career be ascertained or surmised, so that we may at least guess whence they came, and how and when?

Time was, and not long ago, when such questions as these were regarded as useless and vain, when students of natural history, unmindful of what the name denotes, were content with a knowledge of things as they now are, but gave little heed as to how they came to be so. Now such questions are held to be legitimate, and perhaps not wholly unanswerable. It cannot now be said that these trees inhabit their present restricted areas simply because they are there placed in the climate and soil of all the world most congenial to them. These must indeed be congenial or they would not survive. But when we see how Australian *Eucalyptus* trees thrive upon the Californian coast, and how these very redwoods flourish upon another continent—how the so-called wild oat (*Avena sterilis*) of the Old World has taken full possession of California —how that cattle and horses, introduced by the Spaniard, have spread as widely and made themselves as much at home on the plains of La Plata as on those of Tartary, and that the cardoon-thistle seeds, and others they brought with them, have multiplied there into numbers probably much exceeding those extant in their native lands; indeed, when we contemplate our own race and our own particular stock taking such recent but dominating possession of this New World—when we consider how the indigenous flora of islands generally succumbs to the foreigners which come in the train of man, and that most weeds (*i. e.* the prepotent plants in open soil) of all temperate climates are not "to the manor born," but are self-invited intruders, —we must needs abandon the notion of any primordial and absolute adaptation of plants and animals to their habitats, which may stand in lieu of explanation and so preclude our inquiring any further. The harmony of Nature and its admirable perfection need not be regarded as inflexible and changeless. Nor need Nature be likened to a statue or a cast in rigid bronze, but rather to an organism with play and adaptability of parts, and life and even soul informing the whole. Under the former view Nature would be "the faultless monster which the world ne'er saw," but inscrutable as the Sphinx, whom it were vain, or worse, to question of the whence and whither. Under the other, the perfection of nature, if relative, is multifarious and ever renewed, and much that is enigmatical now may find explanation in some record of the past.

That the two species of redwood we are contemplating originated as they are and where they are, and for the part they are now playing, is, to say the least, not a scientific supposition, nor in any sense a probable one. Nor is it more likely that they are destined to play a conspicuous part in the future, or that they would have done so, even if the Indian's fires and white man's axe had spared them. The redwood of the coast (*Sequoia sempervirens*) had the stronger hold upon existence, forming as it did large forests throughout a narrow belt about 300 miles in length, and being so tenacious of life that every large stump sprouts into a copse. But it does not pass the Bay of Monterey, nor cross the line of Oregon, although so grandly developed not far below it. The more remarkable *Sequoia gigantea* of the Sierra exists in numbers so limited that the separate groves may be reckoned upon the fingers, and the trees of most of them have been counted, except near their southern limit, where they are said to be more copious. A species limited in individuals holds its existence by a precarious tenure; and this has a foothold only in a few sheltered spots, of a happy mean in temperature and locally favoured with moisture in summer. Even there, for some reason or other, the pines with which they are associated (*Pinus Lambertiana* and *P. ponderosa*), the firs (*Abies grandis* and *A. amabilis*), and even the incense-cedar (*Libocedrus decurrens*) possess a great advantage, and, though they strive in vain to emulate their size, wholly overpower the Sequoias in numbers. "To him that hath shall be given;" the force of numbers eventually wins. At least, in the commonly visited groves *Sequoia gigantea* is invested in its last stronghold, can neither advance into more exposed positions above, nor fall back into drier and barer ground below, nor hold its own in the long run where it is, under present conditions; and a little further drying of the climate, which must once have been much moister than now, would precipitate its doom. Whatever the individual longevity, certain if not speedy is the decline of a race in which a high death-rate afflicts the young. Seedlings of the big trees occur not rarely, indeed, but in meagre proportion to those of associated trees; and small indeed is the chance that any of these will attain to "the days of the years of their fathers." "Few and evil" are the days of all the forest likely to be, while man, both barbarian and civilized, torments them with fires, fatal at once to seedlings and at length to the aged also. The forests of California, proud as the State may be of them, are already too scanty and insufficient for her uses; two lines, such as may be drawn with one sweep of a small brush over the map, would cover them all. The coast redwood, the most important tree in California, although a million times more numerous than its relative of the Sierra, is too good to live long. Such is its value for lumber and its accessibility that, judging the future by the past, it is not likely in its primæval growth to outlast its rarer fellow species.

Happily man preserves and desseminates as well as destroys. The species will probably be indefinitely preserved to science, and for ornamental and other uses, in its own and other lands; and the more remarkable individuals of the present day are likely to be sedulously cared for, all the more so as they become scarce.

Our third question remains to be answered: Have these famous Sequoias played in former times and upon a larger stage a more imposing part, of which the present is but the epilogue? We cannot gaze high up the huge and venerable trunks, which one crosses the continent to behold, without wishing that these patriarchs of the grove were able, like the long-lived antediluvians of scripture, to hand down to us through a few generations the traditions of centuries, and so tell us somewhat of the history of their race. Fifteen hundred annual layers have been counted, or satisfactorily made out, upon one or two fallen trunks; it is probable that close to the heart of some of the living trees may be found the circle that records the year of our Saviour's nativity. A few generations of such trees might carry the history a long way back; but the ground they stand upon, and the marks of very recent geological change and vicissitude in the region around, testify that not very many such generations can have flourished just there, at least in an unbroken series. When their site was covered by glaciers these Sequoias must have occupied other stations, if, as there is reason to believe, they then existed in the land.

I have said that the redwoods have no near relatives in the country of their abode, and none of their genus anywhere else. Perhaps something may be learned of their genealogy by inquiring of such relatives as they have. There are only two of any particular nearness of kin; and they are far away. One is the bald cypress, our southern cypress (*Taxodium*), inhabiting the swamps of the Atlantic coast from Maryland to Texas, thence extending into Mexico: it is well known as one of the largest trees of our Atlantic forest-district; and although it never (except perhaps in Mexico, and in rare instances) attains the portliness of its western relatives, yet it may equal them in longevity. The other relative is *Glyptostrobus*, a sort of modified *Taxodium*, being about as much like our bald cypress as one species of redwood is like the other.

Now species of the same type, especially when few and the type peculiar, are in a general way associated geographically, *i. e.* inhabit the same country or (in a large sense) the same region. Where it is not so, where near relatives are separated, there is usually something to be explained. Here is an instance. These four trees, sole representatives of their tribe, dwell almost in three separate quarters of the world—the two redwoods in California, the bald cypress in Atlantic North America, its near relative, *Glyptostrobus*, in China.

It was not always so. In the tertiary period, the geological botanists assure us, our own very *Taxodium*, or bald cypress, and a *Glyptostrobus* exceedingly like the present Chinese tree, and more than one *Sequoia* coexisted in a fourth quarter of the globe, viz. in Europe! This brings up the question: Is it possible to bridge over these four wide intervals of space and the much vaster interval of time, so as to bring these extraordinarily separated relatives into connexion? The evidence which may be brought to bear upon this question is various and widely scattered. I bespeak your patience while I endeavour to bring together in an abstract the most important points of it.

Some interesting facts may come out by comparing generally the botany of the three remote regions, each of which is the sole home of one of these three genera—i. e. *Sequoia* in California, *Taxodium* in the Atlantic United States, and *Glyptostrobus* in China, which compose the whole of the peculiar tribe under consideration.

Note then, first, that there is another set of three or four peculiar trees, in this case of the yew family, which has just the same peculiar distribution, and which therefore may have the same explanation, whatever that explanation be. The genus *Torreya*, which commemorates our botanical Nestor and a former president of this association (Dr. Torrey), was founded upon a tree rather lately discovered (that is, about thirty-five years ago) in northern Florida. It is a noble yew-like tree and very local, being known only for a few miles along the shores of a single river. It seems as if it had somehow been crowded down out of the Alleghanies into its present limited southern quarters; for in cultivation it evinces a northern hardiness. Now another species of *Torreya* is a characteristic tree of Japan; and the same, or one very like it indeed, inhabits the Himalayas—belongs therefore to the Eastern Asiatic temperate region, of which China is a part, and Japan, as we shall see, the portion most interesting to us. There is only one more species of *Torreya*; and that is a companion of the redwoods in California; it is the tree locally known under the name of the California nutmeg. In this case the three are near brethren, species of the same genus, known nowhere else than in these three habitats.

Moreover the *Torreya* of Florida has growing with it a yew tree, and the trees of that grove are the only yew trees of Eastern America; for the yew of our northern woods is a decumbent shrub. The only other yew trees in America grow with the redwoods and the other *Torreya* in California, and more plentifully further north, in Oregon. A yew tree equally accompanies the *Torreya* of Japan and the Himalayas; and this is apparently the same as the common yew of Europe.

So we have three groups of trees of the great coniferous order which agree in this peculiar geographical distribution:—the redwoods and their relatives, which differ widely enough to be termed a different genus in each region; the Torreyas, more nearly akin, merely a different species in each region; the yews, perhaps all of the same species, perhaps not quite that (for opinions differ and can hardly be brought to any decisive test). The yews of the Old World, from Japan to Western Europe, are considered the same; the very local one in Florida is slightly different; that of California and Oregon differs a very little more; but all of them are within the limits of variation of many a species. However that may be, it appears to me that these several instances all raise the same question, only with a different degree of emphasis, and, if to be explained at all, will have the same kind of explanation. But the value of the explanation will be in proportion to the number of facts it will explain.

Continuing the comparison between the three regions with which we are concerned, we note that each has its own species of pines, firs, larches, &c., and of a few deciduous-leaved trees, such as oaks and maples; all of which have no peculiar significance for the present purpose, because they are of genera which are common all round the northern hemisphere. Leaving these out of view, the noticeable point is that the vegetation of California is most strikingly unlike that of the Atlantic United States. They possess some plants, and some peculiarly American plants, in common—enough to show, as I imagine, that the difficulty was not in the getting from the one district to the other, or into both from a common source, but in abiding there. The primordially unbroken forest of Atlantic North America, nourished by rainfall distributed throughout the year, is widely separated from the western region of sparse and discontinuous tree-belts of the same latitude on the western side of the continent, where summer rain is wanting or nearly so, by immense treeless plains and plateaux of more or less aridity, traversed by longitudinal mountain-ranges of a similar character. Their nearest approach is at the north, in the latitude of Lake Superior, where, on a more rainy line, trees of the Atlantic forest and that of Oregon may be said to interchange. The change of species and of the aspect of vegetation in crossing, say on the forty-seventh parallel, is slight in comparison with that on the thirty-seventh or near it. Confining our attention to the lower latitude, and under the exceptions already specially noted, we may say that almost every characteristic form in the vegetation of the Atlantic States is wanting in California, and the characteristic plants and trees of California are wanting here.

California has no *Magnolia*, nor tulip-trees, nor star-anise tree, no so-called papaw (*Asimina*), no barberry of the common single-leaved sort, no *Podophyllum* or other of the peculiar associated genera, no *Nelumbo* nor white water-lily, no prickly ash nor sumach, no loblolly-bay nor *Stuartia*, no basswood or linden-trees, neither locust, honey-locust, coffee-trees (*Gymnocladus*), nor yellow-wood (*Cladrastis*), nothing answering to *Hydrangea* or witch-hazel, to gum-trees (*Nyssa* and *Liquidambar*), *Viburnum* or *Diervilla*; it has few asters and golden-rods, no lobelias, no huckle-berries, and hardly any blue-berries—no *Epigæa*, charm of our earliest eastern spring, tempering an icy April wind with a delicious wild fragrance—no *Kalmia*, nor *Clethra*, nor holly, nor persimmon—no catalpa tree, nor trumpet-creeper (*Tecoma*)—nothing answering to sassafras, or to benzoin tree, or to hickory—neither mulberry nor elm—no beech, true chestnut, hornbeam, nor ironwood, nor a proper birch tree; and the enumeration might be continued very much further by naming herbaceous plants and others familiar only to botanists.

In their place California is filled with plants of other types, trees, shrubs, and herbs, of which I will only remark that they are, with one or two exceptions, as different from the plants of the eastern Asiatic region with which we are concerned (Japan, China, and Mandchuria) as they are from those of Atlantic North America. Their near relatives, when they have any in other lands, are mostly southward, on the Mexican plateau, or many as far south as Chili. The same may be said of the plants of the intervening great plains, except that northward and in the subsaline vegetation there are some close alliances with the flora of the steppes of Siberia. And along the crests of high mountain-ranges the arctic alpine flora has sent southward more or less numerous representatives through the whole length of the country.

If we now compare, as to their flora generally, the Atlantic United States with Japan, Mandchuria, and Northern China, *i. e.* eastern North America with eastern North Asia (half the earth's circumference apart), we find an astonishing similarity. The larger part of the genera of our own region which I have enumerated as wanting in California are present in Japan or Mandchuria, along with many other peculiar plants, divided between the two. There are plants enough of the one region which have no representatives in the other. There are types which appear to have reached the Atlantic States from the south; and there is a larger infusion of subtropical Asiatic types into temperate China and Japan: among these there is no relationship between the two countries to speak of. There are also, as I have already said, no small number of genera and some species which, being common all round or partially round the northern temperate zone, have no special significance because of their occurrence in these two antipodal floras, although they have testimony to bear upon the general question of geographical distribution. The point to be remarked is that many or even most of the genera and species which are peculiar to North America as compared with Europe, and largely peculiar to Atlantic North America as compared with the Californian region, are also represented in Japan and Mandchuria, either by identical or by closely similar forms! The same rule holds on a more northward line, although not so strikingly. If we compare the plants, say of New England and Pennsylvania (lat. 45°–47°), with those of Oregon, and then with those of North-eastern Asia, we shall find many of our own curiously repeated in the latter, while only a small number of them can be traced along the route even so far as the western slope of the Rocky Mountains. And these repetitions of Eastern American types in Japan and neighbouring districts are in all degrees of likeness. Sometimes the one is undistinguishable from the other; sometimes there is a difference of aspect, but hardly of a tangible character; sometimes the two would be termed marked varieties if they grew naturally in the same forest or in the same region; sometimes they are what the botanist calls representative species, the one answering closely to the other, but with some differences regarded as specific; sometimes the two are merely of the same genus, or not quite that, but of a single or very few species in each country,—when the point which interests us is that this peculiar limited type should occur in two antipodal places, and nowhere else.

It would be tedious and, except to botanists, abstruse to enumerate instances; yet the whole strength of the case depends upon the number of such instances. I propose, therefore, if the Association does me the honour to print this discourse, to append in a note a list of the more remarkable ones. But I would here mention two or three cases as specimens.

Our *Rhus toxicodendron*, or poison-ivy, is very exactly repeated in Japan, but is found in no other part of the world, although a species much like it abounds in California. Our other poisonous *Rhus* (*R. venenata*), commonly called poison dogwood, is in no way represented in Western America, but has so close an analogue in Japan that the two were taken for the same by Thunberg and Linnæus, who called them *R. vernix*.

Our northern fox-grape (*Vitis labrusca*) is wholly confined to the Atlantic States, except that it reappears in Japan and that region.

The original *Wistaria* is a woody leguminous climber with showy blossoms, native to the Middle Atlantic States; the other species, which we so much prize in cultivation, *W. sinensis*, is from China, as its name denotes, or perhaps only from Japan, where it is certainly indigenous.

Our yellow wood (*Cladrastis*) inhabits a very limited district on the western slope of the Alleghanies. Its only and very near relative (*Maackia*) is in Mandchuria.

The *Hydrangeas* have some species in our Alleghany region. All the rest belong to the Chino-Japanese region and its continuation westward. The same may be said of *Philadelphus*, except that there are one or two mostly very similar in California and Oregon.

Our blue cohosh (*Caulophyllum*) is confined to the woods of the Atlantic States, but has lately been discovered in Japan. A peculiar relative of it, *Diphylleia*, confined to the higher Alleghanies, is also repeated in Japan, with a slight difference, so that it may barely be distinguished as another species. Another relative is our twin leaf, *Jeffersonia*, of the Alleghany region alone. A second species has lately turned up in Mandchuria. A relative of this is *Podophyllum*, our mandrake, a common inhabitant of the Atlantic United States, but found nowhere else. There is one other species of it; and that is in the Himalayas. Here are four most peculiar genera of one family, each of a single species in the Atlantic United States, which are duplicated on the other side of the world, either in identical or almost identical species, or in an analogous species, while nothing else of the kind is known in any other part of the world.

I ought not to omit ginseng, the root so prized by the Chinese, which they obtained from their northern provinces and Mandchuria, and which is now known to inhabit Corea and Northern Japan. The Jesuit Fathers identified the plant in Canada and the Atlantic States, brought over the Chinese name by which we know it, and established the trade in it, which was for many years most profitable. The exportation of ginseng to China has probably not yet entirely ceased. Whether the Asiatic and the Atlantic American ginsengs are exactly of the same species or not is somewhat uncertain; but they are hardly if at all distinguishable.

There is a shrub, *Elliottia*, which is so rare and local that it is known only at two stations on the Savannah river in Georgia. It is of peculiar structure, and was without near relative until one was lately discovered in Japan (in *Tripetaleia*) so like it as hardly to be distinguishable except by having the parts of the blossom in threes instead of fours, a difference which is not uncommon in the same genus or even in the same species.

Suppose *Elliottia* had happened to be collected only once, a good while ago, and all knowledge of the limited and obscure locality was lost; and meanwhile the Japanese form came to be known. Such a case would be parallel with an actual one. A specimen of a peculiar plant, *Shortia galacifolia*, was detected in the herbarium of the elder Michaux, who collected it (as his autograph ticket shows) somewhere in the high Alleghany mountains more than eighty years ago. No one has seen the living plant since, or knows where to find it, if haply it still flourishes in some secluded spot. At length it is found in Japan; and I had the satisfaction of making the identification*. One other relative is also known in Japan; and another, still unpublished, has just been detected in Thibet.

Whether the Japanese and the Alleghanian plants are exactly the same or not, it needs complete specimens of the two to settle. So far as we know they are just alike. And even if some difference were discerned between them, it would not appreciably alter the question as to how such a result came to pass. Each and every one of the analogous cases I have been detailing (and very many more could be mentioned) raises the same question and would be satisfied with the same answer.

* Amer. Journ. Science, 1867, p. 402; Proc. Amer. Acad. viii. p. 244.

These singular relations attracted my curiosity early in the course of my botanical studies, when comparatively few of them were known, and my serious attention in later years, when I had numerous and new Japanese plants to study in the collections made by Messrs. Williams and Morrow during Commodore Perry's visit in 1853, and especially by Mr. Charles Wright in Commodore Rodgers's expedition in 1855. I then discussed this subject somewhat fully, and tabulated the facts within my reach*.

This was before Heer had developed the rich fossil botany of the arctic zone, before the immense antiquity of existing species of plants was recognized, and before the publication of Darwin's now famous volume on the Origin of Species had introduced and familiarized the scientific world with those now current ideas respecting the history and vicissitudes of species, with which I attempted to deal in a tentative and feeble way.

My speculation was based upon the former glaciation of the northern temperate zone, and the inference of a warmer period preceding (and perhaps following). I considered that our own present vegetation, or its proximate ancestry, must have occupied the arctic and subarctic regions in pliocene times, and that it had been gradually pushed southward as the temperature lowered and the glaciation advanced even beyond its present habitation—that plants of the same stock and kindred, probably ranging round the arctic zone as the present arctic species do, made their forced migration southward upon widely different longitudes, and receded more or less as the climate grew warmer—that the general difference of climate which marks the eastern and the western sides of the continents (the one extreme, the other mean) was doubtless even then established, so that the same species and the same sorts of species would be likely to secure and retain foothold in the similar climates of Japan and the Atlantic United States, but not in intermediate regions of different distribution of heat and moisture, so that different species of the same genus, as in *Torreya*, or different genera of the same group, as Redwood, *Taxodium*, and *Glyptostrobus*, or different associations of forest trees, might establish themselves each in the region best suited to its particular requirements, while they would fail to do so in any other. These views implied that the sources of our actual vegetation, and the explanation of these peculiarities, were to be sought in and presupposed an ancestry in pliocene or still earlier times occupying the high northern regions. And it was thought that the occurrence of peculiarly North-

* Mem. Amer. Acad. vol. vi.

American genera in Europe in the tertiary period (such as *Taxodium*, *Carya*, *Liquidambar*, *Sassafras*, *Negundo*, &c.) might be best explained on the assumption of early interchange and diffusion through North Asia, rather than by that of the fabled Atlantis.

The hypothesis supposed a gradual modification of species in different directions under altering conditions, at least to the extent of producing varieties, subspecies, and representative species, as they may be variously regarded—likewise the single and local origination of each type, which is now almost universally taken for granted.

The remarkable facts in regard to the Eastern-American and Asiatic floras, which these speculations were to explain, have since increased in number—more especially through the admirable collections of Dr. Maximowicz in Japan and adjacent countries, and the critical comparisons he has made and is still engaged upon.

I am bound to state that in a recent general work* by a distinguished botanist, Professor Grisebach, of Göttingen, these facts have been emptied of all special significance, and the relations between the Japanese and the Atlantic United States floras declared to be no more intimate than might be expected from the situation, climate, and present opportunity of interchange. This extraordinary conclusion is reached by regarding as distinct species all the plants common to both countries between which any differences have been discerned, although such differences would probably count for little if the two inhabited the same country, thus transferring many of my list of identical to that of representative species, and then by simply eliminating from consideration the whole array of representative species, *i. e.* all cases in which the Japanese and the American plant are not exactly alike,—as if, by pronouncing the cabalistic word *species*, the question were settled, or rather the greater part of it remanded out of the domain of science—as if, while complete identity of forms implies community of region, any thing short of it carries no presumption of the kind—so leaving all these singular duplicates to be wondered at, indeed, but wholly beyond the reach of inquiry.

Now the only known cause of such likeness is inheritance; and as all transmission of likeness is with some difference in individuals, and as changed conditions have resulted, as is well known, in very considerable differences, it seems to me that if the high antiquity of our actual vegetation could be rendered probable, not to say certain, and the former habitation of any of our species, or of very near relatives of them in high northern

* Die Vegetation der Erde nach ihrer klimatischen Anordnung. 1871.

regions could be ascertained, my whole case would be made out. The needful facts, of which I was ignorant when my essay was published, have now been for some years made known, thanks mainly to the researches of Heer upon ample collections of arctic fossil plants. These are confirmed and extended through new investigations by Heer and Lesquereux, the results of which have been indicated to me by the latter.

The *Taxodium* which everywhere abounds in the miocene formations in Europe, has been specifically identified, first by Goeppert, then by Heer, with our common cypress of the Southern States. It has been found fossil in Spitzbergen, Greenland, and Alaska, in the latter country along with the remains of another form, distinguishable, but very like the common species; and this has been identified by Lesquereux in the miocene of the Rocky Mountains. So there is one species of tree which has come down essentially unchanged from the tertiary period, which for a long while inhabited both Europe and North America, and also at some part of the period the region which geographically connects the two (once doubtless much more closely than now), but has survived only in the Atlantic United States and Mexico.

The same *Sequoia* which abounds in the same miocene formations in Northern Europe has been abundantly found in those of Iceland, Spitzbergen, Greenland, Mackenzie river, and Alaska. It is named *S. Langsdorffii*, but is pronounced to be very much like *S. sempervirens*, our living redwood of the Californian coast, and to be the ancient representative of it. Fossil specimens of a similar, if not the same, species have been recently detected in the Rocky Mountains by Hayden, and determined by our eminent palæontological botanist, Lesquereux; and he assures me that he has the common redwood itself from Oregon, in a deposit of tertiary age. Another *Sequoia* (*S. Sternbergii*), discovered in miocene deposits in Greenland, is pronounced to be the representative of *S. gigantea*, the big tree of the Californian sierra. If the *Taxodium* of tertiary time in Europe and throughout the arctic regions is the ancestor of our present bald cypress, which is assumed in regarding them as specifically identical, then I think we may, with our present light, fairly assume that the two redwoods of California are the direct or collateral descendents of the two ancient species which so closely resemble them.

The forests of the arctic zone in tertiary times contained at least three other species of *Sequoia*, as determined by their remains, one of which, from Spitzbergen, also much resembles the common redwood of California. Another, "which appears to have been the commonest coniferous tree on Disco," was common in England and some other parts of Europe. So the Sequoias, now remarkable for their restricted station and numbers, as well as for their extraordinary size, are of an ancient stock; their ancestors and kindred formed a large part of the forests which flourished throughout the polar regions, now desolate and ice-clad, and which extended into low latitudes in Europe. On this continent one species at least had reached to the vicinity of its present habitat before the glaciation of the region. Among the fossil specimens already found in California, but which our trustworthy palæontological botanist has not yet had time to examine, we may expect to find evidence of the early arrival of these two redwoods upon the ground which they now, after much vicissitude, scantily occupy.

Differences of climate, or circumstances of migration, or both, must have determined the survival of *Sequoia* upon the Pacific, and of *Taxodium* upon the Atlantic coast; and still the redwoods will not stand in the east, nor could our *Taxodium* find a congenial station in California.

As to the remaining near relative of *Sequoia*, the Chinese *Glyptostrobus*, a species of it, and its veritable representative, was contemporaneous with *Sequoia* and *Taxodium*, not only in temperate Europe, but throughout the arctic regions from Greenland to Alaska. Very similar would seem to have been the fate of a more familiar gymnospermous tree, the gingko or *Salisburia*. It is now indigenous to Japan only. Its ancestor, as we may fairly call it (since, according to Heer, "it corresponds so entirely with the living species that it can scarcely be separated from it"), once inhabited Northern Europe and the whole arctic region round to Alaska, and had even a representative further south in our Rocky-Mountain district. For some reason, this and *Glyptostrobus* survived only on the shores of Eastern Asia.

Libocedrus, on the other hand, appears to have cast in its lot with the Sequoias. Two species, according to Heer, were with them in Spitzbergen. Of the two now living, *L. decurrens* (the incense cedar) is one of the noblest associates of the present redwoods; the other is far south, in the Andes of Chili.

The genealogy of the Torreyas is more obscure; yet it is not unlikely that the yew-like trees named *Taxites*, which flourished with the Sequoias in the tertiary arctic forests, are the remote ancestors of the three species of *Torreya*, now severally in Florida, in California, and in Japan.

As to the pines and firs, these were more numerously associated with the ancient Sequoias of the polar forests than with their present representatives, but in different species, apparently more like those of Eastern than of Western North America. They must have encircled the polar zone then, as they encircle the present temperate zone now.

I must refrain from all enumeration of the angiospermous or ordinary deciduous trees and shrubs which are now known by their fossil remains to have flourished throughout the polar regions when Greenland better deserved its name, and enjoyed the present climate of New England and New Jersey. Then Greenland and the rest of the north abounded with oaks, representing the several groups of species which now inhabit both our eastern and western forest districts—several poplars, one very like our balsam poplar or balm-of-Gilead tree—more beeches than there are now, a hornbeam, and a hop hornbeam, some birches, a persimmon, and a plane-tree, near representatives of those of the Old World, at least of Asia, as well as of Atlantic North America, but all wanting in California—one *Juglans* like the walnut of the Old World, and another like our black walnut—two or three grape-vines, one near our Southern fox grape or muscadine, the other near our Northern frost grape—a *Tilia* very like our basswood of the Atlantic States only, a *Liquidambar*, a *Magnolia* which recalls our *M. grandiflora*, a *Liriodendron*, sole representative of our tulip-tree, and a sassafras very like the living tree.

Most of these, it will be noticed, have their nearest or their only living representatives in the Atlantic States—and when elsewhere, mainly in Eastern Asia. Several of them, or of species like them, have been detected in our tertiary deposits west of the Mississippi, by Newberry and Lesquereux.

Herbaceous plants, as it happens, are rarely preserved in a fossil state; else they would probably supply additional testimony to the antiquity of our existing vegetation, its wide diffusion over the northern and now frigid zone, and its enforced migrations under changes of climate.

Concluding, then, as we must, that our existing vegetation, as a whole, is a continuation of that of the tertiary period, may we suppose that it absolutely originated then? Evidently not. The preceding Cretaceous period has furnished to Carruthers in Europe a fossil fruit like that of the *Sequoia gigantea* of the famous groves, associated with pines of the same character as those that accompany the present tree—has furnished to Heer, from Greenland, two more Sequoias, one of them identical with a tertiary species, and one nearly allied to *Sequoia Langsdorfii*, which in turn is a probable ancestor of the common Californian redwood—has furnished to Lesquereux in North America the remains of another ancient *Sequoia*, a *Glyptostrobus*, a *Liquidambar* which well represents our sweet-gum tree, oaks analogous to living ones, leaves of a plane-tree which are also in the tertiary and are scarcely distinguishable from our own *Platanus occidentalis*, of a magnolia and tulip-tree, and "of a sassafras undistinguishable from our living species." I need not continue the enumeration. Suffice it to say that the facts will justify the conclusion which Lesquereux (a very scrupulous investigator) has already announced, "That the essential types of our actual flora are marked in the Cretaceous period, and have come to us after passing, without notable changes, through the tertiary formations of our continent."

According to these views, as regards plants at least, the adaptation to successive times and changed conditions has been maintained, not by absolute renewals, but by gradual modifications. I, for one, cannot doubt that the present existing species are the lineal successors of those that garnished the earth in the old time before them, and that they were as well adapted to their surroundings then as those which flourish and bloom around us are to their conditions now. Order and exquisite adaptation did not wait for man's coming, nor were they ever stereotyped. Organic Nature (by which I mean the system and totality of living things, and their adaptation to each other and to the world), with all its apparent and indeed real stability, should be likened, not to the ocean, which varies only by tidal oscillations from a fixed level to which it is always returning, but rather to a river so vast that we can neither discern its shores nor reach its sources, whose onward flow is not less actual because too slow to be observed by the Ephemeræ which hover over its surface or are borne upon its bosom.

Such ideas as these, though still repugnant to some, and not long since to many, have so possessed the minds of the naturalists of the present day that hardly a discourse can be pronounced or an investigation prosecuted without reference to them. I suppose that the views here taken are little if at all in advance of the average scientific mind of the day. I cannot regard them as less noble than those which they are succeeding.

An able philosophical writer, Miss Frances Power Cobbe, has recently and truthfully said*:—

"It is a singular fact that when we can find out how any thing is done, our first conclusion seems to be that God did not do it. No matter how wonderful, how beautiful, how intimately complex and delicate has been the machinery which

* "Darwinism in Morals," in Theological Review, April 1871.

has worked, perhaps for centuries, perhaps for millions of ages, to bring about some beneficent result, if we can but catch a glimpse of the wheels, its divine character disappears."

I agree with the writer that this first conclusion is premature and unworthy; I will add, deplorable. Through what faults or infirmities of dogmatism on the one hand and scepticism on the other it came to be so thought, we need not here consider. Let us hope, and I confidently expect, that it is not to last—that the religious faith which survived without a shock the notion of the fixity of the earth itself, may equally outlast the notion of the absolute fixity of the species which inhabit it—that, in the future even more than in the past, faith in an *order*, which is the basis of science, will not (as it cannot reasonably) be dissevered from faith in an *Ordainer*, which is the basis of religion.

VIII.—*Physico-chemical Investigations upon the Aquatic Articulata.* By M. Félix Plateau. Part II.*

The first part of my investigations, of which an abstract was published in this Journal in 1871 (vol. vii. p. 362), contained the results of my experiments on the causes of the death of the freshwater Articulata in sea-water, and of the marine Articulata in fresh water.

In the present memoir I take up three other interesting questions connected with the life of the aquatic Articulata—questions of detail indeed, the solution of which could not open any new vista in comparative physiology, but which, carefully treated, have led me by numerous experiments to curious and sometimes unexpected results.

I. *Experiments on the time during which the aquatic Articulata can remain in the water without coming to the surface to breathe.*

The swimming aquatic Articulata with aërial respiration (Coleoptera in the perfect state and Hemiptera) come frequently to the surface to renew their provision of air. If we prevent them from performing this operation, what will be the time during which they may with impunity be subjected to submersion? Is their resistance to asphyxia greater than that of terrestrial insects? or only equal or inferior to it?

The experiments were effected as follows: at the bottom of an open vase of the capacity of one litre, and full of ordinary spring water aërated, a smaller vessel containing about 200 cubic centimetres is placed; a piece of cotton net is stretched

* Bulletin de l'Acad. Roy. de Belgique, 2e sér. tome xxxiv. nos. 9 & 10, 1872. From an Abstract by the Author.

over the orifice of the latter, in such a way that an insect placed in this smaller vessel is actually in the general mass of water, but cannot rise to its surface.

Terrestrial insects placed in these conditions ascend, carried by their specific levity, till they rest against the lower surface of the net; the movements of their feet soon cease, they do not seem to suffer, and quickly become insensible. The aquatic Coleoptera and Hemiptera on the contrary, instead of submitting passively to their fate, seek to escape from their prison, swim about rapidly, endeavour to rise to the surface, and continue their agitation until their forces become weakened, and they finally remain as if dead at the bottom.

To cause an insect which has been subjected to a prolonged immersion to recover from its state of insensibility, it is necessary, after taking it out of the water, to dry it with bibulous paper. If the duration of the submersion has not exceeded a certain limit, the animal gradually recovers its original activity, the trial it has undergone leaving no sensible traces upon it.

These experiments were of course repeated as much as possible upon several individuals and with different durations, so as to ascertain for each species the limit of time after which the insect was actually dead. I have thus arrived at the following two curious conclusions, which are supported by a great number of experiments.

1. Terrestrial Coleoptera resist complete submersion during a very long time (from three to four days). For example,

Oryctes nasicornis	resists a	submersion of	96 hours.
Agelastica alni	”	”	72 ”
Carabus auratus	”	”	71 h. 30 m.

2. Natatory aquatic Coleoptera and Hemiptera, far from presenting a greater resistance to asphyxia by submersion, are no better endowed in this respect than terrestrial insects, and even perish in most cases much more rapidly. I cite the following numbers from the tables in my memoir:—

A *Dytiscus marginalis* ♂	died	at the end of	65 h. 30 m.
An *Acilius sulcatus* ♀	”	”	24 hours.
A *Nepa cinerea*	”	”	31 ”
A *Notonecta glauca*	”	”	3 ”

The cause of this unexpected inferiority of the aquatic insects seems to consist exclusively in their greater activity in the water, and consequently in a more rapid expenditure of oxygen.

II. *Influence of cold: effects of congelation.*

What is the lowest temperature that the aquatic Articulata that we meet with in winter in these regioas can endure? can they remain with impunity fixed in the ice for a certain time? And, in the event of a negative answer, what is the cause of the mischief observed?

The aquatic Articulata of our latitudes exist indefinitely in water kept by means of melting ice at a temperature of 32° F. As soon as we have recourse to lower temperatures, the water freezes, and the question then arises to ascertain how long the animals can remain completely fixed in ice at 32° F.

All the experiments were made in winter upon the species which are met with in Belgium in December and January. They consisted in placing an aquatic insect or crustacean, together with the bulb of a Centigrade thermometer, in a thin glass tube containing a little water and surrounded by a freezing-mixture intended to produce the complete congelation of the liquid. Care was taken not to allow the temperature of the ice formed ever to descend below 0° C. After the lapse of a certain time the tube was taken out of the freezing-mixture and immersed in water of the temperature of the room, when, as soon as a commencement of fusion permitted, the lump of ice was extracted from the tube and put directly into water, in order to hasten the disengagement of the animal.

The analysis of the results which I have obtained shows that the time during which the aquatic Articulata may be fixed in ice without perishing is excessively short, the longest resistance not having reached half an hour. The following numbers will give an idea of the rapidity with which death ensues under these circumstances:—

	Imprisonment in ice at 0° C. (32° F.).		
	Maximum period supported without being followed by immediate death.		Period which inevitably causes death.
	minutes.	sec.	minutes.
Agabus bipustulatus	Between 15 and 20	0	25
Hydroporus lineatus	" 25 " 30	0	30
Gyrinus natator	" 10 " 15	0	15
Notonecta glauca	10	0	20
Corixa striata	2	0	3
Asellus aquaticus	10	0	15
Cyclops quadricornis....	1	30	2

I have endeavoured, by means of special experiments, to explain the cause of the rapid death of animals imprisoned in ice at 0° C.; but although these may, perhaps, be of a nature to interest the reader, I shall confine myself to referring for their description to my memoir. The primary cause of rapid death when Articulata are fixed in ice, seems to be the absolute privation of movement and the consequent absorption of the corporeal heat, without any possible restitution.

III. *Action of heat: maximum temperature.*

I have endeavoured to ascertain by experiment the highest temperature which our freshwater insects, Arachnida, and Crustacea can endure—in other words, what is the temperature of the hottest water in which they can live.

I have thus found that the highest temperatures endured without serious accidents oscillate between 33°·5 and 46°·2 C. (=92° and 115° F.), and consequently between very narrow limits.

These temperatures correspond with those of a certain number of known thermal springs, in the waters of which we may meet with articulate animals wherever the salts or gases in solution have no injurious action upon them.

If we compare the results with which the aquatic Articulata have furnished me with those which have been obtained by means of animals belonging to other groups, we find that the highest temperature that aquatic animals, whether vertebrate, articulate, or molluscous, are able to support probably does not exceed 46° C. (115° F.).

IX.—*Additional Notes on* Spatulemys Lasalæ. By Dr. J. E. Gray, F.R.S. &c.

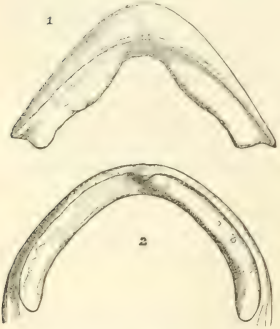
[Plate II.]

Colonel P. Perez de Lasala has brought with him several very interesting specimens from his museum, and has kindly presented to the British Museum a fine adult broad-nosed alligator, and a freshwater tortoise from Rio Paraná, Corrientes, which is quite new to our collections, and the largest example of the family that has yet been brought to Europe; I have named it, from its very depressed form, *Spatulemys*, and dedicated the species to the enterprising collector, by calling it *Spatulemys Lasalæ* (Plate II.).

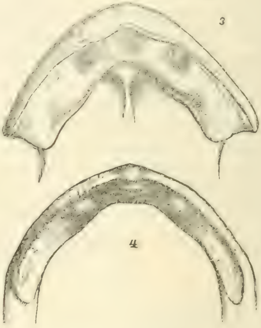
This species was characterized in the 'Annals' for 1872, x. p. 463, to which I wish to add the following particulars and comparisons with allied species, and also a figure of this very interesting animal.

The genus has many similarities to *Hydromedusa*; and I thought at one time that it might be the *H. tectifera* of Mr. Cope, brought from the Paraná or Uruguay river, and described in the 'Proc. Amer. Phil. Soc.' for 1869, p. 147; but it has a nuchal plate in the margin, and only five vertebral plates, and is quite distinct from the genus *Hydromedusa*.

The mouth is semicircular in front, with the gape wide. The palate is broad, flat, with the internal nostrils oval, rather near together, rather before the hinder end of the alveolar surface. Alveolar surfaces flat, broad, well separated from one another in front, broadest about one third their length from the front, and rather more than half the width behind, with a rounded outline. Lower jaw with a slightly concave alveolar surface, which is of the same breadth the whole of its length, and has a well developed raised sharp edge on the outer circumference and a less developed one on the inner margin. There is a well-marked conical tooth-like prominence in the front of the middle of the outer edge.



The upper and lower jaws of ***Spatulemys Lasalæ.***



The upper and lower jaws of ***Hydraspis raniceps.***

The alveolar surface, as seen in the stuffed specimen, is very like that of the skeleton of *Hydraspis raniceps*: but the alveolar plates of the upper jaw of the latter species are well separated in the middle, and the internal nostrils are much further back in the palate; and the alveolar edge of the lower jaw is even—and not with the rounded tubercle on each side, rather behind the central tube.

In *Hydraspis Gordonii* (P. Z. S. 1868, p. 563) the alveolar plates of each side of the upper jaw are separated by a narrow linear space; they are moderately wide and nearly the same width for the whole length, truncated at the front end, and gradually rounded off at the hinder end. The internal nostrils are about opposite to the midddle of the length of the alveolar plate. The alveolar surface of the lower jaw is slightly concave, with a raised edge on the hinder side; it is rather broader behind, and gradually slightly narrowed towards the front. There is a large slightly elevated rounded tubercle occupying the whole of the middle of the alveolar surfaces between the two rami, and a slight elevation on the outer margin on each side of the middle, giving the edge of the jaws rather a sinuated appearance.

X.—*On the* Macleayius australiensis *from New Zealand.* By Dr. J. E. Gray, F.R.S. &c.

Dr. Haast has sent the skeleton of a New-Zealand whale to the British Museum as that of *Caperea antipodarum*; but the examination of the bones led me at first to believe that it was *Eubalæna australis*. However, on further examination, the cervical vertebræ and the blade-bone show that it cannot belong to either of those genera; for it has a broad upper process to the atlas, while they have a small narrow one; and it has an acromial process to the scapula, which is only very rudimentary in *Caperea*, and is of very different shape in *Eubalæna*; like most whales, it has no coracoid. The form of the lobes of the atlas are so like those figured from a photograph by Mr. Krefft, which I described and figured as *Macleayius australiensis* in the 'Proc. Zool. Soc.' 1864, and in the 'Catalogue of Seals and Whales in the British Museum,' 1866, p. 105, f. 10, 11, and p. 372, f. 74, 75, that I am inclined to consider it an example of that genus, which was previously known only from a mass of cervical vertebræ in the Australian Museum at Sydney.

Upper jaw very narrow; the nasal bones oblong elongate, arched out at the front end. Cervical vertebræ united into one mass. Atlas very large and thick, with a very long upper process forming a large keeled crest, which is united to the upper process of the five following vertebræ; the upper lateral process of the atlas high, square, truncated at the end; the lower process twice as high as broad, with an oblong, rounded end. The other cervical vertebræ short, thin: the second with slender upper and lower lateral processes; the remainder with only descending superior processes (and no indication of inferior), which are slender in all but the seventh vertebra, where they are thick and truncated; and this is the only vertebra that has the upper part distinct from the bony crest. The ear-bone is very like that of *Eubalæna*. The sternum is oblong, with two or three irregular tubercles at the side. The first rib, like the others, is simple. The bladebone is triangular, rather wider than long. The acromial process is compressed, attenuated at the end, and bent outwards.

The chief difference between the mass of the cervical vertebræ and the specimen in the Sydney Museum, according to Mr. Krefft's photograph, is that the lower process of the axis in that figure appears to be rather longer and narrower at the end.

The mass of the cervical vertebræ in some respects resembles that of *Balæna mysticetus* of the Arctic seas, but differs in being much more united. It differs from *Caperea* and *Eubalæna* in having the lower lateral process of the second cervical vertebra well developed.

MISCELLANEOUS.

On the Reproduction and Development of the Telescope-fish of China. By M. Carbonnier.

The telescope-carp (*Cyprinus macrophthalmus*, Bloch; in Chinese *Long-tsing-yu*) is a native of the fresh waters of China and Japan. Its conformation is remarkably anomalous. Its body is globular; its caudal and anal fins are doubled; its eyes project from two to five centimetres from its head; in fact the entire animal is the exact model of those fishes, hitherto regarded as chimerical, that we meet with in a great many Chinese paintings. This fish seems to me to be a monstrous goldfish, a monster designedly produced by means of processes of breeding (in which the Chinese are very clever), so powerful that the original anomaly has now become hereditary.

I have already, in goldfish, met with analogous partial monstrosities, especially the gemination of the caudal fin. M. G. Pouchet, in a note presented to the Academy on the 30th May 1870, notices a similar anomaly presented by two living specimens received by him from China; but hitherto, so far as I am aware, no one has had the opportunity of studying the variety of carp which I call telescope-fish.

By the kindness of a relation, I received twenty-four specimens, all presenting the same modifications of structure; only three of these died, the remainder have recovered sufficiently to allow me to try to reproduce them since the first year.

The globular form of the body of the animal renders its equilibrium extremely unstable, and it can swim only with difficulty; hence, whilst its congener the goldfish effects its spawning by rubbing itself against aquatic plants, flexible bodies of little resistance, the telescope-fish seeks a firmer point of support, opposing a direct resistance to the impulse of the fins. It is at the bottom of the water, on the ground, that it rubs its abdomen.

While the female acts thus in oviposition, the males, which are exceedingly ardent in fecundation, pursue her several together, push her with their heads, turn her over and roll her over and over, inflicting upon her an actual punishment.

Having deposited, in a basin containing 20 cubic metres of water, four fishes belonging to a first lot, about a month afterwards (on the 14th of September last) I saw the three males pursuing the female, roll her like a ball upon the ground for a distance of several metres, and continue this conduct, without rest or relaxation, for two days, until the poor female, who had not been able to recover her equilibrium for a moment, had at last evacuated all her ova.

Being then obliged to suspend my observations, I returned a fortnight afterwards, and, carefully examining the surface and the edges of the basin, I had the satisfaction of discovering several little embryos, which swam with considerable difficulty, and which a more careful examination enabled me to recognize as the young fry of the telescope-fish.

They had the same double caudal fin, and the same sinuosity of the upper part of the back; but the eyes were not yet very prominent.

Having brought them to Paris and observed them carefully, they furnished me with the following results. At its earliest age the telescope-fish has the elongated form of most of our young fishes; the transparency of the body allows us to distinguish plainly the air-bladder, lodged in the upper part of the body, and the intestine, forming a right angle, of which the apex is opposite to the bladder. So long as the embryo lives at the expense of the umbilical vesicle, it swims easily and in a horizontal position; but subsequently the absorption of exterior aliment has for its result an abnormal and irregular development, which, in nearly half the specimens, causes a deviation from the normal position, and the animal holds itself vertically, sometimes with the head upwards, but most frequently with it downwards. The faulty position of the air-bladder and the too slight development of the fins neutralize the influence of these directive agents; the want of equilibrium persists, the young animal can no longer seek its nourishment, and it dies in two or three days. I have scarcely been able to make them live for ten or twelve days by mixing triturated animal matter with the water of my aquaria. I have, however, no doubt that the rearing of the young fry which remain will furnish me with some new facts.—*Comptes Rendus*, November 4, 1872, tome lxxv. p. 1127.

Additional Observations on Codiophyllum.
By Dr. J. E. Gray, F.R.S. &c.

More than one botanist has asked me for a specimen of *Codiophyllum* (described in the 'Annals,' for August 1872), which they wanted to examine microscopically and to unravel the fibre. The very expression shows that I have not sufficiently explained the structure of this very curious plant; but I believed that Mr. Ford's excellent figure would exhibit it better than I could explain it in words. The frond of this curious Alga is not formed of continuous fibres interlaced together, but of a number of oblong rings of a cylindrical tube, each gradually formed and all connected and anastomosed together, so as to form an expanded frond: each ring is separately formed; and when complete it sends from a part of its surface a tube of the same form, size, and structure, which gradually lengthens, after a time curves back, and unites itself to the ring from which it sprung, thus forming another ring, and in time emitting a new ring from its surface in the same manner.

Mr. Ford has attempted to show this development in his figure.

The Bell Collection of Reptiles.

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

Oxford, Dec. 16, 1872.

GENTLEMEN,—With reference to the correspondence which has appeared in the recent numbers of the 'Annals' relative to the Bell Collection of Reptiles, and with the view of enabling your readers to form a proper opinion upon the subject, I think it incumbent upon me to state:—that the negotiation for the purchase of the entire collection, on behalf of the Rev. F. W. Hope, was effected by myself with Prof. Bell in 1862; that an estimation of the extent of the collection and of the value thereof was made by Mr. S. Stevens, the Natural-History Agent; that the purchase comprised 288 specimens of tortoises (either entire or shells), about 40 dried snakes and lizards, and 1065 reptiles of various kinds in spirits; and that the collection was immediately removed by Mr. Rowell to Oxford, where it was partially arranged during the last year by Dr. Günther, of the British Museum.

I am, Gentlemen,
Your obedient Servant,
J. O. WESTWOOD.

Answer to Herr Ritsema's "Note on Crinodes Sommeri *" &c.*

By A. G. BUTLER, F.L.S. &c.

A simultaneous attack upon a new genus, in two different magazines, is calculated to impress one with the idea that the discoverer of the supposed error must have been anxious that his acumen should be widely recognized. As an answer to the entirely unwarranted supposition contained in the said paragraph, I need merely inform Herr Ritsema of one or two facts, which, had he studied my writings, he might have discovered for himself: Hübner's 'Sammlung' has been almost constantly on my table for the last seven years; and I know his figures as well as I know my own.

I do not make a practice of hunting up every conceivable resemblance in pattern between a new genus and those previously figured in works known to me; I content myself, at most, with a comparison of structure between closely allied forms*.

I did refer in my paper to the genus *Dudusa* (inadvertently written *Duduna*), a group to which *C. Sommeri* probably belongs†; I had examined two species of this genus, and therefore could speak with confidence of its relationship to *Tarsolepis.*

If Hübner was not attached to the "type system" there is no reason why *C. clara* of Cramer should not stand as the type of the genus *Crino* quite as much as *C. Sommeri.*

* When describing *Tarsolepis,* I knew for certain that the structure before me was entirely new. I admit that I did not remember at the time that Hübner's *Crino Sommeri* was so similar in pattern; had I done so, I might have referred to it as a moth resembling mine in pattern, although clearly belonging to a different genus.

† The females of *Dudusa* have a zone of spatulate scales round the tail, but of only half the length of those in the males; the antennæ are moderately pectinated, more so than in *Crinodes*: but there are no tufts of long hairs at the base of the abdomen in either sex.

The remainder of Herr Ritsema's remarks being to a great extent based upon suppositions, I shall content myself with answering his direct statements. He says that the anal tuft entirely covers the sexual organs; this is not the case with any of the specimens which I have examined, whether of *Crinodes*, *Dudusa*, or *Tarsolepis*.

As to the probability of a long curved brush of carmine hairs being concealed about the body of a *Crinodes*, it is to my mind more preposterous than it would be were our discussion respecting the identity of the Philippine *Eusemia bambusina* and the South-American *Limnas zoega*, to suggest that the difference consisted in the *Eusemia* having concealed the red spots towards the base of the wings*.

If the size of the body is dependent upon sex, it is evident that *C. Sommeri* must be a male; but as Herr Ritsema is avowedly working principally with Mr. Snellen's male, which agrees in all the most important characters with Hübner's figure, it does not signify to what sex the type of *C. Sommeri* belongs. It now seems highly probable that Herr Ritsema actually has the Hübnerian species, whilst it is more evident than ever that I have not.

The inaccuracies stated to exist in Hübner's figures are easily explicable when we know that figs. 1 and 2 represent the opposite surfaces of *C. Sommeri*, and that in fig. 2 hardly any of the inner margin is visible, so that it is impossible to decide whether it is waved or not. The mention of differences in the hind wings of fig. 1 is mere carping.

I have now no more to say on this subject until I have seen Hübner's type. If the two genera come from Java, they will probably add another to the numerous illustrations of mimetic analogy already on record; I shall not, therefore (until I have proof of some such interesting fact, by a comparison of the actual type with Javan specimens), encroach further upon the patience of the readers of this magazine.

On a Mite in the Ear of the Ox.

Prof. Leidy remarked that he had received a letter from Dr. Charles S. Turnbull, in which he stated that while studying the anatomy of the ear he had discovered in several heads of steers, at the bottom of the external auditory meatus, a number of small living parasites. They were found attached to the surface of the membrana tympani. Specimens of the parasite preserved in glycerine, and a petrosal bone with the membrana tympani to which several of the parasites were clinging, were also sent for examination. These prove to be a mite or Acarus, apparently of the genus *Gamasus*. The body is ovoid, translucent white, about three fifths of a line long, and two fifths of a line wide. The limbs, jaws, and their appendages are brown and bristled; the body is smooth or devoid of bristles. The limbs are from two fifths to half a line long. The feet are terminated by a five-lobed disk and a pair of claws; the palpi are six-jointed; the

* In other respects these two insects are as much alike as in most cases of actual mimicry.

mandibles end in pincers or chelæ, resembling lobster-claws; the movable joint of the chelæ has two teeth at the end; the opposed extremity of the fixed joint of the chelæ is narrow, and ends in a hook.

Dr. Turnbull had seen the cattle killed, and was positive that the mites occupied the position in the ear of the steers while these were alive; such being the case, the Acarus may be viewed as a parasite of the ox, and may be specifically named *Gamasus auris.*—*Proc. Acad. Nat. Sci. Philad.* 1872.

The Horns of Antilocapra. By Dr. J. E. Gray, F.R.S. &c.

The British Museum has purchased of Mr. E. Gerrard, junior, the skin of an adult male *Antilocapra* which was just developing the new horny sheath; and this was rather different from what, by observing the horns in a more developed state, I had been led to expect.

The core of the horns was covered with a thick skin, which in the dried state is black; but the apex is covered with a small conical sheath about $1\frac{3}{4}$ in. long and $\frac{7}{8}$ in. wide at the base, hard and perfectly horny, very like the horn of cattle. It is black, with a white acute tip about $\frac{1}{2}$ in. long.

The horny sheath of a more developed specimen brought at the same time has a similar hard horny tip; but the lower part of the horn is less solid and more evidently formed of felted, matted hair, which is more distinct and less compactly matted at its base or last developed part; so that it would appear that the skin of the core first develops the horny tip, and then the more spongy part formed of felted hair.

Notice of a new and remarkable Fossil Bird. By O. C. Marsh.

One of the most interesting of recent discoveries in palæontology is the skeleton of a fossil bird, found during the past summer, in the upper Cretaceous shale of Kansas, by Prof. B. F. Mudge, who has kindly sent the specimen to me for examination. The remains indicate an aquatic bird about as large as a pigeon, and differing widely from all known birds in having *biconcave vertebræ.* The cervical, dorsal, and caudal vertebræ preserved all show this character, the ends of the centra resembling those of *Plesiosaurus.* The rest of the skeleton presents no marked deviation from the ordinary avian type. The wings were large in proportion to the posterior extremities. The humerus is 58·6 millims. in length, and has the radial crest strongly developed. The femur is small, and has the proximal end compressed transversely. The tibia is slender and 44·5 millims. long; its distal end is incurved as in swimming birds, but has no supratendinal bridge. This species may be called *Ichthyornis dispar.* A more complete description will appear in an early number of Silliman's Journal.

Yale College, Sept. 26th, 1872.

THE ANNALS

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XI.—*Summary of Zoological Observations made at Naples in the winter of* 1871–72. By E. RAY LANKESTER, M.A., Fellow and Lecturer of Exeter College, Oxford.

MY chief object during a recent stay of some months in Naples was to commence a study of the general and histological development of Mollusca, with the view of ascertaining what significance is to be attributed to the various parts of their organization in the light of the "germ-layer theory," recently extended with such convincing force by the admirable observations of Kowalewsky from the Vertebrata to various groups of lower animals, such as the Vermes and the Insects.

I propose now to give a very short statement of some of these observations, as well as of others made on some of the innumerable interesting forms of marine invertebrates with which the invaluable fishermen of Santa Lucia provided me.

Development of Loligo.

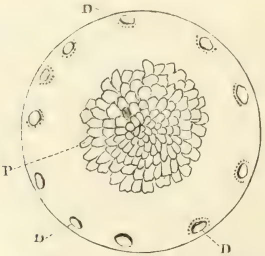
Since the time of Kölliker (1837) no contribution has been made to our knowledge of the development of Cephalopoda. A short note by Mecznikow on *Sepiola* contains very little and is not illustrated. I obtained eggs of *Loligo* first in January, and subsequently with tolerable regularity until April: they are better adapted for observation than those of *Sepia*.

The structure of the ovary is very similar to that of a bird. The branched ovary contains eggs of all sizes enclosed in vascular capsules. The basketwork marking seen on the ovarian egg is not a plication of the proper capsule, but of the surface of the vitellus, *where it is in contact with the inner cellular lining of the capsule*, which sends deeply penetrating ridges and villi into the growing egg. This cellular lining of the capsule grows very rapidly; and its cells are continually being absorbed or fused into the vitellus, whence the increase of this in size. Some of the cells retain their form and are to be found floating in the complex vitellus thus built up.

On attaining full size, the egg, having *lost entirely its large germinal vesicle*, loses all the plications or basketwork of its vitelline surface, and escapes from its capsule, which remains on the branched ovary and undergoes a yellow degeneration. Passing as a free ovoid homogeneous mass of complex yelk (protoplasm and deutoplasm, Van Beneden, combined) into the oviduct, the egg is fertilized; and then at one pole a segregation of plastic yelk, or a germinal patch, occurs in the form of a thin disk or cap. This exhibits subsequently a faint nucleus and commences to divide into two, four, eight, &c. areæ, marked out by intercrossing grooves. In some minor respects my observations differ from Kölliker's, who appears to have represented the segmentation as more regular than it is, and the resulting cells as becoming detached, which they do not.

When this superficial layer of blastodermic cells has spread over an area relatively as large as would be inclosed by the circumference of a half-crown drawn round the pole of a large hen's egg, an exceedingly remarkable fact presents itself, which has not been observed before, and which has great importance in regard to the various theories as to the origin of the "mesoderm," or a portion of that layer. Outside the primitive segmentation-area (fig. 1 P), and quite unconnected with it, appears a ring of very large pellucid nuclei, seven or eight in number (fig. 1 D); they increase in number, and a second, third, and fourth ring of such large nuclei arise, till at last they spread over the whole

Fig. 1.



egg. Meanwhile the cells of the segmentation-area spread by continual division at the free edge of the cap which they form; and *they grow over the large nuclei*, which are thus seen to lie in a lower stratum of yelk than that along which the cap of cells from the primitive segmentation is spreading. Both the segmentation-cells and the large nuclei finally cover-in the whole surface of the egg as two distinct layers. This process I observed over and over again, and repeatedly observed that the large nuclei arise, each one separately, by *segregation from the yelk-mass.* They are products of free-cell formation, and as such of the very highest interest in relation to histogenetic doctrine. The cells which pass into the ovarian egg in such enormous numbers to swell its vitelline mass become so much altered and broken down that it is not possible to regard these large nuclei as descendants from them, though no doubt they, as well as the original egg-cell's protoplasm and the fertilizing male element, have contributed to form an organic "mixture," if one may use the term, from which these free nuclei, as well as the polar segmentation-disk and nucleus, take origin.

The large pellucid nuclei subsequently become branched and stellate; whether they give rise to the whole of the elements of the layer immediately below the outer segmentation-layer it is not possible to say. If they do, contractile muscular cells must be regarded as one of their products. In any case they form the great bulk of the subepidermal tissue, that which corresponds with the mesoderm of vertebrates.

Organs now begin to appear as thickenings on the surface of the blastoderm: two eyes (the details of the primitive development of which are remarkable), two ears (which I repeatedly saw in their primitive state as two pits, holes, or in-pushings of the surface; subsequently they present the condition of capsules, each with a narrow canal opening on the surface of the head, which canal becomes eventually the little ciliated cæcum seen by Kölliker), and a median semicircular primitive mouth; besides these the mantle and arms—the position of the latter marking off the blastodermic sac into two parts, a great yelk-bag, and a smaller embryonic sac, which gradually becomes more and more distinctly pinched off and shaped out. It is not possible to say much of the further development without illustration; but I must mention two very important facts. The primitive semicircular mouth is not the real mouth. It is at this point that an inward cellular growth commences, which eats its way into the mass of homogeneous yelk lying in the embryonic portion of the blastodermic sac, and meets (how or where exactly my observations do not show) a shorter ingrowth from the anal aperture, in connexion with which is also developed the ink-bag, thus agreeing with the renal organ of Gasteropods. The *first portion of the alimentary tube* (which early appears in connexion with the primitive semicircular mouth) *becomes the yelk-duct*. The primitive mouth sinks into the yelk-bag, by the growth of its margins, in a peculiar manner; and there appears at some distance along the primitive alimentary tube *a new mouth*. It seems desirable to speak of these apertures as *primitive* and *secondary* mouth, for the sake of description; but it is a possibility that the *primitive mouth* must be considered identical with the aperture of blastodermic invagination of many Vermes and of *Amphioxus*, discovered by Kowalewsky, and observed also by me in several mollusks (Nudibranchs, *Limax*, *Pisidium*, *Mytilus*).

The second fact of especial interest in the later development of *Loligo* is the occurrence of an in-pushing from the surface in the form of a groove just below (that is, posterior to) the margin of each eye. A somewhat botryoidal mass of tissue is the result of this ingrowth, and gives rise, I believe (though I have not definitely followed out its growth), to the optic ganglion on each side. Lateral masses of tissue are seen to differentiate below the surface on either side of the œsophagus, and extend to the eyes—which may become ultimately other parts of the nervous system. The heart and large vessels develop below the surface, also without any remarkable features. The development of the mantle, gills, and cartilaginous skeleton was accurately described by Kölliker.

The "pen" or shell of *Loligo* develops in a follicle which begins to form at a very early period, and remains open to the surface of the mantle until the embryo is nearly ready to leave the egg-case.

An interesting phenomenon is the contractility of the walls of the yelk-sac, which is observed at a very early period, as soon as the first rudiments of eyes, ears, and mouth have appeared. A rhythmic wave of contraction passes continually along the wall of the sac, at that part immediately in front of the alimentary tube, and doubtless acts so as to cause a circulation of nutrient material in the direction of the young embryo. The tissue which exhibits this contractility is of the same structure (stellate cells) as that of the remarkable contractile vesicle observed in the Pulmonate Gasteropods, and which I have studied in *Limax*. It is probable that the two parts are homogenous.

I should mention that I made frequent examination of eggs of *Sepia*, but found those of *Loligo* the best fitted for study. I was unable to obtain *Argonauta* at Naples; it is to be had in quantity at Messina.

Development of Aplysia.

The development of two species of *Aplysia* was studied in considerable detail as far as the completion of the velum-bearing embryo and its escape from the egg-jelly. Various devices failed of enabling me to observe the later development of this or of several Nudibranchs which were also kept for study.

The *Aplysiæ* were :—a larger species, in which each capsule in the egg-coil contained from thirty to forty embryos ; and a smaller species, in which the number was not more than seven, usually less. The germinal vesicle escapes previously to yelk-cleavage as the "Richtungsbläschen ;" the egg then divides into two larger yellow masses and two smaller pale balls. The pale balls now divide rapidly, and grow over and enclose the larger yellow masses. By a process of multiplication (which I could not satisfy myself was accompanied in *Aplysia* by invagination, though there were indications of such a mode of growth) the pale cells give rise, not to a single layer of cells enclosing the yellow, but, at the pole whence they started, to a considerable mass or thickness of cells. The deeper of these work themselves in between the two large yellow cells and give rise to the alimentary tract ; the outermost cells form epidermis, nerve, and shell-gland, whilst an intermediate portion gives rise to muscles.

In the two species, however, there is a very curious difference: for in the larger species the two yellow cells almost as soon as they are enclosed lose their nuclei and definite outline, becoming mere granular masses, which the deep layer of pale cells rapidly invest and attach to themselves in an intimate manner ; whilst in the small species the two yellow cleavage-masses, each with its large bright nucleus, retain their form to the last (that is, as long as I studied the embryos), the deep pale cells (hypoderm, Darmdrüsenblatt) only passing between the two masses, and growing by absorption of the matter which they yielded, as was evident by their gradual thinning out and shrinking, but without being invested or themselves undergoing any formative changes. The liver-mass, and perhaps the genital glands, subsequently appear in the position occupied by these two big cells, probably growing out *into* them, not from them.

An important fact is the occurrence of cilia on tracts of the pale cells, lying deeply within the segmentation mass ; this I have also seen in the eggs of *Pisidium pusillum*.

The shell-gland is the first organ to appear in *Aplysia*, as it is also in the freshwater Lamellibranch *Pisidium*, and occurs as a groove on the surface, the cells in which take on a special development. It is in this way also that the "cuttle-bone" of *Loligo* takes its origin; and from the observation of this common mode of origin of the shells of Lamellibranchs, Gasteropods, and cuttlefish, I do not doubt that they are fundamentally identical or homogenous—that is to say, have a common ancestral representative. The pharynx and œsophagus early develop in *Aplysia* as in-pushings at the opposite pole to that at which the shell-gland appears, which latter is the pole of active segmentation in the first embryonal changes.

The supraœsophageal ganglion is clearly seen to develop as a thickening of the outer layer of cells in the prostomial region. It sends branches downwards and forwards, and gave rise to the suspicion that the subœsophageal nervous mass was but a lobe of it.

Below the mouth, in a blunt process (which is the foot) the pair of otolithic sacs (or otocysts, as M. de Lacaze-Duthiers terms them) appear; I took great pains to ascertain their earliest beginning. *They certainly never communicate with the exterior*; they have been erroneously supposed to do so in Gasteropoda; and I have established the fact that they really do so in Cephalopoda. The first appearance of each otocyst is, before any organs except the shell-gland are indicated, as a faint vesicle, with no proper walls of its own, just below the most superficial layer of cells; and I believe that it really belongs to that layer. As the foot develops, the otocyst shifts greatly its position, and acquires thicker walls and larger size. The otolith develops within the cyst at a late period; often it may be seen in one cyst and not in the other.

Development of Nudibranchs.

The eggs of species of *Doris*, of *Tethys*, *Pleurobranchus*, and others were frequently studied. I found those of *Polycera quadrilineata* and of *Eolis exigua* the most favourable for study. I was able to determine in these that the first step in development, after the formation by cleavage of the mass of embryo-cells or "polyblast," is the invagination or in-pushing of these cells at one pole, just as Kowalewsky has drawn it in *Amphioxus* and *Phallusia*, and as seen also in the Heteropod mollusk *Atalanta*. The orifice of invagination is at one time large and obvious enough, but closes entirely at a very early period. The same invagination and orifice I have made out in the Lamellibranch *Pisidium*, the development of which I studied in the spring of 1871 at Jena. I also observed it in *Limax*; and its occurrence in a similar stage in certain marine Lamellibranchs is clear from Lovén's admirable figures, though he has mistaken its significance.

Hence the two primitive layers of cells in the embryo mollusk have the same origin as in Vermes and Vertebrata; and, indeed, it would appear that the whole animal series above the Protozoa agree in possessing these two primitive layers at one time of their development. The addition to these of a third, intermediate layer, or mesoderm, is the distinguishing feature of another great branch or stem (Triploblastica), which has as its base the Vermes, and from which diverge the Mollusks, the Arthropods, the Vertebrates, the Echinoderms. That branch which retains but two layers of cells through life, the endoderm and ectoderm, includes the corals, polyps, and sponges (Diploblastica). So far biologists seem to have arrived at very promising results with the germ-layer theory. The great difficulty at present lies in the question, Whence does this third layer, or mesoderm, originate? There are a number of conflicting replies to this question, which have yet to be reconciled.

Development of Terebella nebulosa.

An abundant supply of the eggs of this annelid enabled me to follow its development as far as its opacity permits. A delicate chorion forms round the egg after segmentation, on the surface of the cleavage-cells, which are densely ciliated. I observed that the chorion could be caused to separate from the surface of the cells; and the cilia were then seen to be really processes of the protoplasm of the cells, and to *perforate* this cuticular exudation, since they did not break off with it, as often happens, but were drawn through it, remaining fixed to the cells. The development of the ciliated tracts, segments, appendages, and tubiparous glands was followed and drawn. The young of this species has no otolithic sac.

Young Appendicularia furcata.

Numerous specimens of this most interesting form were obtained in February. The recent memoir of Foll has given very full and accurate information on the anatomy of the *Appendicularíæ*. I have still, however, something to add in this case with regard to the cutaneous glands and the cellular outgrowths of the integument, and as to the heart. It is curious that no one has yet drawn attention to the very remarkable fact that the heart in *A. furcata* consists of but two cells—that is to say, two nucleated histological units. The small number of histological units which build up the organs of an *Appendicularia* is a very noticeable fact, and is parallelled in the case of the Rotifera. The elaboration, however, of so important an organ as the heart from but two units is quite unexampled.

The heart as known and described is an oval pellucid body, with a dense mass at each pole. During life it beats with marvellous rapidity, quite unlike the action of a heart, and suggesting (what I believe it is) a form of protoplasmic movement allied to the ciliary. The mass at each pole of the oval heart is seen in specimens about two thirds grown, when dilute acid is added, to be a nucleated cell. From each of these extends, not a contractile membrane (as would appear from the figures of Gegenbaur, Foll, and others), but from twelve to twenty fine processes or filaments joining one cell to the other, leaving open spaces between them. The rapid contractions of these processes of the cells, which are not unlike (except in being fixed at both ends) those processes known as cilia, agitate the blood in which the heart is suspended; but there is no trace of blood-vessels connected with the heart. In specimens of *Appendicularia furcata* of full size the heart was seen to be a little more complex in structure; for at the base of each fibre or process of the two original large conical cells (which still retain their form and their large nuclei) is developed a small swelling with a nucleus (fig. 2). Moreover each of the fibres is now seen (when treated with picric acid) to possess a transverse striation, like that of the muscular fibres of the great tail or flabellum. I have specimens of *Appendicularia furcata*, treated with picric acid and mounted in glycerine, which exhibit admirably at the present moment this very remarkable structure of the heart.

Fig. 2.

Histology of Sipunculus nudus.

Every naturalist who visits Naples studies this very interesting and abundant worm more or less, and comes to a conclusion respecting its generative organs differing from those of his predecessors. I can only briefly state on the present occasion the results of my study of this worm, as to the histology of which I have a mass of drawings and preparations.

First, as to the corpuscles of the perivisceral fluid. These are the pink corpuscles, the amœboid, the mulberry corpuscles of various sizes (usually regarded as testicular cell-masses), the ova, and the detached portions of the peritoneal membrane, and the "Töpfchen" or ciliated globes. These last were especially studied recently by Brandt; he did not ascertain their origin; he is mistaken in his statements as to "ciliæ capitatæ." The cilia of the "Töpfchen" are in no wise peculiar. What he has supposed to be a head or knob on the end of the cilium is *really* nothing but the bending over of the extremity of the cilium under the influence of the dilute acetic acid which he used. I convinced myself time after time that the cilia of the Töpfchen are perfectly normal, by study, with Hartnack's 10 à immersion, of living specimens, and of others treated with osmic acid. By the use of acetic acid I obtained the knob-like appearance which deceived Alexander Brandt.

Further I have found out the source of the "Töpfchen." They are to be observed in great numbers *attached within* the curious pair of tubes or vessels formed by duplicatures of the peritoneal membrane, which lie on each side of the œsophagus, and the connexion of which with the tentacle-crown was so well shown by Brandt in his memoir. They develop as "buttons" on the cellular surface (fig. 3), which is throughout the perivisceral cavity provided in parts with patches of cilia-bearing protoplasm; and then they become detached and swim off into the fluid. The whole history of this beautiful peritoneal

Fig. 3.

tissue and its shedding of elements into the perivisceral fluid is of extreme interest; but I cannot go into it until my drawings can be given. So much for the Töpfchen at present. Next as to the *ova*. These occur of all sizes in the perivisceral liquid; and Brandt appears to have supposed that they take origin in it. Various zoologists have tried to establish this or that structure as the "ovary." Some have assigned this nature to the pair of large brown tubes opening to the exterior, so paradoxical in character. MM. Keferstein and Ehlers mistook the unicellular cutaneous glands and some vagrant ova for the ovaries, which they actually located beneath the skin; this view I must most fully oppose, as a special study of the integument of *Sipunculus* has shown me what structures these authors have mistaken for ova. Others, again, have taken the strange little diverticulum of the intestine placed near the rectum for the ovary, but without offering proof. I have yet a new view. I consider that the "bush-like processes" described by Keferstein and Ehlers as occurring on each side of the rectum are the ovarian villi. These arborescent tufts are outgrowths of the cellular peritoneum and enclose the ova, which become detached when very small ($\frac{1}{2000}$ inch), either in groups or singly, ensheathed in a portion of peritoneum, and proceed to grow to full size in the perivisceral liquid. The proof of this is in the structure of the villi, and in the structure of floating masses of minute ova occasionally to be found in the perivisceral liquid. The ova are detached from the villi probably at certain seasons and as soon as developed; hence I have never found the villi containing unmistakable ova, when attached in place on the rectum.

The *mulberry spheres* are certainly not, as supposed by Brandt, testicular. They have not the structure of such testicular mulberry masses in Annelids; for in these of *Sipunculus* I have made out what Brandt does not describe, viz. a membrane with a distinct nucleus enveloping the aggregated spherules. They, I believe, give rise to the abundant pink corpuscles of the perivisceral fluid, and are, like the "Töpfchen," detached from the tentacular vessels originally. The true testis is still an open question. I found that the curious little diverticulum of the intestine in several specimens examined in March had become greatly dilated, attaining a full inch in length; and it was filled with a creamy fluid in which were a dense mass of motile filaments. It is possible that these were bacterioid parasites, but most unlikely when they recur in eight individuals examined within two days. There were further appearances of the development of these vibratile rods which tended to confirm the notion that the wall of this diverticulum of the intestine becomes the testis. On the other hand the structure of the great brown pair of tubes was very carefully studied; and I found that they develop in their walls innumerable corpuscles which in spring (May) take quite the form of the Mammalian spermatozoon, and abound in immense number in the liquid filling the brown sacs. The balance of evidence is on the whole in favour of the brown tubes being testes. At the same time let me mention that they become much dilated in May, and take into their cavity large quantities of the perivisceral fluid, and with it the floating ova, or the mulberry spheres, if they are present.

I should mention that one fact in favour of regarding the mulberry spheres as testicular is that when they abound the ova appear to be absent, and *vice versâ*. This is only *apparently* the case; for I have found numerous ova (though far less numerous in proportion than elsewhere) in *Sipunculi* in which the mulberry spheres were predominant, and I have noticed young stages of the mulberry spheres present when ova abounded. It should, however, be noticed that all the full-grown *Sipunculi* (some eighty-five in number) which I opened were distinguishable as either "ova-bearing" or "mulberry-sphere-bearing."

Brandt and, in earlier years, Krohn have been the supporters of the view that the mulberry spheres are testicular; but neither of them has seen the development of the component spherules of the spheres into tailed spermatozoa. Brandt states that he found in May, in a *Sipunculus* of the mulberry-sphere kind, tailed spermatozoa floating in the perivisceral fluid. But he admits that such spermatozoon-like bodies are developed in the brown tubes; and he has no evidence whatever to prove that those he found in the perivisceral fluid had not come thence, especially since he obtained the fluid by puncture and might thus have wounded the brown tubes.

I must yet further mention with regard to the pink corpuscles, that I sometimes found them of large size and containing *crystals* —a fact not noticed by Brandt; also in May I noticed cases in which they were all very small, and in which only a few loosely aggregated mulberry spheres and no ova were present. I believe that the reason why mulberry spheres and ova are reciprocally exclusive in the perivisceral fluid is this, that after the expulsion of the ova a renewal of the pink corpuscles is necessary, and accordingly we get this development of mulberry spheres, destined to break up into young pink corpuscles. It is not until the spheres have fully developed and broken up into young pink corpuscles that a new development of ova takes place, by detachment from the rectal arborescent villi. The testis is either the tissue on the intestinal diverticulum or the brown tubes; which of the two, my notes and drawings do not decide.

The termination of nerves in the skin, the cutaneous glands, the minute structure of the nerve-chord, the structure and varieties of connective tissue in various parts of the worm, and the curious pink or red line on the intestinal wall, which is not a vessel, were examined, and will be described and figured on a future occasion.

Brandt's description of the perforate structure of the egg-envelope is perfectly correct.

Anatomy of Sternaspis.

Specimens of this interesting worm were from time to time brought to me by the fishermen. Its structure presents no special points of contact with the Gephyrea, but rather with the capitibranchiate polychætous Annelids, such as *Pherusia*, which certainly approach the Gephyrea in the condition of their segment-organs. The closed vascular system contains hæmoglobin in solution, and presents an internal series of gills, the structure of which is remarkable in many ways. It would be difficult to make any account of the details of its organization intelligible in this brief summary without illustration.

Notochordal rudiments in Glycera.

The observations of Claparède on the "drei riesige Röhrenfaden" lying above the nerve-cord in *Lumbricus* induced me to search, by means of transparent transverse sections, for evidences of a skeletal or supporting arrangement of the connective tissue in immediate relation with the nerve-cord in other Annelids. The disposition of the muscles in relation to the sheath of the nerve-cord in *Glycera* has some interest in this respect, since these parts are seen, in suitably prepared sections, to have generally the same relations as have the muscles and neural sheath, including the notochord, of a vertebrate.

Terebratula vitrea.

These most beautiful Brachiopods were sometimes brought in quantities by the deep-sea fishermen. I was not able to obtain the ova in a developing condition.

There are still many points in doubt with regard to the Brachiopoda, and especially as to the Terebratulidæ.

This species has not, I believe, been studied in the living state. A young specimen, of the size of a pin's head, exhibited the "arms" in a condition corresponding in general characters with the lophophore of a Polyzoon, with which Mr. Morse's researches on *Terebratulina* also render it clear that the Brachiopod arms are homologous (homogenous). Let me also say here that a comparative study of the structure of the adult arms of *Terebratula* and of the gill-lamellæ of Lamellibranchs leads to the conclusion that these are also homologous (homogenous) structures.

The observations of Mr. Barrett on *Terebratulina*, and of M. de Lacaze-Duthiers on *Thecidium*, are the only ones at present, I believe, as to the condition of the "arms" of Terebratulidæ in the living state.

The cirri are finely ciliated externally; they are also individually movable, though rarely moved. Each cirrus corresponds in essential structure as to its tubular character, its horny and calcareous skeleton, and the circulation within it of the blood, with a tube of certain Lamellibranchs' gills. In young *Pisidium pusillum* the gills originate as three (increasing in number) pairs of tubular processes. In young *Anomia* they equally retain their character as a series of isolated tubules ciliated on the surface. In young *Terebratula vitrea* I found nine pairs of tubular tentacles (wonderfully like the tentacles of a *Pedicellina*); and in the adult we have an immense series of them, which only require to become adherent in order to give the essential structure of the Lamellibranch's gill-plate.

The blindness in relation to the intestine of *Terebratula vitrea* is certainly in that Brachiopod's rectum. There is no anus, but a blunt cæcal termination.

I entirely failed to convince myself that the organ regarded by Mr. Hancock as a heart really has the function of one in *T. vitrea.* I repeatedly opened fresh specimens with rapidity, in order to witness its contractions, if any, but never saw such contractions; nor could I find vessels in connexion with it, nor evidence that it had muscular walls. Dr. Krohn, of Bonn, had equally been unable to obtain evidence that this curious little dilatation has the function of a heart.

The "segment-organs" or oviducts (hearts of Owen) presented a beautiful appearance in the living state, on account of their ciliation. It was possible to preserve them mounted in balsam and also in osmic acid.

The ovaries, lying as they do on the inner surface of the body-wall (which is beautifully marked with calcareous spicula), may be readily studied in various stages of development. The testes are not known at present in any Brachiopod except the diœcious *Thecidium.* The red matter suggested by Hancock as possibly testicular in *Lingula* has its parallel in yellow matter which is abundant amongst the ovarian ova of *Terebratula.* This yellow matter is clearly due to degeneration of the envelopes of escaped ova—is, in fact, a series of *corpora lutea.*

I think it has not yet been clearly pointed out that the ova in Terebratula do not lie freely on the surface of the body-wall ready to drop into the blood-sinus (perivisceral cavity), into which the oviduct opens. Each ovum has really a very delicate connective-tissue envelope; and it is only upon bursting through that that it can escape. Sometimes the ovaries (in December) contain comparatively large eggs, which are readily detached. In the spring, on the other hand, I found most with moderate-sized ova, but some with no ova at all. The ovarian tracts in the latter specimens were obvious enough, since they form a reticulate arrangement of ridges, and the *corpora lutea* marked these tracts also; but no cells which were differentiated as ova were present. Some persons have been inclined to regard these specimens as males; but I consider this merely a temporary condition of the ovary. In some ovaries, at intervals, large white spherical masses containing a quantity of small cells were found; these were the most likely indication of testicular organs which I succeeded in finding. The appearances of the ovary in various conditions, and the structure of the mantle (in which I could not identify the numerous layers distinguished in *Waldheimia flavescens* by Mr. Hancock, in his great essay on Brachiopoda), require illustrations for a fuller explanation.

Phyllirrhoë bucephala *and* Mnestra.

Perhaps the most charming of all the objects which the Naples Bay affords to a zoologist of histological tendencies is the curious little fish-shaped mollusk *Phyllirrhoë*. Its transparency is perfect, at the same time that the tissue-elements present definite outlines. Its anatomy and histology are well enough known from Heinrich Müller's paper. The pulsating heart—lying in the small pericardium which communicates by a long partly ciliated tube (the representative of the organ of Bojanus) with the exterior—is an object of intense interest. It was easy to trace the connexion of the finest nerve-twigs with muscular fibres and with various peculiar corpuscles. Prof. Panceri discovered, whilst I was at Naples, that these corpuscles, as well as the nerve-ganglia, are phosphorescent.

Krohn described, some thirty years ago, a medusoid which presents the remarkable character of being parasitic on *Phyllirrhoë*. I obtained specimens of this, but have no indication of the way in which it becomes attached. The tissue of the medusoid's disk appears to be *fused* at its middle aboral point with the tissues of the *Phyllirrhoë*. It cannot be removed without tearing, and always occurs just below the chin (if the term be allowed) of the *Phyllirrhoë*. I made out (and have drawings of) a circular and four radiating canals, four marginal tentacles, abundance of thread-cells, and a central chamber.

Pyrosoma, Æginopsis, *and* Cercaria.

Prof. Panceri and his assistants were carrying on their valuable investigations on the embryology and phosphorescence of *Pyrosoma* whilst I was staying at Naples. In December we obtained a good supply of these most interesting Tunicates.

I directed my attention chiefly to the early changes in the ovum, but, owing to the interest which the later development also had for me and the impossibility of keeping specimens alive, did not come to definite conclusions. The germinal vesicle seems to disappear; and a cap of blastodermic cells appears at one pole of the egg, somewhat as in *Loligo*. The changes in the mass of the yelk whilst this goes on are remarkable, and lead to the formation of corpuscles, which appear to circulate subsequently in the embryonic blood-system. I can confirm (if confirmation be wanting) Professor Panceri's and Pavesi's description of the heart and mouth of the cyathozooid, and its mode of connexion with the four ascidiozooids. Professor Panceri's recently published figures (Academy of Naples) are excellent. The colonial muscular system described by Panceri (see 'Quart. Journ. Micr. Sci.' Jan. 1873) was also examined; and I repeated the experiments which he had just carried out, leading to the determination of certain granular masses on the sides of the pharynx as the phosphorescent organs of *Pyrosoma*.

Æginopsis was found on one occasion in some water taken from the surface. The structure of the arms was not given by Johannes Müller so fully as examination with a no. 10 Hartnack now allows.

Cercaria echinocerca was obtained and drawn from examination with the 10 immersion on several occasions. It is remarkable for the flattened seta-like processes of the integument of the tail.

The Parasite of the Renal Organ of Cephalopoda.

Dicyema sepiæ and *D. eledonæ* were first described by Kölliker. Claparède afterwards found a species in the *Eledone norvegica*, and referred *Dicyema* to the ciliate Infusoria. Subsequently Guido Wagner described *D. sepiæ* and *D. eledonæ* in more detail than his predecessors.

There is probably no stranger parasite than the *Dicyema*. The renal organ of most *Sepiæ* may be said to be literally made up of these organisms in all stages of growth. They are clearly not Infusoria, but a degraded form of worm, being multicellular in structure. They are, when typically grown, thread-like bodies one third of an inch in length. There is no mouth, but an axial tissue of scattered stellate cells, which is clothed with large epithelial scales: these are at one time all ciliated; but after full growth the cilia only remain about the head. The head is indicated by a knob, on which the epithelial scales are very regularly disposed in two series. It is rare to find a large *Dicyema* with this head well developed—the reason being that the animals are continually dividing transversely, and a complete head with its symmetrically arranged scales never grows at the surface of fission, but only a partially formed ill-shapen head with two or four scales.

In addition to transverse division, *Dicyema* reproduces by two kinds of internally produced embryos, as pointed out by previous writers. One kind is like the long worm-shaped parent; the other is oval, and ciliated at one extremity. No one has succeeded in following out what becomes of this latter "infusorian-like embryo;" but the embryos resembling their parents clearly grow up to the reproductive state within their host's kidney, and are to be seen in all stages.

I have made out, and hope to figure hereafter, the mode of formation of these two kinds of embryos, which differs considerably in the two cases. Each originates from a single nucleated cell, which multiplies. Those cells, however, which grow into infusorian embryos are contained at first in an oval capsule or space, twenty or so together, and escape from this capsule to undergo development in the axial tissue. The worm-like embryos, on the contrary, arise from single cells scattered at intervals in the axial parenchyma, which do not at first present any special characters.

Dicyemæ which are developing infusorian embryos do not at the same time develop worm-embryos. No trace of male reproductive organs is to be seen in these organisms. Their structure admits of the most complete investigation, on account of their small size and transparency.

New type of Infusoria.

Among some eggs of *Terebella*, associated with other Infusoria, I found several specimens of an altogether novel type. The general form was oval; above the mouth projected a small cephalic tubercle; round this oral extremity was raised up a large collar or ruffle, which continually opened and shut with a slight spiral twist, and caused the locomotion of the animal, whilst at the same time food was brought into the region of the mouth. This membranous vibratile collar or ruffle may be compared to a blended crown of cilia. It forms one of the rare examples of undulating membranes, similar to that of *Undulina* (parasitic in the frog's blood, 'Quart. Journ. Micr. Sci.' October 1871), where, however, the membrane is in the form of a crest, and not of a collar as here.

There is not a trace of a cilium on any part of this infusorian, the whole work being done by the vibrating collar.

It is obvious that this form cannot be placed in any one of Stein's divisions of ciliate Infusoria, but must stand alone.

Gregarina sipunculi.

I may refer here to a paper in the 'Quart. Journ. Micr. Sci.' October 1872, in which I have described some facts relating to the development of this form, and figured the pseudo-Navicula or spore-form, the Moneran, pseudo-Cercarian, and Gregarina-forms of this parasite.

Spectroscopic Observations.

Numerous observations with the spectroscope on a variety of animal colouring-matters gave the following results.

Hæmoglobin is present in the nerve-cord of *Aphrodite aculeata*, also in its pharyngeal muscular tissue, in muscles of the dorsal fin of *Hippocampus*, in muscles of the pharynx of various mollusks, in corpuscles in the blood of *Solen legumen*, in corpuscles in the perivisceral fluid of *Glycera*, of *Capitella*, of *Phoronis hippocrepia*, and diffused in the perivisceral fluid of *Polia sanguirubra*.

No characterizable absorption-bands could be obtained from the *blue* pigment of *Velella*, from the *blue* pigment of *Salpa democratica*, or from the *red* pigment of other *Salpæ*, from the *red* pigment of the foot of *Cardium* and other Lamellibranchs, or from the *red* pigment of chromatophores of *Loligo* and other red pigments of fish, &c., or from the *madder-pink* pigment of the corpuscles of the perivisceral fluid of *Sipunculus*.

I cannot conclude this summary without pointing out how great an advantage will be gained by zoologists in the station, now nearly ready for work, which my friend Anton Dohrn has erected on so magnificent a scale, by the devotion of his private fortune and much energy and patience. It stands in the Villa Reale, on the sea's edge; and there the naturalist will not have to dispute and bargain with the intelligent but rascally fishermen; all will be managed for him by the *employés* of the station. Further, he will have the use of a splendid library*, he will be able to keep his specimens with ease in the tanks of the station, supplied with streams of sea-water, and will have constantly the means of contemplating, even when he may not wish to study minutely, those exquisite forms which came in hundreds through my hands, but of which I have here said nothing, with which the waters of the bay are teeming.

* I take this opportunity of asking for contributions of zoological and botanical books or papers to the library of the Naples station. Several publishers in Germany have given valuable works; the Messrs. Engelmann of Leipzig have presented the whole of their biological publications.

XII.—*On the Geographical Distribution, Migration, and Occasional Habitats of Whales and Dolphins* (Cete). By Dr. J. E. Gray, F.R.S. &c.

Dampier long ago observed that seals did not occur within the tropics; and Capt. Maury, in his Whale-Charts, shows that the Sperm-Whale inhabits a belt of sea in or on each side of the tropics in the Atlantic and another in the Pacific Ocean, which was avoided by the Right Whales as if it were a belt of fire. Both these observations are correct in the main—though a seal has been found in the West Indies, and some Humpbacked Whales inhabit near Bermuda, and they and the Finner off the coast of Brazil. The Sperm-Whale wanders away from its usual habitat, to its own destruction, on both sides of the tropical belt, and is carried by currents like the gulf-stream as far north as Shetland and Norway, and very likely as far south in the Antarctic Ocean.

This observation about the tropics is important, as showing that the whales of the northern seas must be of different species from those that inhabit the southern oceans; and the examination of the animals, and especially of their skeletons, has shown the truth of this fact, which is universal as far as I have been able to examine and compare the bones of the Whalebone-Whales, Dolphins, and Ziphioid Whales of the northern and southern hemispheres, and seems also to show that each species has defined limits.

Most whalers, in their writings, state that the whales visit their usual fishing-grounds at stated periods, and inhabit certain bays during their breeding-season, showing that they make migrations, each species within its own district.

Whales and dolphins always inhabit sheltered bays during the breeding-season; and the Whalebone-Whales generally live in shallow water, not very far from the shore or over sunken banks.

Unfortunately our knowledge of these animals is very incomplete, as, the observation of them being attended with so many difficulties, we have very imperfect accounts of the history and habits of the species which inhabit the North and South Pacific, the South Atlantic, and the Indian Ocean. Indeed it is only within the last few years that the species of these seas have begun to be studied and determined. Before that period they were confounded with the whales of the North Atlantic, and included under general names (as Right Whales, Finners, Humpbacks, Scrag-Whales, and Sulphur-bottoms) which are now found to represent so many families or genera.

The study of the whales and dolphins of the North Atlantic exhibits their geographical distribution and migrations, natural or accidental, which give us some idea of what may be the case with the whales of the other parts of the world, where they are perhaps better developed than in the North Atlantic; for there can be no doubt that commerce and, more especially, steamboats in the North Atlantic have driven the northern species further back and confined them more to the Arctic regions, have destroyed many individuals, and limited the breeding of the Mediterranean species and of those which inhabit the southern districts of the North Atlantic, and that several species that are now only found in a subfossil state, imbedded in the alluvial soils of Sweden, Holland, and the coasts of England, were formerly inhabitants of these seas.

The species that are now found in the North Atlantic may be divided into:—first, those that inhabit the Arctic seas and migrate or are accidentally brought south; secondly, those which chiefly live and are bred in the Mediterranean, or in the bays of the southern parts of the North Atlantic, and which migrate and follow the shoals of fish towards the north. There are no doubt some species, as the common Porpoise, the Pike Whale, the common Finner, and the Goose Whale (*Hyperoodon*), that breed in the middle district (on the coasts of Germany, Holland, and Great Britain), and are found in the more northern and more southern seas. On the other hand, the *Ziphius Sowerbiensis* has been found in the German Ocean only in its southern part and off the north coast of Scotland, but is most abundant on the west coast of Ireland, belonging as it does to a Mediterranean group (though not yet observed in the Mediterranean) and perhaps only carried north by the Gulf-stream.

Some species are essentially Arctic, as the *Beluga* and the *Monodon*; but even they are sometimes driven south, perhaps by storms. Others, as the Pilot Whale, always proceed south in large "schools:" some keep on the west side of the North Atlantic and go to the east coast of America; others keep on the east side and are found on the west coast of Europe, the east and west coasts of great Britain, the coasts of France and Spain, and some in the Mediterranean; but the Mediterranean species is generally smaller and may be distinct. The voracious and destructive *Orca*, or Killer, lives in smaller groups, and seems to follow the same course as the Pilot Whale; that is to say, *Orcæ* are found, in the Arctic and other seas, as far south as the Mediterranean; and, like the Pilot Whales, the southern specimens are much the smallest. I determined that we had two species of Killer on the British coast; and by a photograph sent me by the Royal Academy of

Sweden I see they have discovered and recognized my second species in Swedish seas, showing that both the British species probably migrate from the north. The skull of the Mediterranean *Orca*, though so much smaller, is very like those of the Arctic and British ones.

The Grey Finner (*Cuvierius*) is doubtless a northern species that sometimes comes south; but one is not so certain of the Broad-headed Whale (*Rudolphius*) and the gigantic Flat-back (*Sibbaldius*), which have only been found so seldom in the south part of the North Sea or German Ocean that it is impossible to say if they are northern or southern species. At any rate we may make sure that an animal upwards of one hundred feet long does not breed in the much-frequented German Ocean; and neither genus has been discovered in the Arctic Ocean or in the Mediterranean sea. Perhaps they are the last remains of their race.

Thus the Dolphin (*Delphinus delphis*), the Grampus (*Grampus Cuvieri*), and the *Petrorhynchus mediterraneus*, which are essentially Mediterranean species, following the fish out from Gibraltar, come north down the coasts of Spain and France, and impinge on the coasts of Hampshire, Devon, and Cornwall along with the pilchards and mackerel. Some proceed to the left, up the German Ocean—and others to the right, either up the Irish Sea or the Atlantic Ocean on the west side of Ireland, and they have rarely been found as far north as Shetland or the coast of Norway; but I am very doubtful if these animals, like the Sperm-Whales, ever find their way back.

A kind of whale exists in the Bay of Biscay: and we are told that there was formerly a whale-fishery there; but both it and the Basque fisheries have long passed away. A whale at distant periods has occurred, especially at the south-east corner, which is probably the most quiet part of this stormy bay. The occurrence of a specimen is a proof of the existence of enough animals to carry on the race residing permanently in or occasionally visiting the bay; for we may make sure that it is not, as some people seem to suppose, a spontaneous reproduction or renewal of the species.

In January 1854 a cow whale and its calf were observed in the Gulf of Gascony near San Sebastian: the calf was taken; but the mother escaped. The skeleton was preserved in separate bones at Pampeluna; Eschricht obtained it by exchange for the museum at Copenhagen; and Professor Reinhardt intends some day to describe and figure it. It is said to be quite different from the Greenland Whale; indeed Mr. Flower informed me that it is a *Hunterius*, with coarse whalebone and a bifid first rib. It has been called, but not described as, *Balæna biscayensis* by Eschricht. M. van Beneden has made a species under this name from the cervical vertebræ of a whale found at Sainte Marguérite in the Mediterranean, the subfossil cervical vertebræ dredged up at Lyme Regis, and the ear-bones of the *Balæna cisarctica* from the coast of North America (!), never having seen either the skeleton at Copenhagen or a figure of it; and it is easy to see by the comparison of the two cervical masses, which he gives on the same plate, that they do not belong to the same species. It was possible that this might be the same whale that occurs at Sainte Marguérite in the Mediterranean, or might be the same as that found at Lyme Regis, as that is consistent with what we know of the habits of whales; but we have proof of its not being so; and it is not the one found in America, if Mr. Flower's note is correct.

The Arctic whales and dolphins on the western coast of the Atlantic are numerous; Dr. Brown mentions two or three Right Whales. Some of these migrate southwards down the east coast of North America; and it is to be observed that some of the Arctic species inhabit that side of the Atlantic which are not found at all, or only as stragglers, on the north coast of Europe. Some species, as *Beluga*, go much further south on the coast of Labrador and Nova Scotia than they do on the coast of Europe.

There were formerly whale-fisheries on the southern parts of the west side of the Atlantic; but, like those in the Bay of Biscay, they no longer exist, the whales having been destroyed or driven away by commerce. The south-western part of the North Atlantic has forms peculiar to it, as is the case on the eastern side; for as yet the Ziphioid Whales, the *Grampi*, *Delphinus*, &c. have not been observed on the American coast, nor does the Scrag-Whale (*Agaphelus*) occur on the coast of Europe. This is very inconsistent with the theory that the whales of the same species inhabit a belt across the Atlantic and other oceans, each species occurring in a peculiar locality.

In the first volume of the 'Philosophical Transactions' (for 1665, p. 11) there is an account "of the New American Whale-fishing about Bermuda;" and at p. 132 there is "a further Relation of the Whale-fishing about the Bermudas and the Coast of New England and New Netherland;" and it appears that there then existed a Bermuda Company. The writer observes, "these whales are met with between the coast of New England and New Netherland, where they might be caught eight or nine months in the year, whereas those about the Bermudas are to be found there only in the months of February, March, and April." He particularly refers to the "Trumpo," which is evidently the Sperm-Whale, one of which he says was stranded in New England.

The Hon. Paul Dudley, in the 'Philosophical Transactions' for 1724 (p. 256), writes an "Essay on the Natural History of Whales . . . . found on the Coast of New England." He says he is particularly indebted to Mr. J. Coffin, some time at the island of Nantucket, and Mr. Greenhouse, of Yarmouth near Cape Cod, both of them places famous for the whale-fisheries. These fisheries have now disappeared, the fisheries being now carried on in the South Seas. He mentions:—

1. The Right or Whalebone Whale, which is probably a true *Balæna*.

2. The Scrag-Whale. This is evidently the *Agaphelus gibbosus* of Cope, in character intermediate between the true Whales and the Fin-backs. It has no dorsal fins or throat-folds. This animal probably goes south, and is the "Norwega" of Bahia mentioned by Dr. Hartt.

3. The Fin-back Whale is most probably a *Physalus*; but the North-American Fin-backs have not been described. It may be the same species that goes south as far as Bahia; and they are called "*Mystica*." They first appear, according to Dr. Hartt, in the Abrolhos waters at the end of May, and stay until November; the females often bring their young calves with them and seek the shelter of the reefs.

4. The Bunch or Humpback-Whale is probably the *Megaptera osphyia* of Cope, described from a skeleton in the museum at Niagara, which he thinks is one of the largest species of Balænidæ, and may be the same as *Megaptera americana* of Bermuda.

5. The Sperma Cete Whale.

The same migrations or circummigrations appear in the southern part of the Atlantic and the southern seas. Dr. Dieffenbach informs us that the Sperm-Whale, the Black Whale, the Finner, and the Humpback are found in Cook's Straits in New Zealand. The Sperm-Whale inhabits the open sea and does not approach shallow coasts and inlets, as is the habit of the other whales. The Finner and Humpback are seldom captured, on account of their wildness and celerity; and they contain only a small quantity of oil. Almost all the Black Whales caught are females and their calves; indeed it is the affection of the mother for her young that causes her sacrifice, the young being taken to secure the parent. The male is very rarely caught; he never approaches the land so near as the female, and is more shy and wild. The cows approach the shallow coast and smooth waters for the purpose of bringing forth their young, and are generally accompanied by the calf of the preceding year, called a "scrag," which does not leave its mother till it attains its full size. The Black Whale is truly a migratory animal; it arrives in Cook's Straits from the northward at the beginning of May, then passes along the coast of the northern island to Entry Island, then sweeping into Cloudy Bay; and then at the end of October they go to the eastward or return to the northward; and many whales are to be found in the "whaling-ground" which extends from Chatham Island to the eastward of the northern island of New Zealand and thence to Norfolk Island; and the whalers say this district is a shoal. Besides this migration, which rather ought to be called a circumnavigation of a limited district, there exists a daily one; the whales approach the shores and bays with the flood tide and quit them with the ebb; they are often seen in places where the depth of water does not exceed their own breadth (Dieffenbach's Travels in New Zealand, vol. i. pp. 44–47). The whalers thought they were the same species that were found at the Cape of Good Hope, which are known to have similar habits, as also have the Black Whales at Van Diemen's Land; but I now know, from the examination of the skeletons, that there are two Black Whales in New Zealand, both of which are quite different from the two Black Whales that inhabit the Cape of Good Hope.

Mr. E. Hartt, in his 'Physical Geography of Brazil,' observes:—"The first whales (*Physalus brasiliensis*, Gray) appear in the Abrolho waters at about the end of May, and they stay till October. The females often bring their young calves with them, and appear to seek the shelter of the rocks. The fishery begins at Bahia, according to Castelnau, at about the 13th of June, and lasts till the 21st of September; at Caravellas I was assured the whales always appeared later than at Bahia."

Further south, the Finners in passing the Rio de la Plata ascend that river; and Professor Burmeister has described from the skeletons of the whales in the museum of Buenos Ayres, obtained near that city, no less than three distinct species of *Physalus* (see Ann. & Mag. Nat. Hist. 1872, x. p. 413).

Wherever there are whale-fisheries (as in Walvisch Bay near the Cape, Cook's Straits at New Zealand, and Caravellas, and especially Bahia) the bones of the whales killed form large banks, as many as 500 to 1000 whales or more on the same spot (indeed in Walvisch Bay the bank is said to be several miles in length), showing great destruction of these animals in these seas as well as in the northern ones.

In the 'Ann. & Mag. Nat. Hist.' 1870, vi. pp. 391–394, is a list of the species of whales according to the countries in which they have been observed.

XIII.—*Notes on the Whales and Dolphins of the New-Zealand Seas.* By Dr. James Hector, F.R.S. *With Remarks by* Dr. J. E. Gray, F.R.S. &c.

1. *Neobalæna marginata*, Gray.

The tympanic bone of the type of this species in the Colonial Museum agrees exactly with the ear-bone on which is founded *Caperea novæ-zealandiæ*, Gray (Cat. Seals & Whales, p. 101).

Practical whalers, after examining the baleen of this whale, affirm that it is the Fin-fish or Sulphur-bottom, and that it grows to an immense size. It is not the Finner, which has the dorsal fin further back. They judge by the colour of the baleen.

2. *Eubalæna australis*, Gray. (The Black Whale.)

Balæna antipodarum, Gray.

Whalers do not distinguish two species; and if the tympanic bone of the second species cited belongs to *Neobalæna marginata*, there is no evidence that the Black Whale of New Zealand is different from that of the Cape.

3. *Megaptera novæ-zealandiæ*, Gray.

This species is also founded on a tympanic bone. A whale, 34 feet long, with a *falcate* dorsal fin, stranded in Wellington Harbour, has a similar ear-bone, and may be this species. The bones were unfortunately lost.

4. *Physalus australis*, Gray.
(The Southern Finner or Razor-back.)

Physalus antarcticus, Gray.

The only reason given for distinguishing the above is the colour of the baleen. Whalers state the baleen of the Finner to be very variable in colour, even from the same individual.

5. *Catodon macrocephalus*, Lacép. (The Sperm-Whale.)

Several varieties of teeth are in the museum, and must belong to different species.

6. *Delphinus novæ-zealandiæ*, Quoy & Gaim.

A skull of this species in the museum has the intermaxillary plates united, so as to form the nasal groove into a tube throughout two thirds of its length.

7. *Delphinus Forsteri*, Gray.

A skull in the museum agrees in its dentition with this species. It differs from the preceding species in the greater proportional width of the beak and more perpendicular forehead, the width of the middle part of the beak being contained four times in the length from the notch, while in *D. novæ-zealandiæ* it is six times.

8. *Electra clancula*, Gray.

The generic character requires to be amended by leaving out the second dorsal lobe, which is not present in this species.

9. *Pseudorca meridionalis*, Flower. (Tasmanian Blackfish.)

An imperfect skull found in Lyall Bay appears to belong to this species.

10. *Grampus Richardsoni*, Gray.

A lower jaw found on the Munawutu beach agrees with this, except that it has only three instead of four teeth on each side.

11. *Beluga Kingii*, Gray.

A very imperfect skull, in the collection of the late Mr. Swainson, appears to resemble this species. A large white Porpoise is frequently seen at certain seasons in Blind Bay, and may be this species.

12. *Globiocephalus macrorhynchus*, Gray.
(New-Zealand Blackfish.)

Several skulls, more or less perfect, are in the museum, one from the Chatham Islands.

The same trivial name (Blackfish) is also applied to a small species of Sperm-Whale.

13. *Epiodon chathamiensis*, sp. nov.

Beak of skull tapering, callous, with a slight upward curve. Vomer forming a posteriorly truncate callous ridge, depressed between the intermaxillaries. Upper jaw toothless. Lower jaw elongate, bent up, truncate, with two terminal, short, subcylindrical teeth in shallow sockets, and in front of a long dental groove.

Skull: Chatham Islands (coll. G. H. Travers).
Weight of teeth 817 and 836 grains.

	inches.
Total length	36
Width at orbits	20
" notch	12
Length of beak	18
" brain-cavity	6
" sperm-cavity	12
" lower jaw	30
Height of ramus	7

The beak is trigonal, three times as long as the brain-cavity measured internally. The vomer is not observed in the profile as in *Petrorhynchus capensis*; otherwise the general structure of the skull agrees with that species. The teeth are ground down, each with two lateral facets and a central ridge; as these teeth, when the mouth is closed, are beyond the lower jaw, there is probably a callosity on the upper lip against which they are applied.

Two teeth of another individual are in the museum, with triple facets.

This species may be the same as *Epiodon australis*, Burm., of which I have no description.

14. *Mesoplodon Layardii.*

Lower jaw with teeth: Chatham Islands (coll. G. H. Travers).

Total length 33 inches; symphysis one third of total length. Hinder edge of the teeth is 18 inches from the condyle; and their length along the jaw is 5 inches, the anterior margin being in advance of the commencement of the symphysis; no notch on the edge of the jaw posterior to the teeth. The teeth are 6 inches long, 3 inches wide, and $\frac{3}{4}$ inch thick. The acute point in the upper and forward angle is very marked; there is a deep rough notch worn on the anterior margin; and the compressed root of the tooth shows seven distinct fangs. The teeth are directed obliquely backwards and inwards, but do not approach so as to close over the beak, as described in the type of the species (Cat. Seals & Whales, p. 353).

15. *Berardius Hectori*, Gray. (Scamperdown Whale.)

Berardius Hectori, Gray, Ann. & Mag. Nat. Hist. viii. p. 116 (August 1871).

Mesoplodon, sp., Flower, Nature, Dec. 7, 1871, p. 105.

Teeth $\frac{}{2}$. Body fusiform; head rounded, beaked; upper lip long and flexible; eye halfway between angle of mouth and pectorals, which are small; dorsal over the tail; tail-lobes large, falcate.—*Knox.*

Skull globular, with a slender conical beak. The intermaxillaries form thin linear callous plates, incurved over a deep groove that extends back from the snout to the blow-holes, as in Dolphins; they then expand to form a flat lunate area in front of the blow-holes, and rise behind to form moderate knob-like crests that are separated by a notch, owing to the feeble development of the nasals. The maxillaries commence as lateral plates some distance from the top of the beak, but expand behind into slightly concave areas. The blowers are straight, vertical, and almost equally developed.

Before I had seen *Berardius Arnouxii* I took this for the young of that species; but it differs in the presence of crests over the blow-holes, feeble nasals, narrower beak, and more compressed teeth.

The tympanic bones of the two species have a close resemblance.

A second, fragmentary skull, of exactly the same form and dimensions as that described above (see also Trans. N.-Z. Inst. vol. iii.), has been lately obtained in a sandy deposit near Wanganui.

16. *Berardius Arnouxii*, Duv.

Ziphioid whale with skull like a Porpoise.

The specimen in the museum has the first three cervicals united, and the fourth united by the neural arch.

The preceding species has the first two thoroughly united and the third by its spines; the rest are free, not united, as might be inferred from the description (Trans. N.-Z. Inst. iii. p. 129), where the term combined cervical vertebræ referred only to the manner in which they are sketched.

Remarks on some of the Species in the foregoing paper. By Dr. J. E. Gray, F.R.S. &c.

This paper was received from Dr. Hector yesterday morning (December 26, 1872). As it is marked "abstract," probably it refers to a paper that he has sent to the New-Zealand Institute. He does not say, in his letter on other subjects which accompanies it, what I am to do with it; but I suppose it is sent for publication in the 'Annals,' as others received in the same way.

It contains many most valuable observations, and adds considerably to our knowledge of the Cetacea of the southern regions; it is very interesting as confirming the existence of the genera *Grampus* and *Beluga* in the southern or Antarctic seas. It is accompanied by tracings of the skull of *Epiodon chathamiensis*, of the lower jaw of *Mesoplodon Layardii*, of the ear-bones (represented half the natural size) of *Neobalæna marginata*, *Megaptera?*, *Berardius Arnouxii*, and *Berardius Hectori*.

1. *Neobalæna marginata.*

The discovery that the baleen named *Balæna marginata*, and that the ear-bones on which I first established the genus *Caperea*, belong to this whale is entirely due to Dr. Hector; and I gladly accept the correction, although it has always appeared to me that the baleen is very narrow and long for a whale with such a broad upper jaw compared with that of the northern Right Whale; but that may be a peculiarity of the group. The combination of characters thus brought together indicates an entirely new group of whales, which I propose to call *Neobalænidæ*.

The form of the skull and ear-bones is peculiar and very different from that of any known group of Cetacea; and I have always found that the characters derived from these parts are connected with peculiar modifications of the external form. The removal of the ear-bone of *Neobalæna* from the family Balænidæ makes the character from that bone in that family as uniform as it is in the other families of Balænoidea. In form and structure the whalebone is finer, but very similar to that of the Greenland Right Whale, and shows an affinity of this family to the Balænidæ; but the structure of the head is more like that of the Physalidæ, as far as we can judge from the figure, never having had an opportunity of seeing the skull itself. The dilated character of the lower jaw is very peculiar, and no doubt characteristic. The face, or rather maxillæ and intermaxillæ, is broad for a whale having such long and slender baleen.

We await the discovery and the description of the complete *Neobalæna* with great anxiety. If it is the Sulphur-bottom or Fin-fish it will be even more interesting, as removing that often-mentioned and hitherto undetermined whale from our books.

The synonyms will therefore run thus:—

Balæna marginata, Gray, Zool. Erebus & Terror, p. 48, t. 1. f. 1 (baleen only).

Caperea antipodarum, Gray, P. Z. S. 1864, p. 202, fig.; Cat. Seals & Whales, p. 101, f. 9 (ear-bone only); part only of Suppl. Cat.

Neobalæna marginata, Gray, Ann. & Mag. Nat. Hist. 1870, v. p. 221, vi. p. 155, figs. 1 & 2; Suppl. Cat. p. 40, figs. 1 & 2 (skull only).

I applied the name of *C. antipodarum* to this species, believing it to be the Black Whale of New Zealand, of which Dr. Dieffenbach had brought such an accurate figure; and I was confirmed in thinking that it was the same as the skeleton from New Zealand which was in the Paris Museum, by the observations of Milne-Edwards, Professor Lilljeborg, and Van Beneden, who, though the skeleton had lost its ear-bones, seemed to feel no doubt that it was the skeleton of the whale the ear-bones of which I figured. I have never seen the skeleton myself; for when I was in Paris they considered the skeleton a duplicate of the one they had set up, and not worth my seeing.

I think it better to retain the name of *Neobalæna* for this genus. The genus *Caperea*, though first established on the ear-bone of this genus, has had its character enlarged by the study of the Paris skeleton; and it would produce less change of name to retain *Caperea* for the whale the skeleton of which is at Paris; otherwise we should have to form a new name for that genus; but doubtless there will be some one who, wishing to append his name to a new-named old genus, will give it another appellation.

As the specimen in the Paris Museum has lost its ear-bones, M. van Beneden has added to the figure of that skeleton the figure of some ear-bones, said to have come from New Zealand, in the Belgian Museum. Now, as there are at least two Black or Right Whales with very different shoulder-blades that inhabit the seas of New Zealand, it is not possible to say to which of these species the specimens figured by M. van Beneden belong.

2. *Eubalæna australis.*

There are at least two Black Whales in New Zealand; and as yet I have no evidence that the *Eubalæna australis* has been taken in New-Zealand seas. It is doubtful to which of the two Right Whales the animal figured by Dr. Dieffenbach really belongs. I applied to this figure the names of *Balæna antipodarum* (Dieffenb. New Zeal. t. 1) and *Balæna antarctica* (Voy. Erebus and Terror, t. 1); but as this has been applied to the skeleton of the New-Zealand whale in the Paris Museum by M. Milne-Edwards, Prof. Lilljeborg, myself, and M. van Beneden in his 'Ostéographie des Cétacés,' I believe it will be better to retain it for that species. The form of the bladebone, which is different from that of all the other Right Whales known, is not likely to be connected with a change in the external form of the animal.

The synonyms will run thus:—

Balæna antipodarum, Gray, Dieffenb. New Zeal. tab. 1 (animal).
Balæna antarctica, Gray, Zool. Erebus & Terror, Cet. p. 16, tab. 1 (animal, not Lesson nor Owen).

Caperea antipodarum, Lilljeborg; Gray, Cat. Seals & Whales, p. 371, Suppl. p. 45 (not ear-bones).
Balæna antipodarum, Van Beneden, Ostéog. Cét. tab. 3 (skeleton; ear-bones doubtful).

The second Black Whale is *Macleayius australiensis*, a skeleton of which is in the British Museum (noticed in the Ann. & Mag. Nat. Hist. 1873, vol. xi. p. 75), and which is described and will be published in the 'Proceedings of the Zoological Society' for 1873. It was sent from the coast of Canterbury, New Zealand, as *Balæna antipodarum*, by Dr. Haast. I at first thought, from the similarity of the ear-bones, that it was the *Eubalæna australis*; but it is extremely different from this.

3. *Megaptera novæ-zealandiæ.*

The whale stranded at Wellington Harbour with "a falcate dorsal" is most probably a *Physalus*; for the peculiar character of *Megaptera* is to have merely a hunch instead of a dorsal fin, and elongate pectoral fins. The ear-bones of *Megaptera* and *Physalus* are nearly similar; and therefore it is most probably *Physalus antarcticus*. The colour of the baleen may vary, as the whalers say the character and texture are very different—so distinct that a dealer in these articles can distinguish the baleen of the Finners of the different countries, and they fetch different prices.

8. *Electra clancula*, Gray.

I do not know what Dr. Hector's remark refers to; perhaps it does not refer to my description. I published a description and figure which Dr. Hector sent to me in the 'Ann. & Mag. Nat. Hist.' 1872, ix. p. 436, fig.

10. *Grampus Richardsoni.*

The number of teeth varies in the different specimens of the European species.

13. *Epiodon chathamiensis*, and
14. *Mesoplodon Layardii.*

I have not seen the skull of *Epiodon australis*; but as yet I have never seen a species of whale or seal common to the coast of South America and New Zealand. It may be different with the Cape of Good Hope and Australia and New Zealand; but I have seen no decided instance of the same species occurring in two countries; therefore I can give no decided opinion respecting the jaw of *Mesoplodon Layardii*.

At the same time I may observe that the *Mesoplodon Layardii*, or, as I should call it, *Dolichodon Layardi*, has a much longer and more attenuated lower jaw, and much slenderer teeth, than the Chatham-Island specimen, figured and described by Dr. Hector under that name; and I have very little doubt in my own mind that the Chatham-Island specimen will be found, when more perfect specimens are obtained, to be the representative of a very distinct species of *Dolichodon*, which I would propose provisionally to designate as *Dolichodon Traversii*—a curious comment on the comparative anatomists, who think that *Dolichodon Layardi* of the Cape, *Callidon Güntheri* of New South Wales, *Petrorhynchus capensis* of the Cape, &c. "all differ in so trifling a degree as not to exceed the range of individual variations one often meets with in comparing a series of skulls of the same species." Surely the author means of the same domestic animals, and entirely leaves out of the question the experience gained by the study of wild ones and the evidence afforded by the study of their geographical distribution.

I must think that when these authors become more experienced they will wish their observations to have a "tacit burial and oblivion," and perhaps themselves learn how to define genera and species.

15. *Berardius Hectori.*

I know nothing of this skull except from Dr. Hector's figures and description: and the skull has never been in England; so that I do not think that any comparative anatomist has had the opportunity of seeing it. Dr. Hector considered it the young of *B. Arnouxi.* I at once saw that it was different; but as it has the teeth in the front of the jaw like *Berardius*, I considered it best (and am still of the same opinion) to retain it in that genus, with which it agrees in the position of its teeth as developed in the adult animal, and in geographical distribution; and Dr. Hector's tracings of the ear-bones of the two species show that there is a great affinity between them in the very peculiar manner in which those bones are dotted. I consider the position of the teeth a more important zoological character than a slight difference in the "conformation of the naso-premaxillary region," a part that, as every zoologist who has examined several skulls of different ages in the same species of Cetacea knows, is very apt to vary; but when a comparative anatomist draws his conclusions from figures, or the examination of a single specimen of a group, he is often liable to be misled as to the value of the characters to which he attaches much importance. Nothing showed this better than the published results of the labours of a comparative anatomist who has named, but not defined, a multitude of species and genera from fragments of fossil bones, but who when he attempted to name recent skulls, as of crocodiles (of which he has perfect specimens under his eyes), named, described, and published what are now regarded as three distinct species in one case, and two distinct species in another, under the same name, and, on the other hand, a series of skulls of the same species under three different names (see Trans. Zool. Soc. vi. 1869, p. 127), and who mixes up together under one name the skulls of two such large and distinct animals as a one-horned and a two-horned rhinoceros as a double-horned one (see Proc. Zool. Soc. 1867, p. 1015). I need not (but could) refer to many more instances of the same kind. I am in the habit of estimating, from what is written about what I know, the reliance I may place upon what is written of what I do not know, and have thus lost my confidence in this author's writings on zoological questions.

It is an old complaint that persons will write about what they have a limited knowledge of. Thus the comparative anatomists are always giving their opinions on the limits and definitions of genera and the names that ought to be used—subjects not much in their way, and on which they have very crude ideas. What would they say if a zoologist interfered with their anatomical details, their confused nomenclature of bones, and their much controverted homologies? But it is the more remarkable, when we consider how very few animals have been dissected, and how imperfectly those that have been dissected have been described, as is proved by their own papers (see for instance Mr. Clark's paper on the hippopotamus, 'Proc. Zool. Soc.' 1872, p. 185), that an anatomist should leave his subject and diverge to write upon the synonyma of species and the priority of names, all of which is mere compilation on his part.

XIV.—*A Monographic List of the Species of the Genus* Gonyleptes, *with Descriptions of three remarkable new Species.* By Arthur Gardiner Butler, F.L.S., F.Z.S., &c.

[Plate III.]

Family **Gonyleptidæ**, Wood.

Genus Gonyleptes *, Kirby.

1. *Gonyleptes horridus.*

Gonyleptes horridus, Kirby, Trans. Linn. Soc. xii. p. 452, pl. 22. fig. 16 (1818).

Gonyleptes curvipes?, Koch (nec Guérin), Arachn. vii. pl. 224. fig. 555 (1839).

Hab. "Brazil" (*Kirby*); Surinam. One example. B.M.

* I take this genus in its restricted sense, as used by Gervais ('Aptères,' iii. pp. 102-105). Wood, in his recent papers on Gonyleptidæ and Phalangidæ, applies it equally to *Goniosoma* and *Cosmetus*!

2. *Gonyleptes aculeatus.*

Gonyleptes aculeatus, Kirby, Trans. Linn. Soc. xii. p. 452 (1818).
Var.? *Faucheur acanthure*, Duméril, Dict. Sc. Nat., Ent. pl. 60. figs. 14–16 (1819).
Gonyleptes acanthurus, Gervais, Aptères, iii. p. 105, pl. 46. fig. 2 (1844).

Hab. Monte Video (*Darwin*). Two examples. B.M.

3. *Gonyleptes scaber.*

Gonyleptes scaber, Kirby, Trans. Linn. Soc. xii. p. 453 (1818); Koch, Arachn. vii. pl. 223. figs. 553, 554 (1839).

Hab. Monte Video?; Valdivia (*Cuming*). Three examples. B.M.

4. *Gonyleptes acanthopus.*

Phalangium acanthopus, Quoy & Gaim. Voy. de l'Uranie, Zool. p. 546, pl. 62. figs. 2, ♂, 3, ♀ (1824).
Eusarcus grandis, Perty, Del. Anim. p. 206, pl. 40. fig. 2, ♀ (1830–34).
Gonyleptes horridus, Koch, Arachn. vii. pl. 222. figs. 551, 552 (1839).

Hab. Brazil. Five examples. B.M.

5. *Gonyleptes asperatus.*

Gonyleptes asperatus, Gervais, Gay's Chili, Zool., Arachn. pl. 1. fig. 9 (1849).

Hab. Chili.

6. *Gonyleptes planiceps.*

Gonyleptes planiceps, Gervais, Mag. de Zool., Arachn. pl. 2; Aptères, iii. p. 105 (1844); Gay's Chili, Zool., Arachn. pl. 1. fig. 10 (1849).

Hab. Chili.

7. *Gonyleptes pectinatus.*

Gonyleptes pectinatus, Koch, Arachn. xii. pl. 402. fig. 971 (1845).
?*Gonyleptes curvipes*, Koch, Arachn. vii. pl. 224. fig. 555 (1839).

Hab. "Bahia" (*Koch*); near Rio Janeiro (*A. Fry*). One example. B.M.

8. *Gonyleptes curvipes.*

Gonyleptes curvipes, Guérin, Icon. du Règne Anim., Arachn. pl. 4. fig. 5 (1842–49); Gervais, Aptères, iii. p. 104, pl. 46. fig. 1 (1844); Gay's Chili, Zool., Arachn. pl. 1. fig. 6 (1849).
Gonyleptes chilensis, G. R. Gray, Anim. Kingd., Arachn. pl. 20. fig. 2.

Hab. Chili. Four examples. B.M.

9. *Gonyleptes armatus.*

Gonyleptes armatus, Perty, Del. Anim. p. 205, pl. 39. fig. 13 (1830–34).

Hab. Rio Negro.

G. spinipes and *asper* of Perty are referred by Koch to his genus *Ampheres*; *G. curvispina* and *elegans* to his genus *Cœlopygus.*

10. *Gonyleptes acanthops.*

Gonyleptes acanthops, Gervais, Gay's Chili, Zool., Arachn. pl. 1. fig. 4 (1849).

Hab. Chili.

There is a species nearly allied to this in the British Museum.

11. *Gonyleptes bicuspidatus.*

Gonyleptes bicuspidatus, Koch, Arachn. vii. pl. 224. fig. 556 (1839).

Hab. Brazil (*Koch*).

12. *Gonyleptes muticus.*

Gonyleptes muticus, Koch, Arachn. vii. pl. 225. fig. 557 (1839).

Hab. Brazil (*Koch*).

13. *Gonyleptes polyacanthus.*

Gonyleptes polyacanthus, Gervais, Gay's Chili, Zool., Arachn. pl. 1. fig. 7 (1849).

Hab. "Chili" (*Gervais*); ——? One example. B.M.

14. *Gonyleptes modestus.*

Gonyleptes modestus, Gervais, Gay's Chili, Zool., Arachn. in vol. iv. p. 23. n. 4 (1849).

Hab. Chili?; Valdivia (*Cuming*). Two examples. B.M.

15. *Gonyleptes bicornis.*

Gonyleptes bicornis, Gervais, Gay's Chili, Zool., Arachn. in vol. iv. p. 21. n. 2 (1849).

Hab. Chili.

16. *Gonyleptes subsimilis.*

Gonyleptes subsimilis, Gervais, Gay's Chili, Zool., Arachn. pl. 1. fig. 8 (1849).

Gonyleptes polyacanthoides, Gervais, Aptères, iv. p. 577 (1847 ?)*.

Hab. Chili.

Seems to be a female closely allied to *G. aculeatus* ♀; several of the species at present referred to the genus *Goniosoma* have much the same aspect, and may possibly have to be referred to this genus when we know both sexes of them. The two genera have been somewhat artificially separated; but I have thought it better to leave them for the present as Gervais left them.

G. ornatum of Say, recently figured and redescribed by Wood as a *Gonyleptes,* in which genus Gervais also retained it (Apt. iv. p. 344), belongs to the genus *Cosmetus* (Phalangidæ),

* A reference is given at p. 576 to the pagination and plates of Gay's 'Chili.'

the palpi being unarmed. We have four examples from Georgia, where the type also was taken; they agree closely with Say's description, but not with Wood's.

With regard to the species recently described from Ecuador (Trans. Am. Phil. Soc. n. s. xiii. 1869, pp. 435–440, pl. xxiv.), *G. prædo*, *G. injucundus*, and *G. spinipalpus* appear to be *Goniosomata*, and *G. multimaculatus* a mutilated and greasy example of *Cosmetus cordatus*; the species (*O. marginatus*) forming the new genus *Octophthalmus* is unknown to me at present; *O. bilunata** and *O. ferox*, forming the genus *Ortonia*, are also unknown to me, although the latter appears to be congeneric with *Goniosoma raptator* of Gervais, which I have always considered the type of a distinct genus.

The following are new species :—

17. *Gonyleptes armillatus*, n. sp. Pl. III. figs. 1, 2.

Colours: above pitchy, the marginal tubercles of cephalothorax tawny in the centre; tarsi ochraceous; palpi olivaceous; below brownish in parts, the joints of the legs testaceous; mandibles or chelæ olivaceous, their pincers ferruginous.

Male. Above with oculiferous tubercle prominent, arched forwards, and obtusely bifurcate; immediately behind it and in front of the transverse suture two groups of five to six minute tubercles; central area of cephalothorax transversely ovate, margined on either side by six gradually increasing prominent tubercles, and in front of these to just above the suture by a series of minute shining granules; bearing on either side a robust obtuse incurved spine above base of coxæ of hind legs; distinctly convex and crossed by six to seven transverse irregular series of moderate-sized tubercles, besides six prominent central ones placed longitudinally in pairs; posterior area trisegmented, tuberculate, second segmentation bearing a prominent terminal spine: legs short, coarsely rugose, spinous, pilose; hind legs with coxæ obtusely spinous; femora coarsely tuberculate, externally obtusely dentate-spinous; tibiæ coarsely tuberculate: sternal surface entirely tuberculate and pilose, as also the segments of the abdomen; palpi ("mandibules palpiformes" of Gervais) of moderate length, compressed, with slender spines; chelicères short, pilose, the chelæ cylindrical, pincers minutely serrated internally.

* This species has quite the aspect of a *Cosmetus*, so far as one can judge by the figure; but the description says, "Palpi . . . . penultimate joint broadly dilated, somewhat triangular, thin, and armed with minute slender spines on its margins, and a pair of larger ones on its distal end; the distal article more cylindrical, with one or more acute spines, against which the movable claw works."

Length of cephalothorax 4 lines; relative length of legs 1, 3, 4, 2, the second pair being the longest.

Female. Differs chiefly in its narrower cephalothorax, which has smaller tubercles and less strongly developed lateral spines; the legs also are much less spinose.

Hab. Ecuador (*Buckley*). ♂ ♀. B.M.

Must be placed next to *G. curvipes*, but is a very distinct and beautiful form.

18. *Gonyleptes ancyrophorus*, n. sp. Pl. III. figs. 5, 6.

Colours: cephalothorax above pitchy, becoming testaceous at the margins; legs black-brown, with coxæ ochraceous and base of femora ferruginous; femora of hind legs entirely ferruginous; palpi blackish olivaceous, terminal claw and points of spines ochraceous; cheliceres olivaceous, with pincers ochraceous; body below dirty testaceous, clouded with olivaceous, and becoming blackish posteriorly.

Cephalothorax above with oculiferous tubercle prominent, bearing two well-developed and moderately acute divergent spines; entire dorsum unusually convex; posterior area trapezoidal, and bearing on its hinder margin two slightly divergent and well-developed acute spines; legs long, smooth; hind legs irregularly spined along inner margin of femora; palpi rather longer than cephalothorax, their joints more or less cylindrical, irregular, coarsely spined; cheliceres with second joint above trispinose behind; chelæ rather large, fixed finger with two obtuse teeth on its inner margin: inferior surface smooth, the metasternum bearing on either side (about halfway between the third and fourth pair of legs) a strong acute perpendicular spine, and on its outer margin, below the retracted abdominal segments, a long, thick, incurved, and nearly perpendicular horny process, bifurcate at its tip.

Length of cephalothorax 4 lines; relative length of legs, apparently, 1, 3, 2, 4.

Hab. Quito (*W. C. Hewitson*). B.M.

Not nearly allied to any described species.

19. *Gonyleptes telifer*, n. sp. Pl. III. figs. 3, 4.

Colours almost as in *G. armillatus*, but (with the exception of the cheliceres) rather darker; under surface of body pitchy.

Cephalothorax similar in general form to that of *G. armillatus*; irregularly tuberculate, marginal tubercles smaller, some of them obtusely spinose; oculiferous tubercle very prominent, bispinose; six central tubercles of cephalothorax elongated into obtuse spines, the hindmost pair being the longest; margin above base of coxæ of hind legs bearing two widely divergent obtuse spines; posterior area trisegmented, tuberculate, second segmentation bearing a prominent central acute spine, third segmentation terminating in a long, feebly curved, and very robust spine, three lines in length; legs long, rugose, denticulate; hind legs, with the exception of the femora, internally dentated; body below, including abdomen, coarsely tuberculate; palpi moderately long, subcylindrical, with slender spines; cheliceres small; the chelæ cylindrical, pilose, pincers crossing at the tips and strongly denticulate internally.

Length of cephalothorax (excluding terminal spine) $4\frac{1}{2}$ lines; relative length of legs 1, 3, 2, 4.

Hab. Ega (*Bates*). One specimen. B.M.

Most nearly allied to *G. armillatus*, but in general appearance utterly unlike any thing previously described: it reminds me of a similarly ornamented fossil form described by Mr. Henry Woodward (Geol. Mag. vol. viii. p. 385, pl. xi. 1871) as *Eophrynus Prestvicii* (*Curculioides* of Samouelle); the latter, however, excepting in ornamentation, appears to come nearer to *Ischyropsalis* of Koch.

XV.—*Notes on the Longicorn Coleoptera of Tropical America.* By H. W. Bates, F.L.S.

[Continued from p. 45.]

Genus Acyphoderes.

Serville, Ann. Soc. Ent. Fr. 1833, p. 549; Lacord. Genera, vol. viii. p. 505.

The character given by Serville as distinguishing this genus was the broadly ovate depressed uneven thorax. A more constant feature is the rather abruptly subulate elytra. The thorax is sometimes oblong-ovate and convex. The antennæ in all the species are robust and strongly serrated.

I. *Apex of elytra entire.*

A. *Thorax without dorsal ridges.*

1. *Acyphoderes crinitus*, Klug.

Stenopterus crinitus, Klug, Entom. Bras. Specim. alter. p. 56, t. xliv. f. 11.

Rio Janeiro.

2. *Acyphoderes mœstus*, n. sp.

A. niger, velutinus, dense breviter hirsutus; thorace elongato, sub-ovato, postice constricto; elytris disco fuscescenti-albis vitreis. Long. 9 lin. ♂.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Allied to *A. crinitus* (Klug). More slender and elongate. Hind tibiæ with the apical half dilated externally, and densely clothed with rather short black hairs. Head slender; muzzle greatly elongated and narrow; eyes (male) nearly approaching in front the mesial line. Antennæ rather slender; joints dilated at the apex, and serrate from the fifth joint. Thorax similar in form to that of *A. crinitus*, but narrower, considerably constricted near the base; disk depressed. Elytra subulate, reaching scarcely the middle of the fourth segment; disk pale, vitreous; borders black, not clearly defined. Beneath, the breast clothed in the middle with a dense woolly tawny-grey pubescence; metasternum very broad, keeled down the middle. Abdomen (male) slender, cylindrical; terminal ventral segment with two elevated ridges, with their anterior angles projecting and pointed. Legs black; hind femora elongate, gradually clavate.

3. *Acyphoderes femoratus*, Klug.

Stenopterus femoratus, Klug, Entom. Bras. Specim. alter. p. 57, t. xliv. f. 10, ♂.

Acyphoderes brachialis, Pascoe, Journ. of Entom. i. p. 369, ♂.

Brazil.

Pascoe's description agrees closely with that of Klug; and the figure quoted represents clearly the singular form of the anterior legs, which struck both Pascoe and Lacordaire, who both appear to have overlooked Klug's well-known figure.

AA. *Thorax with dorsal ridges.*

4. *Acyphoderes hirtipes*, Klug.

Stenopterus hirtipes, Klug, *l. c.* p. 55, t. xliv. f. 9, ♀.

S. Brazil.

The anterior legs of the male are very similar in form to those of *A. femoratus* ♂.

In both these species the muzzle is intermediate, as to length and narrowness, between *A. crinitus* and *A. aurulentus*. The thorax is elongate and almost cylindrical in *A. femoratus* (although showing faint dorsal ridges), a little more ovate in *A. hirtipes*, differing much in shape according to sex in both species. This character, therefore, is of no avail as a generic distinction.

5. *Acyphoderes aurulentus*, Kirby.

Necydalis aurulentus, Kirby, Trans. Linn. Soc. xii. 443 (1817); Dalm. Anal. Entom. p. 71 (1823).
Acyphoderes sericinus, White, Cat. Long. Col. Brit. Mus. p. 195.

Rio Janeiro, Bahia.

Kirby's original description is made from the dark form of this insect, in which the femora and tibiæ are black in the middle, and the elytra have a furcate black streak on each side. The type of White's *sericinus* is a specimen of this form.

6. *Acyphoderes Olivieri*, Bates.

Acyphoderes Olivieri, Bates, Trans. Ent. Soc. 1870, p. 328.
Necydalis abdominalis, Oliv. no. 74, p. 8, pl. 1. f. 5 (?).

Amazons and Cayenne.

Olivier makes no mention of golden pubescence in his description; and the elytra in the figure have not the form of those of the present species. Nevertheless it is probable his species is the same as *A. Olivieri*.

7. *Acyphoderes carinicollis*, n. sp.

A. minor, fusco-niger, minus pubescens, femoribus læte rufis, posticis basi flavo-testaceis; thorace anguste oblongo-ovato, lineatim aureo-tomentoso, carina lævi mediana marginem anticum attingente, altera utrinque latiore grosse punctata. Long. 6 lin. ♀.

Prov. Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

Small and slender for this genus. Head punctate-scabrous, partly golden tomentose; muzzle moderate; eyes (female) not widely distant in front. Antennæ elongate, slightly thickened towards apex; joints moderately dilated at apex, and serrate from the fifth. Thorax oblong-ovate, as in *Bromiades brachyptera*, sparsely hirsute, and appearing glabrous, except the lines of golden tomentum, of which there are two dorsal (one on each side the median line), one along the anterior and posterior margin, and a short oblique one trending towards the disk from the tomentose flanks. The three longitudinal ribs of the disk are coarsely punctate, except the anterior part of the middle one, which is smooth and extends to the fore margin. Scutellum golden tomentose. Elytra elongate, subulate; margins deep black and clearly defined, and on each side emitting a branch, which passes above the humeral angle to the base; rest of surface yellow, vitreous. Body beneath pitchy black; breast golden tomentose. Legs black; thighs red; posterior pair at base pale, sometimes with a dusky ring at commencement of the rather abrupt club.

8. *Acyphoderes odyneroides*, White.

Acyphoderes odyneroides, White, Cat. Long. Col. Brit. Mus. p. 196, pl. 5. f. 3.

R. Tapajos, Amazons.

The apex of the elytra in this species is prolonged into a very sharp point. The species is an exact mimic of the wasp *Polybia liliacea*, F., found abundantly in the same localities and frequenting the same flowers.

II. *Apex of elytra emarginate-truncate.* (*Thorax with dorsal ridges.*)

9. *Acyphoderes acutipennis*, Thomson.

Acyphoderes acutipennis, Thomson, Classif. des Céramb. p. 179.

Mexico.

Genus Bromiades.

Thomson, Syst. Ceramb. p. 165; Lacord. Genera, vol. viii. p. 506.

This differs from *Acyphoderes* only in the short cuneiform elytra, which barely pass the base of the first abdominal segment, and are scarcely dehiscent at the suture. *B. brachypterus* bears the closest resemblance to *Acyphoderes aurulentus*, even to the tubercle on the anterior part of the prosternum. Lacordaire was unacquainted with the male, which differs from the female only in the less dilated antennæ and the eyes reaching nearly to the median line of the forehead.

Bromiades brachypterus, Chevr.

Bromiades brachypterus, Chevrolat, Rev. Zool. 1838, p. 285.

Cuba and Sta. Marta, New Granada.

A specimen from the latter locality in my collection differs from the Cuban form in having the hind legs wholly tawny red, with the exception of the two apical joints of the tarsi, which are black.

Genus Sphecomorpha.

Newman, Entom. Mag. v. p. 396; White, Cat. Long. Col. Brit. Mus. p. 197.

Syn. *Sphecogaster*, Lacord. Genera, vol. viii. p. 471.

Lacordaire placed this genus in his group *Necydalides*, although its characters interfered much with the compactness of his definition of the group, as shown by his citing it often as an exception. In fact it is merely an extreme form of *Rhinotraginæ* much modified probably by mimetic adaptation. The anterior coxæ are certainly much exserted, but not more so than in *Isthmiade* and in many *Odontoceræ* and *Ommatæ*, in some of which latter the prosternum between the coxæ is also reduced, as in *Sphecomorpha*, to a narrow thread. *Stenopterus murinus* of Klug, which I venture to associate with the typical species, bridges over the difference between it and *Odontocera* and *Acyphoderes*. In both the narrowed part of the subulate elytra is of extreme length and tenuity, ending in a sharp point. The thorax in *Sph. murina* is not so broad as in *Sph. chalybea*, but it is of similar shape; and the third antennal joint is relatively not so long.

1. *Sphecomorpha chalybea*, Newm.

Sphecomorpha chalybea, Newman, *l. c.* p. 396.
S. biplagiatus, Lacord. *l. c.* p. 472, note.

Amazons; Surinam; "Brazil" (*Newm.*).

The species is deceptively similar to *Synœca cyanea*, F., a common wasp in the countries where the *Sphecomorpha* is found.

2. *Sphecomorpha murina*, Klug.

Stenopterus murinus, Klug, Entom. Bras. Specim. alter. p. 55, t. xliv. f. 8.

Rio Janeiro.

The abdomen is much attenuated at the base, and remarkably vespiform in both sexes.

Genus Isthmiade.

Thomson, System. Ceramb. p. 166; Lacord. Gen. vol. viii. p. 504.

The elytra are subulate (narrower than in *Acyphoderes*). The antennæ have all joints elongate and slender, strongly serrate from the sixth joint. The thorax is narrow, strongly polished, and tuberculate. All the species are mimics of Ichneumon flies of the group Braconidæ.

1. *Isthmiade braconides*, Perty.

Stenopterus braconides, Perty, Del. An. Art. Bras. p. 94, t. 19. f. 3.
Isthmiade hephæstionoides, Thoms. *l. c.* p. 166.

South Brazil.

2. *Isthmiade rubra*, n. sp.

I. castaneo-rufa, nitida, vertice nigra; elytris disco pallide fuscis vitreis; alis pallide fuscis, ante apicem fascia fulva. Long. 7–8 lin. ♂ ♀.

Prov. Rio Janeiro et Paraná, Brazil (*coll. W. W. Saunders, Dr. Baden, and H. W. Bates*).

Very similar to *I. braconides* (Perty), differing in its bright glossy chestnut-red colour, and especially its pale brown wings. The thorax is smooth and glossy, with five prominent tubercles on the disk. The eyes in the male do not reach the median line of the front; in the female they are separated by a space about twice the width of that of the male. The elytra are strongly subuliform. The metasternum is very voluminous, and the abdomen very slender, especially at the base, in both sexes. In the male the apical ventral segment is concave in the middle and elevated at the sides.

A single male in Dr. Baden's collection has two strong spines at the apex of the fourth ventral segment, like the male of *Acyphoderes femoratus*. In two other males there is no trace of this armature. The terminal ventral segment in the specimen mentioned has not the concavity and lateral wings of the type. As the form and colours of all the specimens are exactly similar, I do not venture to consider these sexual differences specific.

3. *Isthmiade ichneumoniformis.*

Isthmiade ichneumoniformis, Bates, Trans. Ent. Soc. 1870, p. 326.

R. Amazons.

4. *Isthmiade macilenta*, n. sp.

I. rubræ similis, at minor et multo angustior, thorace vix tuberculato, etc. Valde angustata, rufo-castanea; antennis, elytris, pedibus quatuor anticis, basique femorum posticorum pallidioribus; capite angusto nigro; thorace elongato, angusto, medio paulo dilatato, polito, supra sparsim punctato, tuberculo mediano dorsali parvo; elytris haud subito angustatis, apice late rotundatis, sparsim punctatis, nitidis. Long. $5\frac{1}{2}$ lin. ♀.

S. Brazil (*coll. Dr. Baden*).

Differs from all other species by its narrow elongate thorax, destitute of tubercles except the small discoidal one, the rest of the surface being simply uneven, and sprinkled with small circular punctures; a lateral sulcus is very strongly marked near the base. The antennæ also differ in being distinctly thickened towards the apex, with the joints compact and moderately serrated. The elytra are subuliform, but not suddenly narrowed, the lateral incurvature being much weaker than in the other species. The wings also differ in not having the yellow fascia which gives to the other species their strong resemblance to the Braconidæ; they are very light brown, and have only a faint indication of a yellow stigmoidal spot.

Genus Ischasia.

Thomson, Syst. Ceramb. p. 163; Lacord. Genera, vol. viii. p. 508.

This genus is distinguished by its short and broad cuneiform elytra, not reaching the apex of the first abdominal segment and punctured throughout, the punctures being only a little wider apart on the disk, with the interstices shining. The muzzle is elongated, but rather broad. The legs long and slender, with the thighs rather abruptly clavate and the hind tibiæ not tufted. The antennæ are elongate-clavate; Thomson describes the joints (from the sixth) as "paulo serratis," which is nearer the fact than Lacordaire's statement, "non dentées en scie." In the male the eyes do not reach the median line of the front.

Ischasia rufina, Thoms. *l. c.*

Prov. Rio Janeiro and Paraná (*coll. W. Saunders, Dr. Baden, and H. W. Bates*).

The antennæ and legs are sometimes more or less black.

Genus CHARIS, Newman.

Newman, Entom. p. 21; Lacord. Genera, vol. viii. p. 507.
Syn. *Epimelitta*, Bates, Trans. Ent. Soc. 1870, p. 330.

Having had an opportunity of examining a considerable series of species of these insects, so curiously modified to attain a close resemblance to different species of hairy bees, I think *Epimelitta* may be very well incorporated with *Charis*, the only differences being the broader thorax and more hirsute body.

I. *Elytra very short, cuneiform. Thorax broad, tumid on each side near the hind angle.*

1. *Charis euphrosyne*, Newman.

Charis euphrosyne, Newman, Entom. p. 21.

S. Brazil (*coll. W. W. Saunders*).

2. *Charis barbicrus*, Kirby.

Necydalis barbicrus, Kirby, Trans. Linn. Soc. t. xii. p. 443.
Charis Acede, Newm. Entom. p. 91.

Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

The elytra in this species are strongly emarginate along their sutural margin, and the lateral edge is very little incurved.

3. *Charis scoparius*, Klug.

Molorchus scoparius, Klug, Entom. Bras. Specim. alter. p. 51, t. xliv. f. 2.

Cametá (Amazons).

4. *Charis mimica*, n. sp.

C. nigra, tibiis posticis apice et tarsis rufis, illis dense fulvo-penicillatis; femoribus magnis, crassis, nigro-hirsutis et supra penicillatis. Long. 5 lin. ♂.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden*).

Head coarsely punctured, black; mouth pitchy. Eyes (male) nearly touching in front the median line. Antennæ very slightly thickened towards the tip; joints from the fifth distinctly enlarged at apex and serrate. Thorax strongly transverse, rounded, transversely convex in the middle, the convexity clothed with long, erect, black hairs, partially glabrous and punctured behind. Elytra cuneiform, short, reaching only halfway down the first abdominal segment, black, brownish and punctured on the disk, with a line of long, erect, black hairs curving from the base to the middle of the suture. Legs pitchy black, hairy, short, except the elongated hind pair, of which the femora are much thickened, and have a distinct tuft of black hairs on their upper edge and a fringe beneath. The tibiæ have their apical half reddish, with two tufts of tawny hairs on their outer edge, and a continuous long fringe of similar hairs on their inner edge; the tarsi of the same legs are also reddish; the anterior femora are bearded underneath with long black hairs. Body beneath black; metasternum voluminous, clothed with yellowish hairs; abdomen in male moderately slender.

This curious insect bears a striking resemblance to certain bees of the *Melipona* group.

5. *Charis meliponica*, Bates.

Epimelitta meliponica, Bates, Trans. Ent. Soc. 1870, p. 331.

R. Amazons.

6. *Charis rufiventris*, Bates.

Epimelitta rufiventris, Bates, *l. c.* p. 331.

R. Amazons.

7. *Charis bicolor*, n. sp.

C. niger, griseo-pubescens; partibus oris, antennis basi, abdomine, elytrisque dimidio apicali, fulvo-testaceis. Long. $4\frac{1}{2}$ lin. ♂ ♀.

Resembles *Ch. barbicrus*, Kir. (=*Aœde*, Newm.), but differs in the elytra not incurved along the sutural edge &c. Head rugose-punctate, clothed with silvery-grey pile; muzzle short; eyes in male not reaching the median frontal line, in female rather more widely separated. Antennæ half the length of the body (a little longer in male), thickened and strongly serrated from the sixth joint, tawny testaceous; tips of apical joints blackish. Thorax short, rounded, constricted at the base, and slightly gibbous on each side above the constriction; surface longitudinally confluent-strigose, partially clothed with silvery pile. Elytra short, cuneiform; apex obtuse, sparingly punctured, scarcely shining; basal half violet-black, apical half tawny; tip convex and somewhat darker; a patch of gold-coloured hairs on each side of the scutellum. Abdomen fulvous, not disproportionate to the metasternum, or differing much in form according to sex. Legs pitchy black, hairy; hind legs slightly elongated; tibiæ with a dense brush of blackish hairs on the outer side of their apical half.

The following species, unknown to me, belong possibly to this section:—

8. *Charis Erato*, Newm. Entom. p. 21.

Brazil.

9. *Charis Mneme*, Newm. *l. c.* p. 90.

Brazil.

10. *Charis Melete*, Newm. *l. c.* p. 91.

Brazil.

The description in some respects applies to *Tomopterus laticornis* (Klug), but it is not sufficiently complete to enable one to decide.

II. *Elytra narrowed and strongly divergent towards the apex (reaching nearly to the apex of the second abdominal segment). Thorax subcylindrical.*

11. *Charis Aglaia*, Newm. Entom. p. 22.

Brazil (*coll. W. W. Saunders and H. W. Bates*).

This species forms a transition to the genus *Phygopoda*.

Genus Phygopoda, Thomson.

Thomson, Syst. Ceramb. p. 164.

Differs from *Charis* by the great length of the hind legs and the more abruptly clavate hind femora. In the smaller and narrower thorax and the narrowed and divergent apices of the elytra it agrees with section II. of that genus.

1. *Phygopoda albitarsis*, Klug.

Stenopterus albitarsis, Klug, Entom. Bras. Specim. alter. p. 57, t. xliv. f. 12.
Phygopoda fugax, Thoms. *l. c.* p. 164 (?).

Thomson's description of his *Ph. fugax* agrees with small examples of *Ph. albitarsis*, except the omission of mention of the smooth raised dorsal line of the thorax.

R. Amazons. Abundant occasionally on flowers.

2. *Phygopoda subvestita*, White.

Odontocera subvestita, White, Cat. Long. Col. Brit. Mus. p. 190.

R. Tapajos, Amazons.

This species would be almost equally well placed in the genus *Charis*, sect. II. The hind thighs are longer and rather more abruptly clavate than in any species of *Charis*, but they are less so than in *Phygopoda albitarsis.*

ACORETHRA, nov. gen.

Corpus, præcipue abdomen valde elongatum. *Caput* parvum, rostro paululum producto. *Oculi* ♂ magni antice fere contigui, ♀ modice distantes. *Antennæ* modice breves, articulis a sexto dilatatis, serratis. *Thorax* parvus, antice angustatus. *Elytra* cuneiformia, obtusa, abdominis segmenti primi medium attingentia, disco nitida. *Pedes* postici elongati; *femora* gradatim clavata; *tibiæ* haud scopiferæ; *tarsi* breves. *Metasternum* haud distentum; *abdomen* ♂ lineare, gracile, ♀ sessile.

This genus is closely allied both to *Charis* and *Phygopoda*, but cannot be united to either without rendering their definition impossible. The simple hind tibiæ and obtuse cuneiform elytra distinguish it from *Phygopoda*; and the elongated hind legs and abdomen separate it from *Charis*. The abdomen is of disproportionate extension, exceeding by one half the length of the rest of the body.

Acorethra chrysaspis, n. sp.

A. gracilis, fusco-castanea, capite thoraceque obscurioribus, reticulato-punctatis; elytris cuneiformibus, disco pallide fuscis politis, macula utrinque scutellari scutelloque aureo-tomentosis; pectore aureo-tomentoso; segmento primo ventrali testaceo, cæteris (♀) utrinque macula laterali aureo-tomentosa; pedibus fulvo-castaneis, posticis valde elongatis, tibiis longe hirsutis haud scopiferis, femoribus gradatim clavatis, basi pallidis. Long. 5–7 lin. ♂ ♀.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

Head narrow; muzzle as in *Ph. albitarsis*, moderately elongated. Eyes, in male contiguous in front, in female moderately distant. Thorax gradually narrowed in front and slightly constricted at the base. Elytra not reaching the apex of first segment, dehiscent at suture, obtusely pointed at apex; disk with a few scattered punctures, shining. Antennæ rather more than half the length of the body, thickened at the tips; third to fifth joints linear. The abdomen in the male is very slender and linear, in the female sessile and not disproportioned to the metasternum.

Phespia, nov. gen.

Antennæ breves, gradatim incrassatæ; articulo tertio cylindrico, quarto et quinto trigonis, sexto usque decimum quadrato-dilatatis, perfoliatis, nullo modo serratis. *Thorax* lateribus regulariter rotundatus, supra convexus. *Elytra* abbreviata, gradatim attenuata, apice acuminata, sutura prope apicem hiantia, supra vitta exteriore subhyalina. *Abdomen* brevissimum, vespiforme. *Pedes* subgraciles; *femora* pedunculata, versus apicem clavata; *tibiæ* posticæ apice scopiferæ. Cætera ut in gen. *Odontocera*.

A genus formed for the reception of a small number of species, differing in the form of the antennæ and elytra too much from *Odontocera* and *Acyphoderes* to be united to either. The enlarged antennal joints are not serriform, but almost equally dilated on each side, so as to form a quadrate or thick cylindrical figure; and the elytra are subuliform, in quite a different way from the same members in *Acyphoderes*, *Isthmiade*, *Sphecomorpha*, or in *Odontocera* in the few species which assume this form. They are narrowed almost from the base, most so on their outer side, by which, when closed, the sides of the metasternum and abdominal segments are visible from above; along the suture they are straight until near the apex, whence they taper obliquely and each forms a point at its apex: above, the vitreous stripe runs obliquely from the shoulder, and is interrupted by a dark bar before the apex. The abdomen is relatively very short, not much longer than the meso- and metathorax together. In general appearance the species mimic the species of the *Cerceris* group of solitary wasps.

The genus is no doubt closely allied to *Tomopterus*.

1. *Phespia cercerina*, Bates.

Odontocera cercerina, Bates, Trans. Ent. Soc. 1870, p. 325.

R. Amazons.

2. *Phespia simulans*, n. sp.

Ph. cercerinæ similis, at elytris longioribus; fulvo-brunnea vel nigro-fusca; capite thoraceque nigris, tibiis posticis fere a basi dense fusco-nigro hirsutis. Long. 4–$5\frac{1}{4}$ lin. ♀.

Novo Friburg, Rio Janeiro, and Prov. Paraná (*coll. Dr. Baden and W. W. Saunders*).

Larger than *Ph. cercerina*. Head blackish, with stripe of golden pile down each side of the forehead and round the eyes. Antennæ black, reddish at the base; sixth to tenth joints thick, cylindrical, compact. Thorax closely but indistinctly punctured, black; anterior and posterior margins golden pubescent. Scutellum golden pubescent. Elytra longer than in

Ph. cercerina, reaching to base of penultimate segment, blackish at base and tawny reddish at apex, roughly punctured near the base and shoulders; a line of golden pubescence on each side of the scutellum and a narrow vitreous yellowish vitta beginning near the shoulder and ending long before the apex, with a transverse dusky spot across it before its termination. The breast and abdominal segments have similar transverse lines of pubescence (rich golden) as in *Ph. cercerina.* The legs are reddish tawny, with the exception of the dense brush-like pubescence of the hind tibiæ reaching nearly to the base, which is blackish.

3. *Phespia corinna*, Pascoe.

Charis corinna, Pascoe, Trans. Ent. Soc. ser. 3. vol. v. p. 290.

New Granada.

Genus TOMOPTERUS, Serville.

Serv. Ann. Soc. Ent. Fr. 1833, p. 544.

I. *Elytra short, quadrate, not reaching the base of the abdomen.*

1. *Tomopterus staphylinus*, Serv.

Tomopterus staphylinus, Serv. *l. c.* p. 545.
Tomopterus pretiosus, Newm. Entom. p. 21 (?).

Brazil.

The only character mentioned by Newman as distinguishing his *T. pretiosus* from *T. staphylinus* is its much larger size and greater beauty; but I have no doubt he had not the true *T. staphylinus* before him when he made the comparison, and was misled by the *T. quadratipennis* (described further on) being named as Serville's species. Serville gives his species as 6–7 lines in length, and as having the basal segment of the abdomen testaceous.

2. *Tomopterus bispeculifera*, White.

Odontocera bispeculifera, White, Cat. Long. Col. Brit. Mus. p. 190; Bates, Trans. Ent. Soc. 1870, p. 330.

R. Tapajos, Amazons.

3. *Tomopterus quadratipennis*, n. sp.

T. niger, opacus, thoracis marginibus anticis et posticis fasciaque utrinque abbreviata laterali aureo-tomentosis; elytris apice recte truncatis, apud suturam leviter obliquis, vitta obliqua testacea; antennis (scapo nigro excepto) rufo-piceis. Long. 4–5 lin. ♂ ♀.

Rio Janeiro (*coll. Dr. Baden and H. W. Bates*).

Differs from *T. staphylinus* by its much smaller size, and from

T. obliquus by its more transversely truncated elytra, oblique only at the sutural angle. Head with much elongated muzzle; front and emargination of the eyes clothed with golden pile. Thorax quadrate, with sides slightly rounded; surface convex, regularly punctate-reticulate; the short lateral golden fascia joins the anterior marginal one near the anterior coxæ. Scutellum black, with a spot of golden pile at the apex. Elytra black, closely reticulate-punctate, the lateral margin as well as oblique discal vitta rufo-testaceous. Body beneath finely griseous pubescent; a lateral stripe on mesosternum and metasternum and apical margins of ventral segments golden tomentose. The abdomen is slightly vespiform in both sexes, more slender in the male. The antennæ are pitchy red, the fifth joint being dilated at apex and joints 6 to 10 serrate and thickened; in *T. laticornis* (Klug) the fifth joint is linear.

4. *Tomopterus obliquus*, Bates.

Tomopterus obliquus, Bates, Trans. Ent. Soc. 1870, p. 329.

R. Tapajos, Amazons.

5. *Tomopterus vespoides*, White.

Tomopterus vespoides, White, Cat. Long. Col. Brit. Mus. p. 176, pl. v. f. 8.

Guatemala.

6. *Tomopterus larroides*, White.

Tomopterus larroides, White, Cat. Long. Col. Brit. Mus. p. 177; Bates, Trans. Ent. Soc. 1870, p. 330.

R. Tapajos, Amazons.

This species is an exact mimic of a small bee of the genus *Megachile* (or allied thereto), which frequents the same flowers.

II. *Elytra cuneiform, reaching a little beyond the base of the abdomen.*

7. *Tomopterus laticornis*, Klug.

Molorchus laticornis, Klug, Entom. Bras. Spec. alter. p. 51, t. xiv. f. 1.

Novo Friburg, Rio Janeiro (*coll. Dr. Baden*).

The resemblance in facies and colours between this and the typical species of the genus is very great; but it differs in the elytra being a little prolonged, narrowed and rounded at the apex, and in the antennæ having the sixth to eleventh joints very greatly compressed and dilated, with the fifth joint slender and linear.

The genus *Pandrosos*, Bates (Entom. Monthly Mag. 1867, vol. iv. p. 23), having parallel mesosternal episterna, must be removed from the *Rhinotraginæ*, from which it also differs in its lateral eyes, &c. Its proper place seems to be near *Coremia.*

Pasiphile mystica, Thoms. Syst. Ceramb. p. 164 (Lacord. Genera, vol. viii. p. 508), is unknown to me, both genus and species. The descriptions of the two authors are scarcely reconcilable, Thomson stating the elytra to be "punctata," and Lacordaire "vitrées;" the descriptions in other respects seem scarcely to apply to the same species.

The following genera are closely allied to the *Rhinotraginæ*, but differ in one or more of the essential characters of the subfamily; at the same time they do not quite agree with any of the allied *groupes* established by Lacordaire.

Apostropha, nov. gen.

♂ et ♀. Modice elongata, linearis. *Caput* retractile, latum, genis paululum elongatis. *Oculi* magni, convexi, laterales, antice valde distantes. *Palpi* brevissimi, apice subovati, truncati. *Antennæ* (♂) corpore multo, (♀) vix longiores, filiformes, articulis a sexto leviter serratis, tertio usque septimum extus sparsim setosis. *Thorax* cylindricus. *Elytra* apicem segmenti secundi vix attingentia, versus apicem extus curvata, apice late rotundata, supra passim punctata. *Pedes* graciles, elongati; *femora* abrupte clavata, intermedia et postica elongata; *tibiæ* lineares; *tarsi* postici graciles, articulo primo cæteris longiore. *Prosternum* inter coxas latiusculum; coxæ vix exsertæ. *Mesosternum* et *abdomen* normalia. ♂ segmentum ultimum ventrale breve, apice late rotundato-emarginatum; ♀ modice elongatum, rotundatum.

A genus allied to *Ommata*, but differing in the widely separated eyes (even in the male) from all the typical forms of *Rhinotraginæ.* The eyes, although lateral, are turned a little towards the front; and this character, taken together with the distinct and moderately broad prosternal process, may bring the genus within the limits of this subfamily. The external margin of the elytra is very strongly incurved towards the apex, and the suture widely dehiscent.

Apostropha curvipennis, n. sp.

A. rufo-castanea, vix pubescens, opaca; antennis dimidio basali, capite et thorace obscurioribus, hoc utrinque griseo-lineato. Long. 3–3¼ lin. ♂ ♀.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Head punctured, opaque, blackish; front plane, griseo-pubescent. Thorax very closely punctured, blackish, on each side a narrow line of greyish hairs. Elytra tawny castaneous, rather thickly punctured, more sparsely on the disk, opaque. Legs and underside of the body chestnut-red, base of thighs paler; underside of prothorax and sides of abdomen with patches of short hoary pubescence.

Stenopseustes, nov. gen.

Facies gen. *Ommatæ*. Elongato-linearis, pubescens. *Caput* (♂) retractile, genis modice elongatis, parallelis. *Oculi* magni, distantes, modice convexi, laterales, sed paulo versus frontem inflecti. *Antennæ* corpore vix breviores, apice paululum incrassatæ, longe sparsim setosæ, articulis omnibus elongatis, linearibus, quarto quam quinto paulo breviore. *Thorax* elongatus, cylindricus. *Elytra* corpore paulo breviora, a medio paululum angustata, sutura recta, apice singulatim acute rotundata, subtiliter pubescentia. *Prosternum* inter coxas tenuissimum et subobsoletum; *mesosternum* angustum. *Coxæ* anticæ conico-cylindroides; acetabula postice aperta. *Metasternum* convexum. *Abdomen* gracile, lineare. *Pedes* elongati, graciles, postici longiores, passim longe setosi; *femora* omnia abrupte clavata.

Stenopseustes æger, n. sp.

S. linearis, elongatus, pubescens, flavo-testaceus, thorace vitta dorsali fusco-nigra. Long. 5 lin. ♂.

Prov. Paraná, Brazil (*coll. W. W. Saunders and H. W. Bates*).

Of similar elongate form to *Ommata atrata*, &c., but more exactly linear, the thorax being scarcely narrower than the elytra, and not attenuated in front or broader than the head. The whole insect with fine decumbent golden pile, besides long, erect, fine hairs, which are especially long all round the hind legs. The head, legs, and sides of the thorax are waxy yellow; the antennæ are of the same colour, but sometimes varied with black; the eyes in the male are widely distant both above and below, but the large lower lobes are a little frontal. The thorax is long and cylindrical, closely rugose and opaque, with an indefinite black dorsal stripe. The elytra reach to the base of the terminal segment, and are very minutely rugose and opaque, with a few larger punctures.

The terminal ventral segment (male) is short, with the apical margin broadly and deeply notched.

Xenocrasis, nov. gen.

Linearis, robusta. *Caput* valde retractile; rostro modice elongato, lato; fronte lateraliter carinata. *Oculi* (♀) laterales, haud magni. *Palpi* breves, apice cylindrici, truncati. *Maxillæ* lobo exteriore elongato, exserto. *Antennæ* (♀) corpore paulo breviores, apice incrassatæ, haud serratæ; articulis tertio usque sextum extus setosis; art. undecimo appendiculato. *Thorax* cylindricus, antice paulo dilatatus, dorso valde convexo, margine antico medio producto. *Elytra* fere ut in gen. *Acyphoderes* subulata, apice rotundata, disco toto lævissime hyalino. *Pedes* elongati, postici valde elongati; *femora* abrupte clavata; *tibiæ* posticæ densissime longe hirsutæ; tarsi graciles, breves. *Prosternum* inter coxas angustissimum; *coxæ* subconicæ, exsertæ. *Mesosternum* angustum. *Metasterni* episterna elongato-triangularia, antice lata; metasternum paulo inflatum. *Abdomen* (♀) basi breviter constrictum; segmento ultimo ventrali elongato, angustato, semitubulari.

Xenocrasis presents a strange mixture of characters of true *Necydalinæ* and *Rhinotraginæ*. Its distant and not enlarged eyes, and laterally carinated forehead, remove it from the latter group, to which it is nevertheless more nearly allied than any genus of *Necydalinæ* with which I am acquainted.

Xenocrasis Badenii, n. sp.

X. elongata, robusta; capite thoraceque nigris; pedibus fulvis, tarsis posticis albis; antennis nigris, articulis octavo usque undecimum albis. Long. 9 lin. ♀.

Novo Friburg, Rio Janeiro, Brazil (*coll. Dr. Ferd. Baden*).

Robust. Head black, rather shining; occiput coarsely, forehead sparsely punctured; sides of forehead and centre line of occiput carinated. Antennæ black, joints 8 to 11 white and thickened. Thorax black, opaque, disk sprinkled with small circular foveæ, interstices very minutely punctulate; disk very convex and subcarinate; sides each with an oblique raised patch, smooth on its outer side; the whole surface has an extremely fine silky hoary pile. Elytra with straight suture; sides beyond the middle rather sharply and greatly incurved, leaving the apical third very narrow and nearly parallel; apex obtuse; the whole disk is glassy and perfectly transparent; the extreme margins are black and punctured, and the black colour extends for some distance over the apex and base. Underside black; metasternum proper and abdomen reddish tawny, with very little pubescence. Legs brighter reddish tawny, including the pilosity of the hind tibiæ; anterior and middle tarsi blackish; hind tarsi white.

XVI.—*On a new Species of Turkey Vulture from the Falkland Islands and a new Genus of Old-World Vultures.* By R. Bowdler Sharpe, F.L.S., F.Z.S., &c., Senior Assistant, Zoological Department, British Museum.

The *Catharista* from the Falklands has always been referred to *C. aura*, from which species it is obviously distinct, by reason of the conspicuous grey shade on the secondaries. It might be supposed to be the *Catharista iota* of Molina from Chili; this species, however, is well represented by Mr. Cassin (U. S. Expl. Exp. pl. 1), and differs in its small size and black coloration from both the North-American and the Falkland-Islands bird. The latter is about the size of *C. aura* of North America and by no means smaller.

I am much indebted to the kindness of Mr. Reeve, of the Norwich Museum, for examining the specimens therein contained; and as he finds that the Turkey Vulture from the Falklands presents the same differences as the birds in the national collection, I have no hesitation in proposing the name of *Catharista falklandica* for the aforesaid Vulture.

At the same time I may be permitted to inquire whether there are two species of true Turkey Vulture of Jamaica. I do not refer to *C. atrata*, which is now found there also. The ordinary Turkey Vulture has always been set down as *C. aura*; but the only specimen in the museum from Jamaica is *C. Burroviana* (*C. urubitinga*, Pelz. ex Natt.). Do, therefore, *C. aura* and *C. Burroviana* both inhabit the island?

Passing to Old-World Vultures I would suggest that an end should be put to the indefinite characters of the genus *Gyps*, whose tail-feathers are *either* fourteen or twelve in number, by relegating the two species which enjoy the latter quantity to a separate genus, which may be called

Pseudogyps, gen. nov.

Genus a genere "*Gyps*" dicto, rectricibus 12 nec 14 distinguendum.

The two species to be included in it will be *Pseudogyps bengalensis* and *Pseudogyps moschatus* (*africanus*, Salvad.).

XVII.—*On some Fossils from the Quebec Group of Point Lévis, Quebec.* By H. Alleyne Nicholson, M.D., D.Sc., M.A., F.R.S.E., Professor of Natural History in University College, Toronto.

Having during the preceding summer had the opportunity of paying a hurried visit to Quebec, I was enabled to collect a considerable number of fossils from the Graptolitic Shales of the Quebec group along the fine exposures of Point Lévis. Most of these are, of course, familiar forms, which have been previously described and figured by Hall in his beautiful memoir on the Graptolites of the Quebec group ('Figures and Descriptions of Canadian Organic Remains,' Decade ii.). Two or three, however, of the forms which I obtained are new to science; and in characterizing these I shall at the same time take the opportunity of making some remarks on some of the already described species. The following list embraces the species which I have determined from my collection:—

HYDROZOA.

Callograpsus elegans, Hall.
—— *Salteri*, Hall.
Dictyonema grandis, Nich.
Clonograpsus flexilis, Hall.
—— *rigidus*, Hall.
Tetragrapsus (*Graptolithus*) *bryonoides*, Hall.
—— (——) *fruticosus*, Hall.
—— *quadribrachiatus*, Hall.
—— *approximatus*, Nich.
Didymograpsus (*Graptolithus*) *nitidus*, Hall.
—— (——) *patulus*, Hall.
—— (——) *pennatulus*, Hall.
Phyllograpsus typus, Hall.
Dawsonia acuminata, Nich.
—— *rotunda*, Nich.
—— *tenuistriata*, Nich.
Corynoides.

BRACHIOPODA.

Lingula irene, Billings.

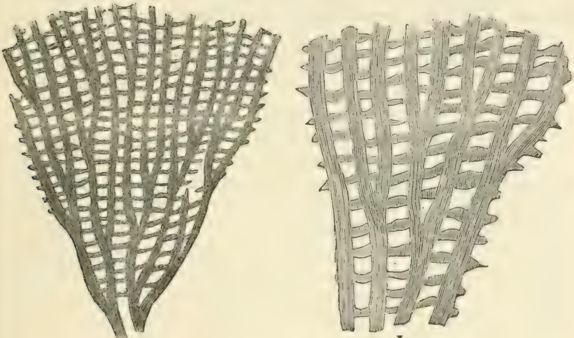
CRUSTACEA.

Caryocaris.

Dictyonema grandis, Nich.

Frond conical or fan-shaped; branches very strong and robust, diverging from the base, frequently and regularly bifurcating, and separated by interspaces which are about twice their own width. Width of the branches from 5 to 6 hundredths of an inch. Fenestrules oblong, from 8 to 10 hundredths of an inch in width by from 5 to 6 hundredths of an inch in length, rarely square or longer than broad. Connecting filaments or dissepiments from 4 to 5 hundredths of an inch in width; sometimes narrower, generally widest in the middle, and often curved, with their convexities directed towards the base of the frond. Cellules undetermined. Surface smooth. Length of the largest frond observed (not a perfect one) a little over two inches, breadth a little above the base about one fifth of an inch, breadth at summit nearly two inches (fig. 1, *a*, *b*).

Fig. 1.



Dictyonema grandis, Nich.: *a*, fragment of a frond, natural size, showing the rapid divergence and bifurcation of the branches; *b*, a fragment, enlarged, to show the fenestrules and connecting filaments.

There can be no doubt as to the close alliance which subsists between this species and the *Dictyonema Murrayi* described by Hall from the shales of Point Lévis (Grapt. Quebec Group, p. 138, pl. xx. figs. 6, 7). The following are the characters ascribed to the latter:—"Frond very large, gradually spreading from its origin. Branches strong, width from 5 to 8 hundredths of an inch, infrequently bifurcating; divisions little diverging, the interspaces being little wider than the branches. The fenestrules have a width of 8 by a length of 11 hundredths of an inch. The connecting filaments are wide at their origin or union with the branch, and slender in the middle; from about one third to one half as wide as the branches. Cellules undetermined. Surface smooth."

When we compare the above description with that of the present species, the latter appears to be clearly separated by the conical form of the frond, and the rapid divergence and frequent bifurcation of the branches, whilst the fenestrules are almost always markedly wider than they are long, the reverse of this obtaining in *D. Murrayi*. These peculiarities along with some other, minor differences, which will be sufficiently evident on a comparison of the descriptions of the two forms, seem to be quite constant, and appear to me to be quite sufficient to establish the specific distinctness of *D. grandis*.

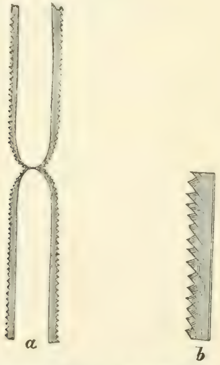
From *D. quadrangularis*, Hall (*op. cit. suprà*, p. 138, pl. xx. fig. 5), to which it also bears some resemblance, though not so close a one, *D. grandis* is readily distinguished by the fact that the branches of the former are nearly parallel and rarely bifurcate, whilst the fenestrules are very nearly square.

Loc. and Form. Common in a single stratum of greenish-grey shale, Point Lévis, the fronds covering large surfaces of the beds.

Tetragrapsus approximatus, Nich.

Frond consisting of four simple undivided stipes, arranged bilaterally, two proceeding from each extremity of the funicle. Regarding the funicle as horizontal, the stipes are as nearly as possible at right angles to it; so that the two stipes on either side of the funicle form nearly a straight line. Stipes curved at their origin from the funicle, and then running nearly straight and parallel to one another. The entire frond closely resembles two examples of *Didymograpsus* (*Graptolithus*) *patulus*, Hall, united back to back by their radicles (fig. 2, *a*).

Fig. 2.



Tetragrapsus approximatus, Nich.: *a*, a specimen nearly perfect, natural size; *b*, fragment of one of the stipes, magnified, to show the form of the cellules.

Dimensions of the frond in the largest specimen observed: length of funicle one tenth of an inch; width of funicle one twentieth of an inch; width of stipe at commencement one twenty-fifth of an inch, at widest portion about one line; total length of frond unknown, but exceeding three inches and a half; distance between the stipes on opposite sides of the frond from one fifth to one fourth of an inch, except close to the funicle.

Cellules about twenty-five in the space of an inch, inclined to the axis at about 45°; the denticles prominent and sharply pointed or submucronate; the cell-mouths curved at right angles or nearly so to the cellules, and making an angle of about 135° with the axis (fig. 2, *b*).

Tetragrapsus approximatus is most nearly allied to *T. crucialis*, Salter (= *Graptolithus quadribrachiatus*, Hall), from which, however, it is separated by several very important peculiarities. Most striking amongst these is the very remarkable shape of the frond. In *T. quadribrachiatus*, Hall, when undistorted, the stipes upon the same side of the funicle are nearly at right angles to one another; so that (keeping the funicle horizontal) the left-hand upper stipe forms nearly a straight line with the right-hand lower stipe, and the other two stipes similarly form a straight line. The whole frond, therefore, has in this species very nearly the shape of the letter X; and it may be compared to what would result if two examples of *Didymograpsus serratulus*, Hall, were united back to back by their radicles. In *Tetragrapsus approximatus*, on the other hand, the two stipes on the *same* side of the funicle (keeping the funicle, as before, in a horizontal position) are nearly in the same straight line, and the two stipes on the one side are, as nearly as may be, parallel with those on the other side. Hence the whole frond (and this is a fact worthy of notice) bears a very close resemblance to two individuals of *Didymograpsus patulus*, Hall, united back to back by their radicles, this resemblance being increased by the similarity in the shape of the cellules in the two species.

Again, the cellules in *Tetragrapsus approximatus* are much more highly inclined to the axis than they are in *T. quadribrachiatus*, the denticles are much more prominent and pointed, and the cell-mouths are markedly curved instead of being straight. As in *T. quadribrachiatus*, the funicle does not appear to have been embraced by a central corneous disk. The peculiarities above mentioned as distinguishing *T. approximatus* are constant in a large number of individuals; and therefore no doubt can be entertained as to the distinctness of the species.

Loc. and Form. Common in dark grey or greenish grey shales of the Quebec group, Point Lévis.

Clonograpsus, Hall.

In the course of last winter, when preparing the first part of my 'Monograph of the British Graptolitidæ,' I wrote to Prof. Hall asking him to propose a generic name for forms like his *Graptolithus flexilis* and *G. rigidus*, which are clearly entitled to be placed in a separate genus. Prof. Hall's reply unfortunately reached me too late to be available in the above mentioned publication, and I therefore left these forms temporarily in the genus *Dichograpsus*. I take the present opportunity, however, of defining the species in question under the generic name of *Clonograpsus* (κλὼν, a twig) proposed for them by Prof. Hall.

The characters of the genus are as follows:—Frond composed of numerous (more than eight) stipes proceeding from a common funicle, on the two sides of which they are symmetrically arranged; the frond dividing dichotomously and the process of division going on after the cellules are developed, till ultimately there may be produced from sixty-four to one hundred and forty-four simple celluliferous stipes. No central disk.

The genus *Dichograpsus*, Salter, will now contain only those Graptolites in which the frond consists of eight simple stipes proceeding from a funicle, the divisions of which are sometimes enveloped in a corneous disk. The celluliferous stipes in this genus do not subdivide or branch.

The genus *Loganograpsus*, Hall, again, will embrace those compound Graptolites in which the frond consists of from eight to twenty-five simple stipes which do not subdivide, and which are sometimes united at their bases by a corneous disk.

From both of these genera *Clonograpsus* is distinguished by the great number of stipes composing the frond (sixty-four to one hundred and forty-four in the typical forms, but fewer in others), by the fact that the celluliferous stipes themselves subdivide, and by the apparently uniform absence of a corneous disk.

The only undoubted species of *Clonograpsus* from the Quebec group are *C. flexilis*, Hall, and *C. rigidus*, Hall, both of which occur in great plenty in the shales of Point Lévis. It is also probable that the *Graptolithus Richardsoni* and *G. ramulus* of the same author, from the same formation, likewise belong to this genus. Of the Graptolites of the Skiddaw series of the north of England, the *Dichograpsus multiplex*, Nich., undoubtedly belongs to *Clonograpsus*, and *Dichograpsus reticulatus*, Nich., may likewise, in all probability, be placed in this genus.

DAWSONIA, Nich.

I propose this genus, named in honour of Principal Dawson of Montreal, for the singular bodies which I have elsewhere (Monograph Brit. Grapt. part i. p. 71, fig. 41) described as the "ovarian vesicles" of Graptolites. I am led to this step by the extreme inconvenience of applying a general name like "ovarian capsules" to fossils which often present differences of specific value, which cannot be properly described unless a special name be adopted. Moreover good authorities are disposed to doubt whether these bodies are truly to be compared to the "ovarian capsules" of the Graptolites; and the name of "grapto-gonophores," which I originally applied to them (Geological Magazine, vol. iii. p. 448), is open to other grave objections as well. Upon the whole, therefore, it appears to me best to found for these fossils the provisional genus *Dawsonia,* which implies no theory as to their nature, and which will enable us to specify and name such varieties as appear to be distinct. In fact this course seems to me to be the best, even whilst I retain my belief as to their truly being the "ovarian capsules" of Graptolites; for it cannot be hoped that we shall ever be able to refer each (or perhaps any) particular species of *Dawsonia* to the species of Graptolite by which it was produced.

The characters of the genus are as follows:—Horny or chitinous capsules of a rounded, oval, conical, or campanulate shape, furnished in most cases with a little spine or mucro, and having a marginal filament exactly resembling the solid axis of a Graptolite. The marginal fibre sometimes complete, sometimes ruptured opposite to the mucro. The mucro sometimes apparently wanting, sometimes marginal, submarginal, subcentral, or central. The surface smooth or concentrically striated.

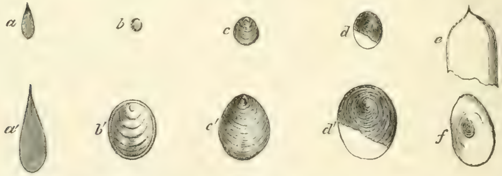
I first discovered the bodies included under this head in the Lower Silurian anthracitic shales of the south of Scotland, where they occur in great numbers along with the Graptolites; and, as before remarked, I regarded them as bearing to the Graptolites the same relation that the "ovarian capsules" do to the colonies of the Sertularians. Subsequently I detected similar bodies in the Graptolitic mudstones of the Coniston series of the north of England, also associated with numerous Graptolites. I consider it the very strongest confirmation of my views as to the nature of these fossils that I have now discovered them in vast numbers in the Quebec group, associated with the Graptolites of that formation. Not only are they very numerous, but there are at least three distinct forms of them, as might be expected when we consider the number and complexity of the Quebec Graptolites. It would seem, therefore, that the constant association of these fossils with Graptolites (whenever these latter occur in any plenty), and their constant absence from strata in which Graptolites are unknown, constitute extremely strong proofs as to there being a natural connexion between the two sets of organisms.

Without entering further into their nature at present, I shall simply describe three well-marked forms of these bodies which occur in the shales of the Quebec group, and which differ both from one another and from the forms which are found in the Graptolitiferous rocks of the south of Scotland and the north of England.

Dawsonia acuminata, Nich.

Capsule of a long oval shape, having one extremity prolonged gradually, and without any marked line of demarcation, into a long acuminate mucro. The marginal fibre extremely delicate, and not always to be detected. Often showing an impressed line, which proceeds inwards from the mucro to a greater or less distance within the sac. Dimensions variable; in the Quebec specimens mostly about one fifth of an inch in length by one tenth of an inch at the greatest width; in English specimens the average dimensions as above, but large examples showing a length of two fifths of an inch by a greatest width of three twentieths of an inch. (Fig. 3, *a*, *a′*.)

Fig. 3.



Various forms of *Dawsonia*: *a*, *Dawsonia acuminata*, natural size; *a′*, the same, enlarged; *b*, *D. rotunda*, natural size; *b′*, the same, enlarged; *c*, *D. tenuistriata*, natural size; *c′*, the same, enlarged; *d*, *d′*, another variety of *D. tenuistriata*; *e*, *f*, forms of *D. campanulata*, enlarged.

Dawsonia acuminata is exceedingly abundant in some beds of the Quebec group at Point Lévis, where it constitutes the commonest form of the genus. The species also occurs not uncommonly in the anthracitic shales of the south of Scotland (Upper Llandeilo). The size of the Quebec specimens is exceedingly uniform, whereas English specimens vary extraordinarily in their dimensions, examples apparently belonging to this species ranging from about one line in length to more than a quarter of an inch. It is probable therefore that, in spite of the identity of shape, more than one form is included under this head. The species to which *D. acuminata* is most nearly allied is *D. campanulata*, from which it is distinguished by the fact that the mucro is not sharply separated from the body of the capsule, whilst its figure is quite different.

Dawsonia rotunda, Nich.

Capsule minute, oval or circular in outline, consisting of a flattened marginal limb surrounding a central elevated seed-like body (the cast of the interior of the capsule). The marginal limb is quite smooth and exhibits no structure ; but the central rounded mass often exhibits striæ or furrows, which are disposed concentrically round a marginal point (fig. 3, *b*, *b′*). Dimensions very constant, the circular specimens having a diameter of a line or a little less, whilst the oval specimens have a long diameter of about a line by a short diameter of about one twentieth of an inch.

This exceedingly distinct form cannot be confounded with any of the ordinary forms of *Dawsonia*. It is found very abundantly in certain beds of the Point-Lévis shales. It is curious to note how closely *D. rotunda* approximates in structure to the "statoblasts" of the Polyzoa, since the capsule, according to all appearances, has been composed of two concavo-convex disks united by their faces, the union being effected by the adhesion of a broad marginal belt on each disk. I have not as yet determined this species from any of the Graptolitiferous strata of Britain.

Dawsonia tenuistriata, Nich.

Capsule oval, obtusely ovate, satchel-shaped, or nearly round, covered with fine concentric striæ, which surround a prominent elevated point. This point (the mucro) marginal, submarginal, subcentral, or central. The striæ differing in closeness and fineness, but always delicate and regular in their arrangement. Dimensions, like the shape, very variable, but the length usually varying from one tenth to one fifth of an inch. (Fig. 3, *c*, *c′*, *d*, *d′*.)

The forms included under this head are extremely like small Brachiopods of the genera *Lingula*, *Obolella*, and *Discina* ; and it is difficult to convince one's self that they do not truly belong to this group. That they are not Brachiopods, however, appears certain from the following considerations. They occur in great plenty, along with the two previously described forms of *Dawsonia*, in the shales of the Quebec group at Point Lévis. They have exactly the same texture, and are in just the same state of mineralization as the ordinary forms of *Dawsonia*. Their shape is so variable that we should have to believe that there were at least four or five distinct species of small Brachiopods in these beds, which is very unlikely. Lastly, the position of the elevated point, which would constitute the beak if they were Brachiopods, is exceedingly variable, being most commonly placed a little within the margin, but being at other times subcentral or marginal. On the other hand all the requirements of the case are met by the supposition that we have in these singular fossils the horny capsules of a species of *Dawsonia*, in which the capsule was furnished with striæ concentric to the mucro. On this view the elevated point round which the striæ are disposed is the mucro; and its variable position, as well as the variable shape of the capsule, can be readily explained by supposing that it is due to the variable direction in which the capsule has been compressed. When compressed laterally the mucro will be marginal; when compressed from above downwards the mucro will be more or less nearly central; when compressed obliquely the mucro will be submarginal.

Dawsonia campanulata, Nich.

Capsule bell-shaped, with a very distinct marginal fibre and a strong and distinct mucro. The mucro does not pass insensibly into the body of the capsule, but is sharply separated from it. The surface of the capsule smooth. The marginal fibre sometimes continuous, sometimes ruptured opposite to the mucro (fig. 3, *e*, *f*). Dimensions extremely variable; average specimens about one fifth of an inch in length by three twentieths of an inch in breadth.

Ordinary specimens of this form present the appearance shown in fig. 3, *e*, where the capsule has been compressed laterally and the mucro is marginal. Many specimens, however, present the appearance shown in fig. 3, *f*, in which the compression has been directed from above downwards, and the mucro forms an elevated point within the margin, surrounded by a few concentric ridges. This appearance might lead to its being confounded with *Dawsonia tenuistriata*; but it is really very different. In the latter the concentric striæ which surround the mucro are really proper to the capsule, and they are extremely fine, delicate, and regular; in vertically compressed specimens of *D. campanulata*, on the other hand, the concentric ridges which surround the mucro are truly foreign to the capsule, being merely the result of the direction of the pressure, and being very irregular in size and number. In fact they are not striæ, properly speaking, at all, but simply concentric crumplings or corrugations of the capsule.

I need not discuss here further the affinities and structure of *D. campanulata*, as I have not yet detected the species in the shales of the Quebec group. It is, however, the commonest species which occurs in the anthracitic shales (Upper Llandeilo) of the south of Scotland.

Corynoides calicularis, Nich. (?)

Numerous examples of a species of *Corynoides*, Nich., occur in a bed of black shale at Point Lévis; but their state of preservation is such as to render their specific determination impossible. They agree very well in their dimensions with *C. calicularis*, Nich. (Geological Magazine, vol. iv. p. 107, pl. vii.), which is an abundant fossil in the Upper Llandeilo shales of Dumfriesshire, Scotland. It is quite possible, however, that more perfect examples will show that the Quebec species is distinct.

Caryocaris, sp.

It is very interesting to notice the occurrence in the Point-Lévis shales of a species of the Crustacean genus *Caryocaris*, Salter, this genus being exceedingly characteristic of the corresponding formation of the Skiddaw Slates of the north of England. The state of preservation of the Quebec specimens is such as to render their specific determination hazardous and uncertain; and I prefer therefore to leave them undescribed at present. Upon the whole they closely resemble small specimens of *Caryocaris Wrightii*, Salter (Quart. Journ. Geol. Soc. vol. xix. p. 139); but it is probable that they will turn out to be distinct. None of my specimens shows more than the carapace, and that considerably crushed.

XVIII.—*Notes on Tortoises.* By Dr. J. E. Gray, F.R.S. &c.

Testudinella Horsfieldii.

General Goldsmid has kindly presented to the British Museum a small and a larger specimen of the shell of a tortoise, the large one wanting the front of the sternum, from Rud-I-Mil, Chuh Suguti to Duruh, in Persia, which were collected on March 23rd, 1871; they evidently belong to this species, though we have not the animal to determine the number of its claws.

The two specimens are exceedingly like *Peltastes græcus* in general character, but are much more depressed, and the horny dorsal plates are pale, with a darker edge and a dark diffused spot in the middle of the areola; the front sides of the upper part of the marginal plates are brownish; the sternum is varied with diffused black marks; the caudal marginal plate is marked with a central groove.

Rhinoclemmys.

The species of this very natural genus may be thus divided:—

I. *Shell black above and below; sternum with a pale (when alive red?) lateral stripe. Costals not spotted. Head black, with a streak on each side, sometimes united in front.*

1. *Rhinoclemmys melanosterna.*

Head black, with a white streak on the side of the nose and head. (Gray, P. Z. S. 1870, p. 722, fig. 1.)

Emys dorsalis, Spix (young)?

2. *Rhinoclemmys scabra.*

Head black, with a small spot on each side of the nose and of the crown, a diverging streak on each side of the head, and a round spot on the occiput. (Gray, *l. c.* fig. 2.)

3. *Rhinoclemmys lunata.*

Head black, with a spot on each side of the nose and occiput, and a streak on each side of the head, united across the forehead. (Gray, *l. c.* fig. 3.)

II. *Shell blackish above and below; sternum with pale lateral stripes, with a spot on each side of the nose and numerous longitudinal stripes on the side of the crown.*

4. *Rhinoclemmys callocephala.*

Geoclemmys callocephala, Gray, P. Z. S. 1863, p. 254, fig. (head); Suppl. Cat. Shield Rept. p. 23, fig. 10 (head).

Hab. Tropical America.

III. *Shell olive above, with a pale spot in the centre of the areola of each costal, surrounded by pale rings in the young; beneath black, with a pale margin.*

5. *Rhinoclemmys frontalis*, n. sp.

Head dark olive, nose with a narrow central streak above and a narrow streak on the lateral margin extending to over the orbits.

Hab. Tropical America.

An adult specimen was purchased from the Zoological Society in the year 1864.

Head olive, with a narrow longitudinal central streak on the upper part of the nose, a narrow white streak from the upper part of the nostrils to the front of the orbit, and a narrow white streak from the upper part of the nose, continued along the side of the crown over the orbit and the outer side of the temporal muscles to over the tympanum.

The shell olive above, with a distinct oblong, broad, pale streak over the middle of the areola of the costal plates. The sternum and underside of margin blackish, with a broad yellowish white band (perhaps bright red when alive) down each side of the sternum. There is a pale mark on the middle of each marginal plate, more distinct on the hinder plates. Under surface and side of face and neck whitish; side of neck punctulated with black.

This species has the peculiar pale spot which was previously regarded as characteristic of *Rhinoclemmys mexicana*; but it has quite a different head.

6. *Rhinoclemmys mexicana.*

Rhinoclemmys mexicana, Gray, P. Z. S. 1870, p. 659, fig. (head), 1871, p. 296, t. 28.

IV. *Shell blackish, with more or less distinct pale rays; underside black, with a pale band round the margin, and pale triangular spots on the underside of the front and hinder marginal plates; nose with a central longitudinal streak; crown white-varied; sides of head with a diverging black-edged streak.*

7. *Rhinoclemmys annulata*, Gray, *l. c.* fig. 5 (head).

Hab. Ecuador.

8. *Rhinoclemmys pulcherrima.*

I described and figured a young specimen of a freshwater tortoise in the British Museum, said to have come from Mexico, under the name of *Emys pulcherrima*, Cat. Shield Rept. p. 25, t. xxv. f. 2. The large cavity in the centre of the sternal bones, like what is found in the young *Rhinoclemmys*, and the short scarcely webbed toes make me think that it is most likely a *Rhinoclemmys*, or at least very nearly allied to it. The specimen is very young, the marginal bones being very rudimentary and only slender, half-ovate. It must be the young state of a very large species.

The alveolar surface of the jaws appears to be like that of *Rhinoclemmys*; but the colouring of the back is very different from that of any known species, and may indicate a new genus.

9. *Rhinoclemmys ventricosa.*

Shell oblong, broad, ventricose. Back swollen on the sides.

Vertebral plates keeled, more especially the three hinder ones. Above black; under margin and sternum white, with a large black blotch occupying the greater part of the middle of each sternal shield. Sternum flat, rather convex, greatly bent up in front. Shell $7\frac{1}{2}$ inches long, $5\frac{1}{2}$ inches wide.

Hab. Tropical America (Mus. Utrecht, no. 39).

This shell was at one time taken for a specimen of *Hardella Thurgi*; but it is very unlike, and is at once known from that genus by the peculiar triangular form of the first pair of marginal plates, as in the other species of this genus. The dorsal and side of marginal plates have a more or less dark spot in the centre of the areola.

Emys Fraseri, n. sp.

Shell olive, minutely darker-spotted; underneath darker, black-varied. Front legs with a series of four or five large plates on the outer edge, and with two larger plates on the upper part of the outer side of the front legs. Jaws strong, with a rather broad alveolar surface.

Hab. Lake Tetzara, Algiers. Shell 8 inches long.

This species has much the appearance of *Eryma laticeps*, with which it has been confounded; but the head is much longer, and the alveolar surface of the two jaws narrower. It agrees with *Emys caspica* in the shape and proportions of its head; but the alveolar surface of the jaws is much wider.

I do not know if *Emys caspica* is also found in Algiers; but we have in the British Museum four very young Terrapins (one brought by E. Doubleday, one by Canon Tristram, and two by Mr. Fraser) from that country, which have a red stripe on each costal plate, and a black sternum, like the young *Emys caspica*. Perhaps this character is common to the young of the two species. One of these I have called *Emys Fraseri* in the 'Suppl. Cat. Shield Rept.' p. 36.

Chrysemys.

We have in the museum three distinct forms of this genus, which in a large series do not appear to pass into each other, and which have special localities.

1. *Chrysemys picta*.

Sternum one-coloured, pale edge of the front discal plate broad; lateral angles of the second, third, and fourth vertebral plates anterior; marginal plates with a central spot and concentric rings above, and a yellow spot beneath.

Hab. North America, Eastern States.

2. *Chrysemys pulchra*, n. sp.

Sternum with a large central blotch sinuated on the sides; pale edge to all the discal plates narrow, uniform; the outer angle of the vertebral plates in the middle of their margin; the marginal plates with a small central marginal spot and two or three interrupted pale rings above, and a large spot and pale ring, with a broad black edge, beneath.

Hab. North America, Mississippi (*Brandt*).

The specimens in the museum have been called *Emys oregoniensis* (Fitzinger) by Brandt; but they are not *E. oregoniensis* of Harlan, which certainly is what I previously called *C. Bellii*. They may be one of the four species that Agassiz names but does not characterize.

3. *Chrysemys Bellii*.

Sternum with a blotch in the centre, which is longest over the suture of the plates; the yellow edge of the discal plates narrow, uniform; the outer angles of the vertebral plates in the middle of the lateral margin; marginal plates with a pale edge, and divided into halves by a pale cross band; costal plates with a simple or forked subcentral pale cross band.

Emys Bellii, Gray, Syn. Rept.
Emys oregoniensis, Harlan, t. 31; Holbrook, t. 16.
Young. *Actinemys marmorata*, Lord.

Hab. West coast of North America; British Columbia.

Trachemys lineata, n. sp.

This species is very like *T. Holbrookii*; but the pale markings of the vertebral shields are quite different, they being elongate and separate from each other—the lines of the different plates nearly meeting together, forming a series of continuous, more or less bent, lines on each side of the very narrow central line; the black spots on the sternum are large and solid.

Hab. North America.

There is a young specimen in the British Museum with fine, slender, obscure markings on the vertebral plates, and numerous regular black spots with pale centre on the sternum. This specimen is somewhat like the young specimen figured by Agassiz (Contrib. t. 3. fig. 9) as *T. elegans*; but it is also like the young specimen he has figured as *T. rugosa* (t. 16. fig. 4), but perhaps more like the former.

Trachemys lineata is at once known from *T. Holbrookii* by the slender lines on the vertebral plates. In the other species of the genus the pale and dark lines are in more or less oblong rings on each side of the vertebral plate, peculiar and complete in each plate. There is no doubt that the lines in *T. lineata* are a modification of this form: but the ends of the loops do not exist; for they would be out of the margin of the plate.

Callichelys concinna, n. sp.

Head elongate, chin convex. Shell very ventricose, longitudinally rugose on the costal plates; brownish olive, with a roundish, dark, solid spot on the hinder angle of the fourth costal, and on the suture of each marginal plate both above and below.

Hab. San Mateo, Tehuantepec: freshwater lagoons.

Length of shell 12 or 11½ inches.

This species is very like *Callichelys ornata*; but the head is longer, and neither of the two specimens has any dark areolar spot on the hinder edge of the dorsal plates, and the spots on the margin are solid and not ringed. The upper jaw is notched in front. The shell is ventricose like *Pseudemys ventricosa*, but quite differently marked.

Damonia Reevesii. (Hairy Tortoise.)

Dr. William Lockhart in 1865 presented to the museum a young freshwater tortoise, which is closely covered with a long, simple, filiform species of *Conferva*, from the Kiu-Kiang Yangtse.

These tortoises have excited considerable interest from their having been figured by the Chinese in their books and on their paper-hangings, and have been regarded by some naturalists as a very peculiar animal,—in fact a hairy reptile. They are figured on the titlepage of Temminck and Schlegel's 'Fauna Japonica;' but they are only a freshwater tortoise or terrapin, with a species of simple *Conferva* parasitic on their backs. They are collected and much esteemed in China; and an account of them has been reprinted from Cooper's travels in a former volume of this Journal (1871, vol. viii. p. 72).

I have abstained from describing this species, in the hope that I might obtain a more fully developed specimen; but it is of little consequence, as the characters of the genera do not alter during age, though the species modifies its form; but the rules of these modifications are well understood, and the young animal shows the markings of the head more distinctly. I have no doubt that it is a very young state of a tortoise which the late Mr. John Reeves brought from China many years ago, and which I figured in the 'Illustrations of Indian Zoology' under the name of *Emys Reevesii*. It is now called *Damonia Reevesii*. We at first only received specimens about 3 inches long; but now they are brought over nearly as large again.

The specimen we received from Dr. Lockhart is $1\frac{3}{8}$ inch long. The head is olive, with a short dark-edged white streak from the middle of the hinder edge of the eye, and from the upper hinder edge of the eye a longer dark-edged white streak, which is forked behind; the upper branch extends along the side of the neck, and the lower one over the tympanum; on the other side of the head the upper line is interrupted and broken into three parts.

Dumerilia madagascariensis.

The British Museum has just received the skeleton of an adult freshwater tortoise from Anuavandra (on the west coast of Madagascar), which has been named *Dumerilia madagascariensis* by Grandidier. It has been arranged with *Pelomedusa*. It belongs to the tribe *Peltocephalina* of the family Peltocephalidæ, which is essentially a South-American family, this genus being the only exception. It chiefly differs from the genus *Peltocephalus* in having, according to M. Grandidier (for, of course, they are not to be seen in the skeleton), two short beards on the chin, which are entirely wanting in that genus, and two series of oblique lunate shields on the outer surface of the tail. The alveolar surface of the upper jaw is broad, with an angular ridge near and parallel to the sharply acute outer margin. The alveolar surface of the lower jaw is narrow in front, much broader behind, with a rather convex ridge, becoming broader behind, occupying a great part of its surface, and with a groove parallel and quite close to the outer edge.

The head is like that of *Peltocephalus*, but is more depressed and the crown flat and broad. The nose is shorter, and the lower jaw not with such an acute point; and the upper jaw is not so sinuated in front. The frontal plate is hexangular, elongated behind; and the temporal plates are large and meeting in the centre behind the frontal one, whereas in *Peltocephalus* the central plate is very large and separates the temporals to the occiput; but in other respects the two genera are very similar. It is a much smaller species, the shell of the adult animal being only 12 inches long.

BIBLIOGRAPHICAL NOTICES.

Records of the Rocks; or Notes on the Geology, Natural History, and Antiquities of North and South Wales, Devon, and Cornwall. By the Rev. W. S. Symonds, F.G.S. &c. 8vo. London, 1872.

The author says, "This book . . . . is written for amateurs who, like myself, enjoy passing their leisure hours among rocks, old castles, old authors, and the wild flowers of strange wayside places. It does not assume to be a strictly scientific description of the geological structure of the different tracts of country to which it alludes; but I trust it is correct as far as it goes." It begins with a general petrographico-geological introduction, and proceeds with a dilettante account of the districts mentioned in the titlepage, with the successive geological formations as the basis for a systematic collocation of every thing the author finds cause to put together, in a pleasant talky style, from his note-books and his memory, from his geological text-books and local guide-books, his county-histories and his library in general, but more especially from the late Sir Roderick Murchison's standard work 'SILURIA.'

In fact the 'Records of the Rocks' may be succinctly described as consisting of 'Siluria' deeply diluted with antiquarian gossip, folklore, local botany, and recent geological notings, the prominent personage in that book being replaced by the *ego* and his friends in this. It is garnished with 82 woodcuts, of which 62 have been taken bodily, descriptions and all, from 'Siluria' without any special references, but noticed generally in the preface only as an enrichment for Mr. Symonds's volume.

Although fully appreciating the advantage to the amateur geologist, whether indoor or out, of his having in his guide-book or book of reference such good illustrations as those transferred from 'Siluria' to this general itinerary and field-book for Mr. Symonds's favourite districts, we must regret that their respective relationships with the original are not carefully acknowledged by proper indications, and that their transference is not in every case unaccompanied with avoidable mistakes.

Printed in good legible type, and with little pretence of indicating technical words, this book is intended for easy-going amateurs "round the Wrekin," and will serve them for a pleasant book of reference. The geologist, too, will find much readable information here and there throughout its pages, if he cares to winnow it out from among country-seats and personal history—such as the *résumé* of the Cambrian rocks and fossils at one end, and of the bone-caves at the other, also of the Drift observed in the Woolhope Valley (p. 165), &c. There is, however, quite sufficient to bear out the author's statement that the book is not strictly scientific. Thus the woodcut at p. 72 and its description are transferred from 'Siluria' without the corrections from the list of *errata* of that work, and the cut at p. 215, with the old references, instead of new ones to Mr. Woodward's perfect monograph; the description of the cut at p. 261, modified by an idea taken from the page opposite the cut in 'Siluria,' carries more than the exact truth; at p. 271 the asterisk left under the cut finds its meaning only in 'Siluria;' at p. 281 the name of fig. 1 has not been corrected, whilst the new name of fig. 2 is indicated by an initial only. The supposition that *Sequoia* is a "fir" (p. 289), and the making Mr. Lankester hold a fossil fish in two genera at once (p. 184), are weak points; and the misprints of names of fossils are too frequent,—as "Palœopyge," "Bowmannii," "aspermus," "Illœnus," "hemispherica," "Platychisma," "Euglypha cardiola," "Paleaster," "Brodei," "Cronchii," "crenistra." We imagine that "Heterostracon" and "Osteostracon Cephaspidæ" (p. 219) should be either English, Heterostracous and Osteostracous Cephalaspids, or properly converted into the Latin form.

The guidance of the Author, of Mr. Jones, gardener at Builth, and other good people, is recommended *passim* to the reader; and papers in the 'Geological Magazine' and other useful periodicals are cited for information old and new: but why the only perfect geological work on North Wales (Geol. Surv. Mem. vol. iii.), the real basis of Mr. Symonds's country, should not have been kept well before the reader, and why the guidance of the Geological Surveyors should have been so little thought of, it is difficult to conjecture.

We have thus pointed out several matters for improvement in this well-intentioned book, which we hope will be required in a new edition. Written by one who has known his country-side, with cultivated intelligence and an eye for nature, for many years, and who has long enjoyed the companionship of good observers, thinkers, and writers, the Rev. Mr. Symonds's 'Records of the Rocks,' like his other writings, is directed, with a good and useful aim, to the advance of knowledge among the so-called "educated," but frequently little-informed, class of society. It is a learned and comprehensive guide-book, thoroughly imbued with a love of nature in her many aspects, and with a desire that all should benefit by an intelligent recognition of the natural sciences and by scientific pursuits.

A Manual of Palæontology for the Use of Students, with a General Introduction on the Principles of Palæontology. By H. A. Nicholson, M.D., D.Sc., &c. 8vo. Edinburgh, 1872.

Schools and colleges now find themselves better provided with zoological and palæontological text-books than heretofore. Dr. Nicholson's 'Manual of Palæontology' has several good points. Though very comprehensive it is not too diffuse (only to Graptolites, a favourite subject, are a few extra pages given); it keeps the conditions of fossilization and geological succession well before the reader (especially in Parts I. and IV.)—and treats the Vertebrate remains less in detail than the Invertebrate, in accordance with the larger acquaintance the student has usually to make with the latter than with the former..

Part III., on fossil Plants, treated of as the successive floras of geological periods, is a useful addition to the palæozoology, and is carefully worked as far as it goes; but unaccountably it makes no mention of the Diatomaceæ and the Calciferous Algæ (*Lithothamnium* &c.), which, like *Chara*, play such an important part in the constitution of many strata.

The author judiciously handles fossils of obscure affinities, such as *Stromatopora*, *Receptaculites*, *Crossopodia*, &c. But a study of Mr. Albany Hancock's memoir "on Vermiform Fossils," in the 'Annals of Natural History' for 1858, would have enlightened him on the nature of the last-mentioned fossil and its innumerable allies, including even some of the *Oldhamiæ*, Eophytons, and Fucoids. Nor does he seem to be aware that two head-portions of *Palæopyge* (p. 167) have been found and published, thus removing it from the category of the doubtfuls.

Dr. Nicholson's illustrations are numerous and apt. They have been selected for the most part from such as the Geological Survey of Canada, Principal Dawson (author of 'Acadian Geology'), the publishers of D'Orbigny's 'Cours élémentaire,' and, he might have added, Page's 'Text-book' and his own 'Text-book of Zoology' have supplied him with. Why the wretched Ventriculite at p. 70 should claim its paternity so boastfully from "Lyell" is not clear. That the authorship of some only, and not of all the cuts (often as they may have been used before), should have been acknowledged is to be regretted; for if the real origin of all the figures were carefully indicated, the student might have the opportunity of learning something more of the history of genera and species by referring to the original observers. Not but that many authors are mentioned in the text: by following, however, a good example in this matter, such as Dana's excellent 'Manual of Geology,' Dr. Nicholson would have improved his well-designed book; and he would probably have been reminded that the Russian Mammoth skeleton (p. 445) is always a puzzle to tyros on account of its unexplained head-skin and shapeless hoofs, that the Ichthyosaur at p. 369, with outlined body, ought to have a fluked tail in the figure as well as in the text, and that Mr. S. V. Wood's fine Alligator-relic, at p. 367, is an *upper* and not a *lower* jaw.

MISCELLANEOUS.

Anatomical Investigations on the Limuli. By A. Milne-Edwards.

On June 26, 1869, I communicated to the Philomathic Society the first part of an investigation which I had just made upon the anatomy of the *Limuli*; and a short abstract of this communication was inserted in the 'Bulletin' of that learned Society and in the 'Journal de l'Institut.' This memoir, accompanied by numerous figures, ought to have been printed soon afterwards; but the unhappy circumstances under which France laboured in 1870 and 1871 prevented its publication, and it is only now that I am able to bring it out in its entirety.

The first notions that we possess as to the internal organization of the *Limuli* date from 1828, and are due to Strauss-Dürckheim. Ten years afterwards Van der Hoeven published on the whole group a very carefully executed monograph; but all the anatomical part of his work, which was studied by means of individuals preserved in spirit, leaves much to be desired, and we observe in it serious errors, which, however, it was almost impossible to avoid under the circumstances in which this author found himself.

About the same time Duvernoy added some details to what was previously known as to the respiratory apparatus of the *Limuli*. In

1855, Professor Owen inserted in his 'Lectures on the Anatomy of Invertebrata' various facts with regard to the structure of these singular Arthropoda; and quite recently an English journal announced that this illustrious naturalist had resumed the investigation of the same subject; but his work is as yet known only by an abstract published in 1871. Some points relating to the histology of the *Limuli* have been treated by M. Gegenbaur; and works of great interest on the habits of these animals, on their embryology, and on their zoological affinities, have been published by MM. Lockwood, Packard, Dohrn, and E. van Beneden. Finally, Mr. Woodward, in several consecutive memoirs, has presented us with very interesting observations upon the relations of the *Limuli* with the Trilobites, the *Pterygoti*, and various articulate animals, the remains of which occur in the fossil state in the Silurian, Devonian, and Carboniferous formations.

I have no intention of discussing here the questions relating to the zoological affinities which may exist between the *Limuli* and the extinct species of ancient geological periods. My observations relate to the anatomy of these animals, and principally to the constitution of their circulatory apparatus and to the structure of their nervous system.

The circulatory apparatus of the *Limuli* is more perfect and complicated than that of any other articulate animal. The venous blood, instead of being diffused through interorganic lacunæ, as in the Crustacea, is for a considerable portion of its course enclosed in proper vessels with walls perfectly distinct from the adjacent organs, originating frequently by ramifications of remarkable delicacy, and opening into reservoirs which are for the most part well circumscribed. The nutritive liquid passes from these reservoirs into the branchiæ, and, after having traversed these respiratory organs, arrives, by a system of branchio-cardiac canals, in a pericardiac chamber, then penetrates into the heart, of which the dimensions are very considerable. It is then driven into tubular arteries with resistant walls, the arrangement of which is exceedingly complex, with frequent anastomoses, and of which the terminal ramifications are of marvellous tenuity and abundance. By making use of the microscope we can trace them, with their contours still well defined, even into the substance of the finest and most transparent membranes (for example, the intestinal coats and even the floor of the pericardiac chamber); we see them also, by employing sufficient magnifying-power, in the midst of the primitive muscular fibres, which they do not even equal in diameter; and some of those which I measured had a calibre of less than $\frac{1}{100}$ millim.

One of the most striking peculiarities of this vascular apparatus consists in its relations with the nervous system. Thus the abdominal artery, formed by the union of the two aortic branches, ensheathes the whole of the ganglionic chain: most of the nerves are lodged in the branches which spring from this median vessel.

These relations of the apparatus of innervation with the arterial system of the *Limuli* were perceived, although very imperfectly, by

Prof. Owen, and are more intimate than that eminent anatomist seems to think. In fact the nervous chain of these animals is not simply enveloped by the ventral blood-reservoir, and fixed to it in such a way as to be difficult to distinguish from it, but is enclosed in it; and this reservoir does not consist of a simple interorganic lacuna due to the disappearance of the arterial walls in this portion of the animal economy. It is not a case of juxtaposition of the nerves and arteries; it is a complete ensheathment of the former by the latter. The nerves destined for the integuments alone constitute an exception to this; they are free, and the vascular walls only accompany them to a small distance from their origin.

The principal arterial trunks open freely into one another, in such a manner that the blood can traverse a circulatory course without passing through the veins. These ways of communication are wide and easy; but there are others, formed by the terminal capillaries of the arterial system, which are continuous with the roots of the venous system. The latter is formed in part by interorganic lacunæ, in part by tubular vessels with perfectly distinct walls and presenting all the characters of true veins. This last mode of organization exists throughout in the substance of the liver. The hepatic veins open into a wide trunk situated on each side at the ventral part of the body, and giving origin to the afferent vessels of the branchiæ. The neighbouring muscles are arranged so as to act upon these venous trunks, and can cause alternately their contraction or dilatation. The blood which, by means of this mechanism, has traversed the respiratory apparatus, afterwards passes into the pericardiac reservoir.

The origin of the nerves which go to the different appendages enables us to determine the homologies of these parts, and to establish that in the *Limuli* there are no antennæ, as has been supposed by some anatomists. Lastly, I shall add that the visceral ganglionic system is not composed only of stomato-gastric and angeian ganglia in connexion with the œsophageal collar; there are also small nervous centres attached to the ganglionic chain, and furnishing branches to the terminal portion of the digestive tube.—*Comptes Rendus*, Dec. 2, 1872, pp. 1486–1488.

On the Boomdas (Dendrohyrax arboreus). By Dr. J. E. Gray, F.R.S. &c.

The British Museum has lately received three skins, with their skulls, of a species of *Dendrohyrax* from Elands-Post, South-east Africa.

They appear to be the Boomdas, *Dendrohyrax arboreus* of my monograph. This species was first described by Dr. Andrew Smith as *Hyrax arboreus*, and is known from the *D. dorsalis* of the west coast of Africa by the fur being much longer and softer, and the dorsal streak yellowish white; but the great difference is to be observed in the skull.

The skull of *Dendrohyrax dorsalis* is elongate and depressed, that of *Dendrohyrax arboreus* is short and high. The hinder part of the lower jaw of *D. dorsalis* is moderately dilated, and the back edge ascending from the condyle is gradually rounded off; whereas in *D. arboreus* the hinder part is much more dilated, and the ascending edge is straight nearly to the hinder end and then rounded.

The following measurements show the most striking differences between the skulls of the two species:—

	D. dorsalis. inches.	*D. arboreus.* inches.
Length of adult skull	$4\frac{1}{8}$	$3\frac{5}{6}$
Height of skull	$2\frac{7}{8}$	$2\frac{11}{12}$
Length of lower tooth-line	$1\frac{1}{2}$	$1\frac{1}{4}$
Width of upper part of lower jaw	$1\frac{1}{4}$	$1\frac{5}{12}$

The skull of *D. arboreus* is most like that of *Hyrax Burtoni* in its height, but differs in the shape of the lower jaw and by the very small diastemata, especially that of the lower jaw.

On Deep-sea Dredging in the Gulf of St. Lawrence. By J. F. Whiteaves, F.G.S. &c.

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

Montreal, Dec. 20, 1872.

Gentlemen,—As I did not see any proofs of my article on Deep-sea dredging in the Gulf of St. Lawrence (published in the 'Annals,' ser. 4, vol. x. no. 59), I should be glad if you would correct the following typographical and other errors which occur in it.

Page 343, lines 14 and 15 from the bottom of the page, for "only a portion of these have" read "only a few of these have."

Page 347, at the bottom, it appears as if *two* species of *Retepora* were collected; the specimens all belong to that form which Smitt calls *Retepora cellulosa*, var. *elongata*.

Page 349. Under the head *Dacrydium vitreum* the phrase occurs, "This and the preceding are new to America." The words with quotation marks belong to the preceding species, *Yoldia frigida*; *Dacrydium vitreum* is not new to America, but *Yoldia frigida* and *lucida* are.

Page 350. The asterisk placed before *Utriculus pertenuis* belongs to *U. hyalinus*; specimens of the latter shell had been identified by me as *Bulla debilis*, Gould. My intention was to give Mr. Jeffreys as the authority for the statement that *Bulla hyalina*, Turton, and *B. debilis*, Gould, are synonymous.

Page 352, lines 10 and 11 from the bottom. Strike out the words "if any such there are."

Additions and Alterations.

Foraminifera. The long-spined *Marginulina* described on page 343 is, I believe, *Marginulina spinosa*, M. Sars.

ACTINOZOA. Prof. Verrill thinks (and I quite agree with him) that the St.-Lawrence *Pennatula* is a well-marked variety of *Pennatula aculeata*, Danielssen. This latter species he considers to be distinct from *P. phosphorea*. My St.-Lawrence specimens vary so much in their characters that I am not yet satisfied on this latter point. For the present the St.-Lawrence specimens may be provisionally called *Pennatula aculeata*, Danielssen, var. *canadensis*. Those who accept Kölliker's views as to specific differences in this group would regard the Canadian sea-pen as one of the many protean forms of *P. phosphorea*.

Urticina digitata (Müll.). Recognized by Prof. Verrill among specimens dredged in 120 fathoms off Bear Head, Anticosti.

Zoanthus (sp.) is *Epizoanthus americanus*, teste Verrill.

MOLLUSCA. *Dentalium abyssorum*, Sars. Adult but dead specimens of a *Dentalium* dredged last year were referred to this species. Having since taken the same shell alive in all stages of growth, I now doubt the correctness of this identification. It is never pentagonal when young; and I believe it is the shell originally described by Dr. Gould, though erroneously, as *Dentalium dentale*, his specimens being few and very imperfect. Its proper name is *Dentalium occidentale*, Stimpson, a perfectly good and distinct species, nearly related to *D. abyssorum*—widely different from *Entalis striolata*, which has not yet been found north of the Bay of Chaleurs.

Sipho Sarsii, Jeffreys. The proper name of this shell seems to be *Sipho curtus* (Jeffreys).

Nitophyllum litteratum, *a new British Alga*.
By Prof. T. G. AGARDH.

This seaweed was received from Mrs. Griffith as *Nitophyllum Hilliæ*: but it is very different in the form of the leaflets; the sori are not dot-like and scattered as in that species, but linear-oblong or variously shaped, scattered between the veins, looking, on the lower lobes, like letters or signs.

"*N. litteratum*, stipite brevi cuneato, in frondem venis dichotomo-anastomosantibus obscuriusculis inferne venosam, cuneato-reniformem subpalmato-pinnatifidam abeunte lobis cuneato-linearibus margine minute undulato-crenulatis, basi contractis, soris inter venas seriatis figuras irregulares inter se plus minus confluentes formantibus.

"*Hab.* Ad littora meridionalia Angliæ."—*Lunds Univ. Årsskrift*, t. viii. p. 49.

On a new Freshwater Tortoise from Borneo (Orlitia borneensis).
By Dr. J. E. GRAY, F.R.S. &c.

ORLITIA.

Head covered with large plates, plain-coloured; lower jaw strong, acute, curved up at the tip ; alveolar plate of upper jaw narrow, with a raised inner margin, of lower jaw narrow, sharp-edged. Toes short, well webbed to the end ; claws 5 . 4, short, acute. Thorax ovate, very convex, shelving on the sides, with a blunt and interrupted vertebral keel. Vertebral plates in the young as broad as long, front one narrowed behind ; second, third, and fourth hexagonal ; fifth much smaller, square. First, second, and third costal plates large, angular above ; the fourth very small, square, only as high as the small fifth vertebral. Marginal plates broad, hinder four much narrower, with a serrated edge. Nuchal plate broad, well developed. All the discal and upper part of the marginal plates in the young with a very large punctate areola. Sternum flat, strongly keeled on the sides. Anal shields small. Tail short.

The general form is very peculiar, somewhat like *Cuora* ; but the sternum is perfectly solid, and there is no indication of any mobility of the two lobes. The animal differs externally in the head being one-coloured, without any band over the eye.

Orlitia borneensis.

Cistudo borneensis, Bleeker.

Hab. Borneo (*Bleeker*).

I mentioned this specimen under *Cuora amboinensis* in the 'Suppl. Cat. Shield Rept.' p. 21 ; but on reexamination I am satisfied that it has no relation to that species. It is evidently the young of a very large and solid species ; for even this young specimen is well solidified, though there is an oblong groove (the remains of the opening of the yelk-bag) in the central suture of the abdominal and preanal plates.

Descriptions of three new Species of Crustacea parasitic on the Cetacea of the N. W. Coast of America. By W. H. Dall, U.S. Coast Survey.

Genus Cyamus, Lam.

Cyamus, Lam. Syst. An. s. Vert. p. 166; Bate & Westwood, ii. p. 80. *Larunda* and *Panope*, Leach.

Cyamus Scammoni, n. sp.—Male. Body moderately depressed, of an egg-ovate form ; segments slightly separated ; third and fourth segments furnished with a branchia at each side ; this, near its base, divides into two cylindrical filaments spirally coiled from right to left ; at the base of each branchia are two slender accessory filaments not coiled, quite short, and situated one before and the other behind the base of the main branchia ; second pair of hands kidney-shaped, with the carpal articulation halfway between the distal and proximal ends, and having two pointed tubercles on the inferior edge, before the carpal joint ; third and fourth segments somewhat punctate above, all the others smooth, the sixth and seventh slightly serrate on the upper anterior edge, and without ventral spines. Colour yellowish white. Long. ·70, lat. ·39 in., of largest specimen.

Female similar to the male in all respects, excepting in being a little more slender, and in wanting the accessory appendages to the branchiæ; the ovigerous sacs are four in number, overlapping each other.

Hab. On the California grey whale (*Rhachianectes glaucus* of Cope) on the coast of California, very numerous. This species is named in honour of Capt. C. M. Scammon, U.S. Rev. Marine, well known by his studies on the cetaceans. The specimens here described were collected and submitted by him for description, and will be figured in his forthcoming monograph of the West Coast whales. I may remark here that these species are all so distinct from those figured by Milne-Edwards, Gosse, Bate, and Westwood, that a comparative description has seemed unnecessary—also that the species obtained on different species of cetaceans have so far been found invariably distinct. The inference is, of course, that each cetacean has its peculiar parasites, a supposition which agrees with our knowledge of the facts in many groups of terrestrial animals.

Cyamus suffusus, n. sp.—Body flattened, elongate; segments subequal, outer edges widely separated; branchiæ single, cylindrical, slender, with a very short papilliform appendage before and behind each branchia; superior antennæ unusually long and stout; first pair of hands quadrant-shaped; second pair slightly punctate, arcuate, emarginate on the inferior edge, with a pointed tubercle on each side of the emargination; third joint of the posterior legs keeled above, with a prong below; pleon extremely minute; segments all smooth; no ventral lines on the posterior segments. Colour yellowish white, suffused with rose-purple, strongest on the antennæ and branchiæ. Length ·41, breadth (of body) ·25 in. All the specimens which have passed under my observation, some eight or ten in number, were males.

Hab. On the "humpback" whale (*Megaptera versabilis*, Cope), Monterey, California.

Cyamus mysticeti, n. sp.—Body flattened, subovate, segments adjacent; branchiæ single, short, stout, pedunculated, a single papilliform appendage behind each; head short and wide; first pair of legs very small; hands all simple and smooth, fingers greatly recurved; carpal articulation in the second pair of hands halfway between the proximal and distal ends of the hand; pleon very minute. Colour dark brownish yellow. Length ·33 in., breadth (of body) ·16 in. Two female specimens.

Hab. On the northern "bowhead" whale (probably *Balæna mysticetus*, Linn.), near Behring Strait.

This is the most compact of the three species, as well as the smallest. I find, in comparing large series of *C. Scammoni*, that a considerable variation in form obtains, so far as regards comparative length and breadth, even in adult specimens, and these differences are greater than those observed, in the same characters, between the sexes.—*Proc. Calif. Acad. Sci.*, Nov. 1872.

Orca stenorhyncha (*the Narrow-nosed Killer*).

I described a new *Orca* or Killer from a skeleton received by the British Museum from Weymouth. The skull is figured in the 'Suppl. Cat. Seals and Whales,' pp. 86–88, figs. 7–9.

The authorities at the Zoologiska Riks-Museum at Stockholm have sent to the British Museum three large photographs of an animal which they have determined to be this species, and which was taken at Bohuslän in November 1871, showing that it is coloured like the other Killers, and that it (like *Orca latirostris*) is an inhabitant of the north seas.—J. E. Gray.

Preliminary Descriptions of new Species of Mollusks from the North-west coast of America. By W. H. Dall, U. S. Coast Survey.

Voluta (*Scaphella*) *Stearnsii*, Dall.—Shell large, slender, spindle-shaped, moderately thick; colour livid purple, more or less obscured by an ashy-white outer layer, more conspicuous near the sutures and on the callosity of the inner lip; exterior smooth (but not polished), except for the strong lines of increase; sutures appressed; siphonal fasciole strong; nucleus small, white, mammillated; aperture more than half as long as the shell, white and livid purple, with a dash of brighter purple at the posterior notch and on the anterior portion of the callus; edge white; callus reflected, thick and strong, with a chink behind the anterior portion; canal twisted to the right, moderately deep; whorls 6–8. Long. 4·13 in., lat. 1·62 in., long. apert. 2·59 in.; defl. 40°. Living, from stomach of cod, Shumagin Islands; dead on beach, Gull rocks, Akutan Pass, and west side of Amaknak Island, Captain's Bay, Unalashka.

Nacella (?) *rosea*, Dall.—Shell small, egg-ovate, of a deep rose-colour, externally smooth, except for very faint radiating ridges divaricating from the apex, and for lines of growth; margin entire; apex minute, produced before the anterior margin; interior smooth, white, except the margins, which are polished and of the same colour as the exterior; nacre, especially when weathered, silvery. Long. ·35 in., lat. ·27 in., alt. ·12 in., of largest specimen.

Dead on beach, east side of Simeonoff Island, Shumagins; living, probably on Fuci, off shore.

This, from its appearance, is probably a true *Nacella*, congeneric with the Cape-Horn species, and the first described from the northern hemisphere. Its occurrence with that of several other mollusks in the Aleutian fauna is remarkable; and the facts, on further inspection, have developed a considerable resemblance between these antipodal faunæ.

Littorina aleutica, Dall.—Shell depressed; whorls 4, the nucleus including one and a half, last whorl much the largest; spire depressed or nearly flattened; colour variable, from dark brown or purple to waxen white, or banded with white on a darker ground; nucleus polished, dark brown, translucent; sculpture consisting of rather coarse lines of growth, and about six or eight nodulous revolving ridges, more or less strongly elevated in different specimens, the three middle ones being the most prominent, and faint revolving lines being also traceable occasionally between the ridges; aperture very oblique, smooth, white or purplish within; outer lip sharp; columella broad, straight, generally with a chink behind it; anterior margin a little produced. Long. ·41 in., lat. ·53 in., of an average specimen. Animal and operculum precisely as in *L. sitkana*, which was abundant on the same rocks.

Hab. Living at Gull rocks, Akutan Pass, Aleutian Islands, abundantly (*W. H. Dall*).

This is a very remarkable and distinct species, resembling no other on the west American coast.

NOTES.—*Buccinum Kennicottii*, Dall, proves, on obtaining specimens containing the soft parts and the operculum, to be a *Chrysodomus*. It was originally described as a *Buccinum*, in deference to the opinion of the late Dr. William Stimpson, who had recently monographed the northern species of that group. Its distribution is from the Shumagins eastward, not, as was originally reported, from Unalashka.

Buccinum Baeri, Midd., proves to be a very marked race of *B. cyaneum*. *B. Fischerianum*, Dall, which was suspected at the time it was described to be similarly related to *B. cyaneum*, proves to be distinct.

Haliotis, which has long been tabulated as an inhabitant of the Aleutian chain, does not exist in that part of the archipelago east of Unalashka, and probably not in these islands at all.—*Proceedings of the California Academy of Sciences*, Oct. 8, 1872.

Projectile Power of the Capsules of Hamamelis virginica. By Mr. T. Meehan.

The Author said that while travelling through a wood recently he was struck in the face by some seeds of *Hamamelis virginica*, the common Witch-Hazel, with as much force as if these were spent shot from a gun. Not aware before that these capsules possessed any projecting-power, he gathered a quantity in order to ascertain the cause of the projecting force, and the measure of its power. Laying the capsules on the floor, he found the seeds were thrown generally four or six feet, and in one instance as much as twelve feet away. The cause of this immense projecting-power he found to be simply the contraction of the horny albumen which surrounded the seed. The seeds were oval, and in a smooth bony envelope; and when the albumen had burst and expanded enough to get just beyond the middle (where the seed narrowed again), the contraction of the albumen caused the seed to slip out with force, just as we should squeeze out a smooth tapering stone between the finger and thumb.—*Proc. Acad. Nat. Sci. Phil.* part iii. p. 235 (1872).

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XIX.—*On the Original Form, Development, and Cohesion of the Bones of the Sternum of Chelonians; with Notes on the Skeleton of* Sphargis. By Dr. J. E. Gray, F.R.S. &c.

[Plates IV., V., & VI.]

It has long been known that the sternum of all Chelonians is formed of four pairs of bones with an odd one, which is always attached to the centre of the inner edge, opposite the suture between the front pair. In some Chelonians these bones always remain of nearly the same form, and are more or less separate from each other during the whole life of the animal. In the land Tortoises and the freshwater Tortoises or Terrapins the bones of the young become expanded as the animal grows, coalesce, and at length form in the adult animal a single bony disk.

Cuvier, in his chapter on the "Ostéologie des Tortues," in the Oss. Foss. v. p. 204, observes:—

"Dans les tortues de terre et d'eau douce, et dans les chélydes, ils ne laissent de vides entre eux que dans le premier âge seulement, où ils se forment de rayons osseux dirigés en divers sens dans le disque encore cartilagineux du plastron, comme les os du crâne dans les fétus des mammifères; mais avec l'âge ces rayons se joignent de toute part et forment un disque compact dans toutes ses parties et qui s'unit par une étendue plus ou moins considérable de chaque côté au bouclier dorsal. Voyez pl. xii. f. 44, le plastron d'un jeune *Testudo scabra*."

The sternum figured is very like that here figured as belonging to *Emys concentrica*, and is quite different from that of

T. scabra of Latreille, which is figured here under the name of *Rhinoclemmys scabra*. Mr. Owen figures the skeleton of a young *Testudo indica* 'Phil. Trans.' cxxxix. 1849, t. 19. f. 4–6. These are the only observations I have noticed on the form of the bones in the sternum of the young Chelonians. These authors did not seem to be aware of the great variation in the forms of the bones in the young of the different genera, the changes that they undergo during the growth of the animal, and the important assistance that their study affords in the arrangement of the animals.

Land-Tortoises (Testudo).

The bones of the sternum in young Land-Tortoises (*Testudo*) are the same in number as in the Terrapins, but of very different form. The front two pairs and the hinder two pairs each form a very distinct group, separated by a more or less broad space across the middle of the sternum. The front pair of bones are generally large and well developed, and the odd bone on the inner side of them is triangular and usually small. The two lateral pairs are somewhat similar, broad and expanded, and more or less semilunar, each pair having a convex semicircular edge towards the middle of the inner central vacant disk. The hinder pair are attached to the inner side of the outer edge of the hind lateral pair, and are generally united together.

This formation is well exhibited in a specimen of *Testudo tabulata* (Pl. IV. fig. 1) 2½ inches long, and also in a specimen of *T. elephantopus* (Pl. IV. fig. 2), about 4 inches long, and *Testudo radiata*, 2½ inches. The lateral bones in *Testudo radiata* and in *T. indica* are much more convex and irregular on the edge towards the centre of the sternum.

In *T. platynota* (Pl. IV. fig. 3), about 2 inches long, the lateral bones are of the same lunate shape as in *T. tabulata*, but the lateral pair are much further apart. Perhaps this arises from the ossification being less developed. The lateral bones in *T. semiserrata*, about 2 inches long, are similar to those of the young *T. tabulata*, but rather more irregular in their outline; but the opposite bones are rather further apart, leaving a broader central space between them than in *T. tabulata*.

These bones evidently enlarge in size, their edges approximate, and at length join and coalesce. Thus *T. stellata* (Pl. IV. fig. 4) appears to become solidified when of a very small size; for in a specimen only 2 inches long the ribs are dilated and ossified nearly to the margin, and the sternal bones are very expanded, forming a nearly solid disk, leaving only a broad rhombic vacant space not quite half the width of the sternum; and in a specimen $2\frac{1}{2}$ inches long, this vacant space is reduced in size so as not to be a third of the diameter of the disk. But I think it is very probable that in the very young of this species the separate bones of which the sternum is composed are all more dilated than in the other species, although I have no specimens by which I can indicate this fact.

Freshwater Tortoises or Terrapins.

The sternum of the young Freshwater Tortoises is composed of the same number of bones (which are united together into a bony disk in the adult animal) as that of the Land-Tortoises; but these bones are very different in shape and disposition from those of the Land-Tortoises, and differ in the various groups, offering a curious subject of study.

The sterna of the adult animals are naturally divided into three groups:—

1st. The sternum solid, continuous, and firmly connected with the marginal and other bones of the dorsal disk by an ascending lateral process from each of the central lateral pair of bones.

2nd. The sternum is only connected with the marginal plates of the dorsal disk by a cartilaginous suture or an adhesion between the bones of the sternum and the marginal plates. These are called Box Tortoises.

The Box Tortoises present two forms:—

In the *true* Box Tortoises the sternum is divided transversely into two portions, which close down on the cavity of the upper shell before and behind. The suture is about the middle, between the two lateral bones—the front lobe consisting of the anterior and anterior lateral bones, and covered externally by the gular, pregular, and pectoral plates, the hinder portion consisting of the hinder lateral and the hinder sternal bones. It is covered externally by the abdominal, preanal, and anal shields.

In the Trap Tortoises the sternum is divided into three portions by two transverse sutures. The middle one, which consists of the anterior and posterior lateral bones (which form a square central portion), is attached by a cartilaginous or more or less bony suture to the margin of the dorsal shield, and does not send any ribs up to the inner part of it. It is covered by two large abdominal shields. The front flap consists of the frontal pair of bones and the odd bone; the front pair are very much larger than usual. It is covered by the gular plates (which are generally soldered into one) and the intergular and pectoral plates (which are triangular). The hinder flap only consists of the hinder pair of bones, which are much larger than usual, and united by a straight median suture; it is covered by the preanal and anal plates.

This form is described from the genera *Swanka* and *Kinosternon*, where this modification of the sternum is in its most developed state. The sternum of the other genera is often narrow, and a portion is only slightly mobile, and the plates (which cover it) are diminished in number or coherent together.

The land-tortoise *Pyxis* and the fluviatile *Sternothærus* have the front lobe of the sternum free; but it is only the front lobe of the sternum that is free, the abdominal portion being firmly united to the marginal portion of the back, as in the tortoises with an undivided sternum.

The true Box Tortoises consist of the family Cistudinidæ.

The Trap Tortoises consist of the Chelydradæ.

3rd. All the other families of Freshwater Tortoises or Terrapins have a simple undivided sternum.

One might premise that these three forms would each have a distinct development of the bones of which the sternum is formed, or that the bones of each of the three forms would be of the same shape and developed in the same manner during the growth of the animal. But the examination of the young specimens which have come under my observation (which, unfortunately, are too few for the proper study of the subject) proves this not to be the case; and I am inclined to think that the study of the development of these bones may be subservient to the natural arrangement of these animals, and also a great assistance in the determination of the fossil species.

The development of bones of the sternum of Freshwater Tortoises may be divided into three series, thus:—

I. The nine bones in the very young state are well developed, the lateral bones being largely developed and covering the greater part of the middle of the sternum. There is a moderate-sized vacant space in the middle of the sternum, and a smaller one at the hinder part of the sternum, between the inner hinder angles of the lateral pair of bones and the inner side of the hinder plates, and an oval space on each side of the angular odd bone between it and the inner front edge of the anterior lateral bone.

This form is well exhibited in the sternum of *Malaclemmys concentrica* (Plate V. fig. 1) of the family Malaclemmydæ, and of *Pelomedusa subrufa* (fig. 2), family Hydraspidæ. The anterior lateral bones are larger and more developed in *Malaclemmys* than in *Pelomedusa*; and this appears to be the most usual form of the sternum of the Freshwater Tortoises.

In *Chelydra serpentina*, even when the shell reaches 7 inches length, the sternum is not united along the central longitudinal suture, and there is a triangular cavity on each side of the narrow lanceolate odd bone and the front end of the front lateral, and a moderate-sized square unossified portion between the inner ends of the front and hinder lateral bones on the suture between the pectoral and abdominal plates.

The sternum of the skeleton of the young *Stauremys Salvinii* in the British Museum is like that of *Chelydra*; but the inner edge of the front bones is further apart, and the odd sword-shaped bone is thinner and longer.

II. In the second form the four pairs of bones form a ring round the margin of the sternum, the two pairs of lateral bones being the least developed and forming the narrowest part of the ring, leaving a large open space in the centre between all the bones which form the greater part of the sternum, with the point of the odd bone projecting into it. This form is well seen in the sternum of *Cyclemys dhor* (figs. 3), belonging to the family Cistudinidæ.

Rhinoclemmys scabra (fig. 4). As this animal grows, the front part of the sternum becomes more dilated and extended externally on the front of the outer side. It is also to be observed in the animal that I have described and figured as *Emys pulcherrima* (Cat. Sh. Rept. pl. xxv. fig. 1), which may be a *Rhinoclemmys*. These two latter terrapins belong to the family Emydidæ.

III. This form is somewhat intermediate between the two former. The four pairs of bones in the young animal are even less developed, and form only a narrow ring round the margin of the sternum, leaving a very large part of the sternum only formed of membrane, occupying more of its space than even in the former kind; but the anterior lateral and posterior lateral bones throw out each a more or less narrow bony process across the space, dividing it into three portions. Into the front edge of the front one the small triangular odd bone projects. In *Notochelys platynota* (Pl. IV. fig. 5) the front pair of bones is moderate. The inner process of the front pair of lateral bones is small, but broad and divided into three or four finger-like lobes at the end. This belongs to the family Cistudinidæ.

In *Kachuga* (Pl. VI.) the front pair of bones is less developed. The inner lobes of the front lateral pair of bones are, as in the former, broader and divided into finger-like lobes at the end. The internal bony lobes of the hinder lateral bones are well developed, and like those of the front pair of bones, but much narrower; but, unlike the sternum of *Notochelys*

(Pl. IV. fig. 5), the hinder pair of bones are not united together behind, and each sends forth a lobe from the middle of the inner side, which eventually unite in the centre line, leaving a small posterior central space between the hinder ends of these bones.

This form seems common and perhaps peculiar to the family Bataguridæ. I have figured the inside of the sternum of a very young specimen of *Kachuga major* (Pl. VI. fig. 1), which has the bones and lobes very slender. These parts are more developed in *Kachuga dentata* even in the youngest state, the outside of which is figured (fig. 2), and which has the posterior pair of bones; and in an older specimen in the British Museum this is also figured from the outside.

In *Morenia* and *Pangshura* the hinder part of the sternum is ossified soonest if these vacant spaces exist in the very young specimens.

In the young *Morenia Berdmorei*, about 4 inches long, there is an oblong longitudinal unossified space on each side between the branches of the sternum and the margin, and an elongate four-sided space in the centre between the sutures of the pectoral and abdominal plates, and another rather smaller one between the preanal plates. There is a series of large spaces between the ends of the ribs and the marginal bone.

In a skeleton of a half-grown *Pangshura tecta* there are two rhombic imperfections, the one placed between the sutures of the pectoral and abdominal plates, and a rather smaller one between the two preanal plates.

This form bears some relation to the bones found in a very young *Chelonia* (Pl. VI. fig. 4), where the anterior bones are very narrow. The anterior and posterior lateral bones of each side are separate from each other, having a simple rounded end; each of them has two digitate external lobes, extending towards the margin of the dorsal disk: the anterior one has two simple processes towards and uniting at the centre; the hinder one has a series of simple digitate processes extending towards the centre and hinder part of the sternum.

Another form is very peculiar; and as yet I have only seen one example, in a very young specimen of *Elseya dentata* (Pl. V. fig. 5), belonging to the Hydraspidæ, from Australia. The front pair of bones, the odd bone, and the front lateral bones are all united together and form a solid front half to the sternum. The hinder lateral bones and the hinder pair of bones are narrow, and form a margin to the hinder half of the sternum, leaving a very large triangular central space. In an older specimen the large naked space becomes filled up, except a very small oblong hole in the middle of the suture of the preanal plates, and a larger roundish subhexagonal open space occupying the place of the suture between the abdominal plates.

Perhaps a somewhat similar structure exists in the young *Hydromedusa flavilabris* (Pl. VI. fig. 3); but I have only been able to examine and figure the outside of this specimen, and have not described the separate bones of which it is composed. But this form does not seem to be universal in the Hydraspidæ, as in the young *Chelymys Victoriæ* in the British Museum (about five inches long), examined from the outside, there is a narrow rhombic unossified space in the suture between the pair of abdominal plates, and a narrower lanceolate space between the hinder part of the preanal plates, somewhat like what we find in the young Bataguridæ.

Thus it will appear that the tortoises that have a solid continuous sternum in their adult state have the bones of which it is composed of a very different form in their young state, though they are all developed into a solid mass composed of nine bones in the adult state, as, for example, *Malaclemmys* (Pl. V. fig. 1) of Malaclemmydæ, *Pelomedusa* (fig. 2) of Pelomedusidæ, *Chelydra* and *Stauremys* of Chelydradæ, *Kachuga* (Pl. VI. figs. 1 & 2), *Morenia*, and *Pangshura* of Bataguridæ, *Rhinoclemmys* (Pl. V. fig. 4) of Emydidæ.

Thus, among the Box Tortoises, the sternum of the young *Cyclemys dhor* (Pl. V. fig. 3) is very like that of *Rhinoclemmys*, and the young of *Notochelys platynota* is like that of *Batagur*. We have not had the opportunity of examining the young state of the other genera of Box Tortoises.

I labour under the same disadvantage with regard to the young state of the two-flapped Trap Tortoises. I have only seen the young stuffed specimen of *Kinosternon pennsylvanicum* (Pl. V. fig. 6), which I can only examine from the outside. That has an oblong slender unossified space occupying more than half the length of the central suture of the sternum, somewhat like, but narrower than, the unossified space of *Cyclemys* and *Rhinoclemmys*.

Mud-Tortoises (Trionyx).

The bones of the sternum of the young and adult Mud-Tortoises undergo little alteration of shape; only the adult animals have on the outer surface of each an expanded bony callosity, which, like those on the outer surface of the ribs, is pitted externally and covered with a soft skin, so that the expansions of the ribs and sternal bones are only seen in the animal when it is dry. They are peculiar for having the first pair of sternal bones elongate and bent like an L, one branch of each being directed straight forward, and the elongate odd bone, on the inner margin of the other branch, slightly arched.

In some genera there is only in the adult state a callosity on the sides next the suture between the two middle pairs of bones, as *Aspilus*; in others these callosities are expanded, as in *Rafetus*; but generally the anal pair of bones are also covered with expanded callosities, as in *Trionyx*. In some, as *Emyda*, the front pair and the odd front bone are provided with callosities. The Mud-Tortoises are generally without any bones on the margin; but some few bones are developed in the margin of the adult animal in *Emyda*.

The development of the genus *Emyda* has been imperfectly observed. In *E. punctata* the margin of the disk of the young is flexible, without any marginal bones. At length an oblong marginal bone is developed on the front part of the hinder side over the hind legs; and afterwards a series of smaller marginal bones are developed on the margin behind it. When very young the expanded bony dorsal disk is very narrow, only occupying the centre of the back, the expanded part being shorter than the ribs.

The odd front bone is rather broader than long, and separated from the front pair of bones by the prominent square first vertebral callosity; but as the animal grows the odd first callosity becomes much broader and closely united to the first pair of callosities, which become wider so as quite to enclose the first vertebral callosity. It is not until after this change has taken place that the single anterior nuchal callosity and the two hinder lateral callosities before referred to, over the hind feet, are developed. At length the anterior transverse callosity is united to the front of those of the first pair of ribs to form the dorsal shield, and the single anterior marginal callosity fits into a central notch in its front margin.

In the young specimen the odd anterior marginal callosity is not developed. When the three marginal bones before mentioned are developed, then it is oblong, transverse, and very small; but it enlarges as the animal increases in size.

In the very young specimen the front pair of sternal callosities are small, roundish, and very far apart. They gradually increase in size, being at first rounded quadrangular, rather longer than broad; but they at length spread out on the sides, and are much broader than long, being broader in front than on the outer side. The hinder pair of sternal callosities are always separate behind. In the very young specimens the pair are far apart, much longer than broad, arched on the inner and straight on the outer side. As they increase in size they become broader compared with their length, and closer together, and at length irregularly semicircular, rather longer than broad, nearly close together, and oblique to each other.

The other species (*E. ceylonensis*), when adult, has the hinder pair of callosities subquadrangular, parallel, and nearly united by a straight inner edge and a large rounded anterior callosity.

Sea-Turtles.

The number of the sternal bones of Turtles is the same, and the first pair and the odd bone on the inside of them are of the same form, as in the Terrapins ; but they always remain more or less separate from one another, and do not enlarge, solidify, and consolidate into a continuous bony disk.

As in the Terrapins, the bones of the sternum in the young Turtles are found in two forms. In the true Turtles (*Chelonia*) (Pl. VI. fig. 4) the three hinder pairs of lateral bones are always expanded and furnished with radiating lobes on the inner and outer edges. These lobes are very uniform in their direction and generally in their form, and afford very good characters for the distinction of the species and their division into groups. In the Luth (*Sphargis*) (Pl. VI. fig. 5) the sternal bones in the young state are very narrow, cylindrical and weak, merely forming a slight framework to the circumference of the sternum, and the two front pairs form a group which is separated by a considerable space on the side of the sternum from the part of the ring formed of the two hinder ateral pairs, being in this respect somewhat like the sternum of the young Land-Tortoises, but consisting of slight cylindrical rudimentary bones instead of the broad expanded ones of that group.

The study of the development of the sternum of the tortoises has brought out affinities between groups that have not hitherto been observed; and no doubt, as the state of the bones in more young specimens is known, it will greatly add to our knowledge of the relations which the genera bear to each other. This may be exhibited by the following table, which will lead the zoologist and comparative anatomist to consider this subject, and see many affinities between groups that have hitherto been considered very different, and divergences in groups that have hitherto been regarded as allied.

Chelonians may be divided thus :—

I. The bones of the sternum, and also of the dorsal disk and margin, of the adult animal all united together and consolidated as if they were a single bone.

a. The bones of the sternum in the young animal expanded, and forming a more or less bony disk protecting the greater part of the sternum.

* The sternal bones in the very young expanded and forming two groups :—the front, of the two anterior pairs of bones and the odd bone ; the hinder, of the two hinder pairs of bones, leaving a space in the middle of the sides. *Tylopoda* or Land-Tortoises : *Testudo* &c.

** The sternal bones of the very young united into a disk or marginal ring. *Steganopoda* or Terrapins, as *Malaclemmys*, *Pelomedusa*, *Chelydra*, and *Staurotypus*.

It is to be observed that it is among the latter genera of the family Chelydradæ that the sternum of these animals is smaller and less developed compared with the size of the animal than in any other Chelonians.

b. The bones of the sternum in the young animal slender, and merely forming a ring round the circumference of the sternum, leaving the centre part vacant, to be filled up by the development of the bones.

In the most developed form of this group the bones form a simple external ring, leaving the centre of the disk vacant, as in the genus *Rhinoclemmys* among the Terrapins with a continuous sternum, and *Cyclemys* among the Box Tortoises (which have the sternum divided into two parts by a central suture) ; and the structure seems to be similar in the genus *Kinosternon* (Pl. V. fig. 6), which have the sternum divided into three parts by two cross sutures, and have been called Flap-Tortoises.

Some of the tortoises that have the sternum in the very young state supported by a ring of bones send forth bony lobes from the inner side of the three pairs of lateral bones, which divide the vacant central space into four parts ; this has only been observed in the genus *Kachuga* among the Asiatic Batagurs. This group is intermediate between the two sections *a* and *b* ; and the sternum of the young has considerable affinity to the sternum of the adult turtles.

II. The bones of the sternum in the adult animal remaining separate, and only forming a ring of bones round the centre part of the disk.

In the marine Turtles the marginal bones are only slightly developed ; and in the freshwater Mud-Tortoises the marginal bones are not developed at all, or only deposited on part of the margin when the animal arrives at the adult age. These may be divided into :—

The Mud-Tortoises (Trionychidæ). The front pair of sternal bones separate, slender, bent at a right angle in the middle, the front part produced forwards, the hinder to the side, and attached on the inner side to the elongate arched odd bone.

The Turtles (Chelonia) have the front and hinder pairs of bones narrow, and the front pair furnished with an elongate, more or less lanceolate, odd bone at the posterior end of the suture between the front pair.

* The two lateral pairs of sternal bones being expanded and more or less united in the Turtles.

** The two lateral pairs of sternal bones linear and far apart in the Luth.

The Mud-Tortoises and the Luth are peculiar among tortoises for being covered with a soft leathery skin instead of the horny plates peculiar to this group of animals: but the Mud-Tortoises have beneath their skin more or less dilated callosities, forming their ribs and sternum into a solid mass; while in the Luth the ribs and sternal bones are very slightly developed, separate from each other, being chiefly supported by the hard callosities enclosed in the skin, so that it may be regarded as a reptile on the border of the vertebrate kingdom.

On the Osteology of Sphargis *&c.*

In the adult *Sphargis* the bones are not more developed, considering the size of the animal, than they are in the very young (previously described), and very unlike the skeleton of other Chelonians. There is no regular dorsal or sternal shield, nor marginal bones. The vertebræ are compressed; the seven ribs on each side are depressed, weak, of nearly the same width the whole length, and quite separate from each other, and without any bony expansion between them to form a dorsal disk as in other Chelonians. In all the other very young tortoises I have seen, the ribs are lanceolate, more or less dilated near the vertebral column; and it is from the upper surface of this dilatation that the callosities of the outer surface by which the ribs are united commence and gradually proceed down the ribs to the marginal bones.

The sternum of the adult specimen (5 feet long) examined was more rudimentary and less apparent than in the very young specimen about 4 inches long, which is figured in Pl. VI. fig. 5.

The animal, unlike the generality of Chelonians, appears to be chiefly supported by its hard, longitudinally costate skin. The skin is very thick, and the whole outer surface is studded with very close hard hexangular disks, more like the surface of a trunkfish (*Ostracion*) than any thing that I can compare it with. These disks are larger and more oblong on the longitudinal ridges of the back, the sides of the sternum, and on the sides of the tail, and are produced above into hard conical elevations or tubercles, which are largest on the ridges of the tail. These tubercles are somewhat like those to be observed on some species of *Ostracion* and on *Lophius* and other fishes.

The form of the two hinder central bones of the dorsal disk (placed beyond the one that bears the pelvis, and forming the central line of the hinder part of the shell that covers the tail of the animal) is very different in the young and halfgrown specimens of the different kinds of turtles, and affords a very good character to determine the species; but these bones expand in the more adult state when the dorsal shell becomes solidified by the dilatation and coherence of the ribs, when they lose the distinctness of their form, or at least they become coalesced with the other bones and are not to be observed.

Thus in the young *Caouana* the hinder bone is narrow and compressed, with a prominence on its outer side; in the other turtles this bone is flat and expanded. In the Green Turtle (*Mydas*) the last bone is lanceolate, ovate, and broad at the base, and slightly contracted at the front edge, and the hinder part is gradually contracted into a point. The last bone of the Hawk's-beak (*Caretta*) is similar, but broader and more rapidly attenuated behind, and not contracted in front next to the pelvis.

EXPLANATION OF THE PLATES.

Plate IV.

Fig. 1. Testudo tabulata.
Fig. 2. Testudo elephantopus.
Fig. 3. Testudo platynota.
Fig. 4. Testudo stellata.
Fig. 5. Notochelys platynota.

Plate V.

Fig. 1. Malaclemmys concentrica.
Fig. 2. Pelomedusa subrufa.
Fig. 3. Cyclemys dhor.
Fig. 4. Rhinoclemmys scabra.
Fig. 5. Elseya dentata.
Fig. 6. Kinosternon pennsylvanicum.

Plate VI.

Fig. 1. Kachuga major.
Fig. 2. Kachuga dentata (outside).
Fig. 3. Hydromedusa flavilabris (outside).
Fig. 4. Chelonia mydas.
Fig. 5. Sphargis mercurialis.

XX.—*On the Homologies of the Shoulder-girdle of the Dipnoans and other Fishes.* By Theodore Gill, M.D., Ph.D., &c.*

Few problems involving the homologies of bones in the vertebrate branch have been in so unsatisfactory a condition as that respecting the shoulder-girdle and its constituents in fishes. But the recent observations of Bruhl, Gegenbaur, and Parker have thrown a flood of light upon the subject. Some minor questions, however, appear still to be unsettled; the writer, at least, has not been able to convince himself of the correctness of all the identifications, and of the names conferred as expressions thereof. Recent study has increased such doubts respecting the applicability of former nomenclatures, and has led to conclusions different from those announced by previous investigators.

The following are assumed as premises that will be granted by all zootomists:—

1. Homologies of parts are best determinable, *cæteris paribus*†, in the most nearly related forms.

2. Identifications should proceed from a central or determinate point outwards.

The applications of these principles are embodied in the following conclusions:—

1. The forms that are best comparable and that are most nearly related to each other are the Dipnoi, an order of fishes at present represented by *Lepidosiren*, *Protopterus*, and *Ceratodus*, and the Batrachians as represented by the Ganocephala, Salamanders, and Salamander-like animals.

2. The articulation of the anterior member with the shoulder-girdle forms the most obvious and determinable point for comparison in the representatives of the respective classes.

The Girdle in Dipnoans.

I. The proximal element of the anterior limb in the Dipnoi has, almost by common consent, been regarded as homologous with the *humerus* of the higher vertebrates.

II. The humerus in the Urodele Batrachians, as well as the extinct Ganocephala and Labyrinthodontia, is articulated chiefly with the coracoid.

Therefore the element of the shoulder-girdle with which the humerus of the Dipnoi is articulated must also be regarded

* Abstract, communicated by the Author, from a forthcoming work ('Arrangement of the Families of Fishes') now being printed for the Smithsonian Institution.

† Parts affected by teleological modifications may be excepted.

as the *coracoid* (subject to the proviso hereinafter stated), unless some specific evidence can be shown to the contrary. No such evidence has been produced.

III. The scapula in the Urodele and other Batrachians is entirely or almost wholly excluded from the glenoid foramen, and above the coracoid.

Therefore the corresponding element in Dipnoi must be the *scapula*.

IV. The other elements must be determined by their relation to the preceding, or to those parts from or in connexion with which they originate.

All those elements in *immediate* connexion* with the pectoral fin and the scapula must be homologous as a whole with the coraco-scapular plate of the Batrachians; that is, it is infinitely more probable that they represent as a whole or as dismemberments therefrom the coraco-scapular element than that they have independently originated.

But the homogeneity of that coraco-scapular element forbids the identification of the several elements of the fish's shoulder-girdle with regions of the Batrachian's coraco-scapular plate.

And it is equally impossible to identify the fish's elements with those of the higher reptiles or other vertebrates which have developed from the Batrachians. The elements in the shoulder-girdles of the distantly separated classes *may* be (to use the terms introduced by Mr. Lankester) homoplastic; but they *are not* homogenetic.

Therefore they must be named accordingly.

The element of the Dipnoan's shoulder-girdle continuous downwards from the scapula, and to which the coracoid is closely applied, may be named *ectocoracoid*.

V. Neither the scapula in Batrachians nor the cartilaginous extension thereof, designated suprascapula, is dissevered from the coracoid.

Therefore there is an *à priori* improbability against the homology with the scapula of any part having a distant or merely ligamentous connexion with the humerus-bearing element.

Consequently, as an element better representing the scapula exists, the element named scapula (by Owen, Günther, &c.) cannot be the homologue of the scapula of Batrachians.

On the other hand, its more intimate relations with the skull and the mode of development indicate that it is rather an element originating and developed in more intimate connexion with the skull.

* The so-called scapula and suprascapula of most authors are excluded from this connexion.

We may therefore regard it, with Parker, as a *post-temporal.*

VI. The shoulder-girdle in the Dipnoi is connected by an azygous differentiated cartilage, swollen backwards.

It is more probable that this is the homologue of the *sternum* of Batrachians, and that in the latter that element has been still more differentiated and specialized, than that it should have originated *de novo* from an independently developed nucleus.

The homologies of the elements of the shoulder-girdle of the Dipnoi appear then to be as follows:—

Nomenclature adopted.	Owen.	Parker.	Günther.
HUMERUS.	Humerus.	Humerus.	Forearm.
CORACOID (or PARAGLENAL)*.		Scapula.	Humeral cartilage.
SCAPULA.	Coracoid.	Supraclavicle.	Coracoid§.
ECTOCORACOID (or CORACOID)†.		Clavicle.	
STERNUM‡.		Epicoracoid.	Median cartilage.
POSTTEMPORAL.	Scapula.	Posttemporal.	Suprascapula.

The Girdle in other Fishes.

Proceeding from the basis now obtained, a comparative examination of other types of fishes successively removed by their affinities from the Lepidosirenids may be instituted.

I. With the humerus of the Dipnoans the element in the Polypterids (single at the base but immediately divaricating, and with its limbs bordering an intervening cartilage) which supports the pectoral and its basilar ossicles must be homologous.

But it is evident that the external elements of the so-called carpus of teleosteoid Ganoids are homologous with that element in Polypterids.

* Gelenkstelle der Brustflosse am primären Schulterknorpel (Gegenbaur).

† Clavicula (Gegenbaur).

‡ Verbindungsstelle des beiderseitigen Schulterknorpels (Gegenbaur). Prof. Gegenbaur regards the median cartilage as a dismemberment of a common cartilage, the upper division of which receives the pectoral limb, while the lower unites with the corresponding dismemberment of the opposite side and forms the median cartilage.

§ The suture separating the "coracoid" into two portions has been observed by Dr. Günther, but he could "not attach much importance to this division."

Therefore those elements cannot be carpal, but must represent the humerus.

II. The element with which the homologue of the humerus, in Polypterids, is articulated must be homologous with the analogous element in Dipnoans, and therefore with the *coracoid.*

The coracoid of Polypterids is also evidently homologous with the corresponding element in the other Ganoids; and consequently the latter must be also *coracoid.*

It is equally evident, after a detailed comparison, that the single coracoid element of the Ganoids represents the three elements developed in the generalized Teleosts (Cyprinids &c.) in connexion with the basis of the pectoral fin; and such being the case, the nomenclature should correspond. Therefore the upper element may be named *hypercoracoid*, the lower *hypocoracoid*, and the transverse or median *mesocoracoid.*

III., IV. (*Proscapula*, or united *scapula* and *ectocoracoid.*) The two elements of the arch named by Parker, in *Lepidosiren*, "supraclavicle" (= scapula) and "clavicle" (= ectocoracoid) seem to be comparable together and as a whole with the single element carrying the humerus and pectoral fin in the Crossopterygians (*Polypterus* and *Calamoichthys*) and other fishes*, and therefore not identical respectively with the "supraclavicle" and "clavicle" (except in part) recognized by him in other fishes.

As this compound bone, composed of the scapula and ectocoracoid fused together, has received no name which is not ambiguous or deceptive in its homological allusions, it may be designated the *proscapula.*

V. The posttemporal of the Dipnoans is evidently represented by the analogous element in the Ganoids generally, as well as in the typical fishes.

The succeeding elements (outside those already alluded to) appear from their relations to be developed from or in connexion with the posttemporal, and not from the true scapular apparatus; they may therefore be named *posttemporal*, *posterotemporal*, and *teleotemporals.*

The homologies of the elements of the girdle of Dipnoans with those of other fishes, and the added elements in the latter, will be as follows:—

* Dr. Günther (Phil. Trans. vol. clxi. p. 531) has observed, respecting the division in question in *Lepidosiren* and *Ceratodus*:—"I cannot attach much value to this division; the upper piece is certainly not homologous with the scapula of Teleostean fishes, which is far removed from the region of the pectoral condyle."

	Cuvier.	Owen.	Gegenbauer.	Parker.
ACTINOSTS.	Os du carpe.	Carpal.	Basalstücke der Brustflosse.	Brachial.
CORACOID or PARAGLENAL.	Simple in Dipnoi and Ganoidei.			
HYPERCORACOID.	Radial.	Ulna.	Oberes Stück (Scapulare).	Scapula.
MESOCORACOID.	Troisième os de l'avant-bras qui porte la nageoire pectorale.	Humerus.	Spangenstück.	Precoracoid.
HYPOCORACOID.	Cubital.	Radius.	Vorderes Stück (Procoracoid).	Coracoid.
PROSCAPULA*.	Humeral.	Coracoid.	Clavicula.	Clavicle.
SCAPULA. ECTOCORACOID.	Differentiated only in Dipnoi.			
STERNUM.	Differentiated in Dipnoi.			
	POSTTEMPORAL ELEMENTS.			
POSTTEMPORAL.	Suprascapulaire.	Suprascapula.	Supraclaviculare (*a*).	Posttemporal.
POSTEROTEMPORAL.	Scapulaire.	Scapula.	Supraclaviculare (*b*).	Supraclavicle.
TELEOTEMPORALS.	Os coracoïdien.	Clavicle.	Accessorisches Stück.	Postclavicles.

It will thus be seen that the determinations here adopted depend mainly (1) on the interpretation of the homologies of the elements with which the pectoral limbs are articulated, and (2) on the application of the term "coracoid." The name "coracoid," originally applied to the process so called in the human scapula, and subsequently extended to the independent element homologous with it in birds and other vertebrates, has been more especially retained (*e. g.* by Parker in mammals &c.) for the region including the glenoid cavity. On the assumption that this may be preferred by most zootomists, the preceding terms have been applied. But if the name should be restricted to the proximal element nearest the glenoid

* The name scapula might have been retained for this element, as it is (if the views here maintained are correct) homologous with the entire scapula of man, less the coracoid and glenoid elements; but the restricted meaning has been so universally adopted, that it would be inexpedient now to extend the word.

cavity in which ossification commences, the name *paraglenal* (given by Dugès to the cartilaginous glenoid region) can be adopted; and the coracoid would then be represented (in part) rather by the element so named by Owen. That eminent anatomist, however, reached his conclusion (only in part the same as that here adopted) by an entirely different course of reasoning, and by a process, as it may be called, of elimination; that is, recognizing first the so-called "radius" and "ulna," the "humerus," the "scapula," and the "coracoid" were successively identified from their relations to the elements thus determined, and because they were numerically similar to the homonymous parts in higher vertebrates.

The detailed arguments for these conclusions, and references to the views of other authors, will be given in a future memoir. I will only add here that these homologies seem to be fully sustained by the relations of the parts in the generalized Ganocephalous Batrachians (*Apateon* or *Archegosaurus*, &c.).

XXI.—*Additions to the Australian* Curculionidæ. Part IV. By Francis P. Pascoe, F.L.S. &c.

Brachyderinæ.

Evas lineatus.

Molytinæ.

Psaldus ammodytes.

Hyperinæ.

Hypera acaciæ.
Prophæsia confusa.

Hylobiinæ.

Orthorhinus tenellus.
—— infidus.
—— carinatus.

Erirhininæ.

Agestra, n. g.
—— suturalis.
Eniopea, n. g.
—— amœna.
Diethusa, n. g.
—— fervida.
Emplesis filirostris.
—— storeoides.
Lybæba, n. g.
—— subfasciata.
—— repanda.
Enide, n. g.
—— porphyrea.
—— æstuans.
—— saniosa.
Hedyopis, n. g.
—— selligera.
Gerynassa, n. g.
—— nodulosa.
—— basalis.
Dicomada, n. g.
—— litigiosa.
—— ovalis.
—— terrea.
Paryzeta, n. g.
—— musiva.
Xeda, n. g.
—— amplipennis.
—— bilineata.
Olanæa, n. g.
—— nigricollis.
Antyllis, n. g.
—— setosa.
—— griseola.
—— aurulenta.
Cyttalia, n. g.
—— griseipila.
Phrenozemia lunata.
Meriphus coronatus.

AMALACTINÆ.
Brexius lineatus.

CRYPTORHYNCHINÆ.
Psepholax Mastersii.
—— egerius.
—— latirostris.
Poropterus satyrus.
Poropterus inominatus.
—— varicosus.
—— oniscus.
—— tumulosus.

CEUTORHYNCHINÆ.
Rhinoncus nigriventris.

Evas lineatus.

E. nigro-piceus, omnino dense squamosus, supra lineis cervinis argenteisque alternatis, infra pedibusque totis argenteis; rostro crasso, capite haud angustiore, incisura triangulari apice angusta, bene determinata; prothorace latitudine longitudini æquali, cervino-trivatto, vitta intermedia latiore; elytris sulcato-punctatis, interstitiis primo secundoque, quarto et sexto cervinis, totis squamis erectis argenteis uniseriatim instructis, apicibus parum divaricatis. Long. $3\frac{1}{4}$–4 lin.

Hab. Queensland (Gayndah).

The male is considerably narrower than the female, and is perhaps more definitely marked. In proposing the generic name (Trans. Ent. Soc. 1870, p. 182) I overlooked the fact that *Evas* is masculine.

Psaldus ammodytes.

P. ovatus, brunneo-testaceus, vage setulosus; oculis nigris; capite rostroque punctis sparsis leviter impressis; prothorace latitudine vix longiore (haud confertim) rugoso-punctato; elytris fortiter sulcato-punctatis, interstitiis convexis; abdomine sparse punctato. Long. $1\frac{1}{4}$ lin.

Hab. Champion Bay.

Besides colour, this species differs from *P. liosomoides* in its differently punctured rostrum. From a renewed examination of *Aphela* and *Emphyastes* I am inclined to think that these two genera and *Psaldus* should form a subfamily near Molytinæ. *Emphyastes*, placed by Mannerheim by the side of *Trachodes* and *Styphlus*, is referred by Lacordaire to Amalactinæ, notwithstanding its very short metasternum; at the same time he says that it is one of the most aberrant genera of the Curculionidæ, and that if put anywhere else it would be still more out of place. In the three genera the scrobe runs to the eye, widening more or less distinctly, so that its upper boundary, if continued, would pass above the eye; the scape either lies in front, when of normal length, or passes over or above the eye when the scape impinges on it, as it does in *Psaldus*. They are all found on the sea-shore under seaweed or burrowing in the sand, some below high-water mark.

Hypera acaciæ.

H. lata, fusca, squamis umbrinis griseisque confuse vestita; rostro prothorace manifeste breviore, sat tenuato, basi angustiore; oculis ellipticis, antice paulo approximatis; antennis ferrugineis, funiculi articulo primo duobus sequentibus longitudine æquali; prothorace sat confertim punctato, vitta laterali indistincte notato; elytris prothorace multo latioribus, paulo depressis, striato-punctatis, interstitiis latis, uniseriatim setosis, subplagiatim griseo-variis; corpore infra castaneo, squamis subargenteis, rotundatis elongatisque intermixtis, vestito; pedibus breviusculis. Long. $2\frac{1}{2}$ lin.

Hab. Queensland (Gayndah).

A true *Hypera*, but with broader elytra than usual. Mr. Masters tells me it is found on wattles (*Acacia*, sp.).

Prophæsia confusa.

P. pallide ferruginea, supra squamis oblongis, infra magis elongatis vel piliformibus, albis vestita; rostro apicem versus gradatim paulo latiore; prothorace sat confertim punctato, punctis singulis squama plerumque piliformi gerentibus; elytris striato-punctatis, interstitiis haud convexis, leviter punctulatis; sutura prima abdominis fortiter arcuata. Long. $2\frac{1}{2}$ lin.

Hab. Tasmania.

The scales vary in size and form, as they do in the other two species; but in this one they are not close together so as almost to hide the sculpture, but irregularly scattered, although approximating in parts so as to form indefinite patches, which are more or less connected according, apparently, to the freshness of the specimen.

Orthorhinus tenellus.

O. cylindricus, fuscus, squamis albidis ochraceisque dense vestitus; rostro brevi, basi squamoso; antennis subferrugineis; funiculo brevi; clava breviter ovata; prothorace latitudine longitudini æquali, tertia parte anteriore paulo constricta, in medio valde convexo, ad latera vage granulato, apice fasciculis duabus parvis ochraceis munito; scutello conspicuo; elytris sulcato-punctatis, interstitiis alternis remote granulatis, singulis tuberculis quatuor, una basali, una mediana, duabus prope apicem ochraceo-fasciculatis, instructis; corpore infra pedibusque dense albo-squamosis; femoribus anticis majusculis, sed tibiis brevibus, compressis. Long. $2\frac{3}{4}$ lin.

Hab. Champion Bay.

Like a small starved specimen of *O. simulans*, Boh., but proportionally longer and more slender; in my solitary example the upper surface has a somewhat silvery hue.

Orthorhinus infidus.

O. anguste ovatus, piceus, squamis silaceis elongatis vel setiformibus sat vage vestitus; rostro modice elongato, crebre punctato; oculis subgrosse granulatis; antennis subferrugineis; funiculo longiusculo, articulo primo elongato; prothorace subtransverso, lateribus pone apicem fortiter rotundato, confertim granulato-punctato, squamis setiformibus vestito, in medio, apice excepto, carinato; elytris modice convexis, sulcato-punctatis, punctis leviter impressis, interstitiis convexis, granulis transversis concoloribus rude instructis, squamis elongatis, postice magis condensatis, conspersis; tibiis posticis prope apicem fortiter compressis. Long. 6 lin.

Hab. Richmond River.

A dull-coloured species, which in the smaller facets of the eyes resembles *O. hilipoides*, a species which in momentary aberration I described as an *Alcides*; in the sculpture of the elytra it is unlike any of its congeners. This and the following species have no fasciculi.

Orthorhinus carinatus.

O. oblongo-ovatus, fuscus, sordide griseo-squamosus; rostro breviusculo, rude punctato, parce elongato-squamoso; antennis subtestaceis, squamis piliformibus vestitis; funiculo articulo primo elongato; prothorace subtransverso, quarta parte anteriore manifeste constricta; elytris sat fortiter convexis, apicem versus parum latioribus, substriato-punctatis, interstitiis alternis tuberculato-carinatis, carina interiore ante apicem evanescente, secunda postice paulo prominula, basi plaga umbrina, margine postico arcuata et bene limitata notatis, sed aliquando fere obsoleta; tibiis, præsertim anticis intermediisque, brevibus, illis valde compressis. Long. $3\frac{1}{4}$–4 lin.

Hab. Wide Bay.

The outline and well-marked carinæ on the elytra are the principal diagnostic characters of this species.

As I have to propose several new genera of Erirhininæ, the following table will be useful in showing their more prominent diagnostic characters; and it includes, I believe, all the Australian genera yet published. There will still remain, however, several unnamed species in collections to be examined. The subfamily is apparently a very numerous one in Australia, and, from the exceeding variability of its characters, a very difficult one to classify. The two New-Zealand genera (*Hoplocneme* and *Stephanorhynchus*) are widely removed from all known Australian forms*. I think that in Mr. Wallace's Malayan

* A third genus, *Eugnomus* (Schönh. Mant. Sec. p. 45), is said to be from New Zealand; but no species has been described.

collection of more than a thousand species of Curculionidæ only five or six species belong to the Erirhininæ. In the table I have followed Lacordaire's division into five "groupes;" but it seems to me that two of these ("Cryptoplides" and "Storéides") cannot be maintained satisfactorily, and should be united to "Erirhinides vrais." Some of the genera might be placed in either of them.

"Erirhinides vrais."

Pectus not canaliculate.
  Club of the antennæ with closely united joints.
    Scrobes nearly terminal .... *Desiantha.*
    Scrobes more or less distant from the mouth.
      Rostrum quadrangular.......... *Nemestra.*
      Rostrum rounded or cylindrical.
        Antennæ inserted near the base of the rostrum .. *Orichora.*
        Antennæ inserted near the middle.
          Femora not toothed.
            Scrobes connivent beneath .... *Aoplocnemis.*
            Scrobes not connivent.
              Anterior tibiæ spurred.
                Anterior tibiæ slightly flexuous.......... *Erirhinus.*
                Anterior tibiæ falcate .... *Œnochroma.*
              Anterior tibiæ not spurred .... *Nedyleda.*
          Femora toothed beneath .... *Agestra.*
  Club of the antennæ loosely jointed .... *Eniopea.*
Pectus canaliculate .... *Diethusa.*

"Hydronomides."

Pectus canaliculate.......... *Bagous* *.

"Cryptoplides."

Funicle 6-jointed.
  Tarsi 4-jointed .... *Endalus.*
  Tarsi 3-jointed .... *Misophrice.*
Funicle 7-jointed.
  Elytra callous posteriorly .... *Rhachiodes.*
  Elytra without callosities.
    Tarsi 4-jointed.
      Claw-joint not passing beyond the lobes of the third *Cryptoplus.*
      Claw-joint passing beyond the lobes of the third .. *Emplesis.*
    Tarsi 3-jointed .... *Thechia* †.

"Storéides."

Funicle 7-jointed.
  Pectus canaliculate.
    Rostrum cylindrical.......... *Lybæba.*
    Rostrum narrowing gradually to the apex .... *Enide.*
  Pectus not canaliculate.
    Second abdominal segment scarcely longer than the third .... *Storeus.*

* I have three Australian species of this well-known northern genus.

† This genus will be published in my "Contributions towards a Knowledge of the Curculionidæ," Part iv., in the Journal of the Linnean Society. It is related to a new Malayan form.

Second abdominal segment as long as or longer than the next two together.
  Prothorax bisinuate at the base.
    Anterior and intermdiate tibiæ bicalcarate ...... *Hedyopis.*
    Anterior and intermediate tibiæ with a single spur *Erytenna.*
  Prothorax rounded at the base.
    Eyes coarsely faceted .... *Gerynassa.*
    Eyes finely faceted.
      Intermediate coxæ remote.
        Rostrum cylindrical throughout .... *Cydmæa.*
        Rostrum broader at the apex .... *Dicomada.*
      Intermediate coxæ approximate.
        Scrobes running to the eye.
          Rostrum slender, broader at the apex .... *Paryzeta.*
          Rostrum stouter, cylindrical throughout .. *Xeda.*
        Scrobes running beneath the rostrum ...... *Olanæa.*
Funicle 6-jointed .... *Antyllis.*

"Eugnomides."

Rostrum abruptly connected with the head.
  Femora pedunculate.............................. *Meriphus.*
  Femora not pedunculate.
    Anterior coxæ contiguous .... *Myosita.*
    Anterior coxæ not contiguous...................... *Orpha.*
Rostrum gradually continued to the head.
  Scape attaining the eye .... *Phrenozemia.*
  Scape passing to the posterior border of the eye .... *Cyttalia.*

Agestra.

Rostrum tenue, arcuatum; *scrobes* submedianæ, paulo obliquæ. *Scapus* oculum attingens; *funiculus* 7-articulatus, articulo primo ampliato, cæteris brevioribus, obconicis; *clava* distincta. *Oculi* ovati, fortiter granulati. *Prothorax* subtransversus, basi perparum bisinuatus, lobis ocularibus nullis. * *Elytra* oblongo-cordiformia, prothorace paulo latiora. *Coxæ* intermediæ haud approximatæ. *Femora* crassa, subtus emarginata, obsolete dentata; *tibiæ* anticæ et intermediæ fere rectæ, apice mucronatæ, posticæ subflexuosæ; *tarsi* articulo tertio anguste bilobo, quarto elongato. *Abdomen* segmentis duobus basalibus brevibus, secundo tertio quartoque conjunctim manifeste breviore, sutura prima obsoleta. *Corpus* esquamosum.

The insect forming the type of this genus is remarkable for the shortness of the two basal abdominal segments—the second, however, owing to its close union with the first, being very indistinctly limited. The genus seems to have more affinity with *Dorytomus* than with any other. The facets of the eyes are very minute; but, as only about ten or so may be counted

* I have omitted to mention the scutellum in this and some other genera, as in the Erirhininæ (and oftentimes in other Curculionidæ) it is very small, and, unless the scales are rubbed off, it is often difficult to ascertain its form.

across the short diameter, the eye, in proportion to its size, must be characterized as coarsely granulate.

Agestra suturalis.

A. ovata, supra silacea, in prothorace saturata, subtus capiteque umbrina, setulis subaureis adspersa, rostro, antennis, pedibusque subferrugineis vel silaceis; rostro prothorace vix longiore; funiculi articulo primo secundo tertioque conjunctim manifeste longiore; clava late ovata; prothorace pone apicem fere parallelo, supra sat crebre punctato; elytris seriatim punctatis, punctis majusculis, approximatis, interstitio suturali nigro; femoribus posticis magis clavatis, dente minus obsoleto instructis. Long. 1 lin.

Hab. Fremantle.

Eniopea.

Rostrum subcylindricum, arcuatum, apice parum latius; *scrobes* præmedianæ, rectæ. *Scapus* longiusculus, oculum attingens; *funiculus* 7-articulatus, articulo primo ampliato, cæteris gradatim brevioribus; *clava* magna, laxe articulata. *Oculi* subovati, fortiter granulati. *Prothorax* oblongus, basi subrotundata, quam apice paulo latiore, lobis ocularibus nullis. *Elytra* oblonga, prothorace manifeste latiora. *Coxæ* intermediæ approximatæ. *Femora* crassa, mutica, basi subpedunculata; *tibiæ* anticæ et intermediæ flexuosæ, apice mucronatæ; *tarsi* articulo tertio bilobo, quarto elongato. *Abdomen* segmentis duobus basalibus breviusculis, ultimo magno; processus intercoxalis haud remotus.

The diagnostic characters of this genus are found in the antennal club and in the abdominal segments; the former, which is nearly as long as the six preceding joints of the funicle together, has its joints (except the last) narrowed at the base, as in many of the Anthribidæ. As to the last abdominal segment, in some of my specimens, probably females, it extends beyond the elytra, and is more or less scaly, a true pygidium in fact. As in many other variegated species, little can be said in regard to the distribution of colours, as they vary in almost every individual; but in most there is to the *naked eye* a well-marked spot at the side of each elytron; under the lens it is a large spot among a confused mass of others. I have placed the genus provisionally near *Erirhinus.*

Eniopea amœna.

E. oblonga, picea, squamis argenteis fuscisque variegata; rostro ferrugineo, prothorace manifeste longiore, basi capiteque parce griseo-pilosis; funiculi articulo primo quam secundo duplo longiore; prothorace latitudine paulo longiore, utrinque rotundato, supra plerumque vitta argentea lateraliter ornato; elytris oblongo-cordiformibus, plagiatim variegatis; corpore infra pedibusque ferrugineis, squamis argenteis adspersis; femoribus in medio nigrescentibus. Long. $1\frac{1}{4}$ lin.

Hab. Fremantle.

Diethusa.

Rostrum breviusculum, versus apicem cito angustius; *scrobes* submedianæ, laterales, obliquæ. *Scapus* oculum attingens; *funiculus* 7-articulatus, articulis duobus basalibus longiusculis, primo incrassato, reliquis obconicis, ultimis transversis; *clava* distincta. *Oculi* rotundati, subtenuiter granulati, antice parum approximati. *Prothorax* subconicus, basi bisinuatus, lobis ocularibus nullis. *Scutellum* oblongum. *Elytra* subcordiformia, prothorace multo latiora. *Pectus* breve, canaliculatum. *Coxæ* anticæ basi fere contiguæ, intermediæ distantes; *femora* crassa, dentata; *tibiæ* breves, flexuosæ, apice bicalcaratæ (posticæ fere obsoletæ exceptæ); *tarsi* articulo tertio bilobo, quarto minusculo; *unguiculi* divaricati. *Mesosternum* depressum, antice arcuatum. *Abdomen* segmentis duobus basalibus ampliatis, suturis tribus intermediis rectis.

The peculiar character of the rostrum, in conjunction with the normal character of abdominal segments and pectoral canal, is at once distinctive of this genus. The two spurs of the anterior and intermediate tibiæ are, I consider, mucros, the outer and larger one being in the usual position, the inner one replacing the tuft of hairs often present when the tibia is a little dilated on the inner margin of the apex.

Diethusa fervida.

D. nigra, squamis læte rufo-ferrugineis, supra maculatim ochraceis, dense vestita; rostro antennisque fulvo-ferrugineis, vel ferrugineis, illo prothorace manifeste breviore; funiculi articulo primo modice elongato, secundo breviore; prothorace utrinque rotundato; elytris striato-punctatis, punctis elongatis, nitidis, interstitiis modice convexis; corpore infra pedibusque fulvo-ferrugineis, sejunctim griseo-squamosis; femoribus posticis dente ampliato instructis. Long. 2 lin.

Hab. South Australia.

Emplesis filirostris.

E. oblongo-elliptica, picea, squamis griseis sejunctim tecta; capite inter oculos squamis majoribus prominulis instructo; rostro filiformi, ♂ duplo, ♀ prothorace triplo longiore, castaneo, nudo, fere impunctato; antennis gracilibus, sparse setulosis; prothorace transverso, antice constricto, lobis ocularibus nullis; elytris prothorace quadruplo longioribus, humeris rotundatis, striato-punctatis, punctis approximatis, interstitiis haud convexis; corpore infra squamis piliformibus adsperso; pedibus sejunctim squamosis. Long. $2\frac{1}{2}$ lin.

Hab. Champion Bay.

In this and the following species there is a decided curve at the sides of the three intermediate abdominal segments, a character which places them in the "Storéides" of Lacordaire; however, they cannot, in my opinion, be separated from *Emplesis.*

Emplesis storeoides.

E. sat late elliptica, nigra, supra sat dense umbrino-squamosa; capite, antennis rostroque ferrugineis, hoc prothorace longiore, nudo, nitido, fere impunctato; oculis majusculis; funiculi articulo primo manifeste crassiore; prothorace valde transverso, apice fortiter angustato, utrinque pone apicem modice rotundato; scutello ovali; elytris elongato-cordatis, striatis, in medio dimidii basalis nigro-squamosis, postice vage nigro-maculatis; corpore infra pedibusque ferrugineis, sparse albido-squamosis. Long. 2 lin.

Hab. Queensland (Gayndah).

Lybæba.

Rostrum tenuiter cylindricum, arcuatum, basi paulo compressum; *scrobes* submedianæ, rectæ, fere in medio oculorum currentes. *Scapus* oculum vix attingens; *funiculus* 7-articulatus, articulo primo elongato, cæteris gradatim brevioribus, obconicis; *clava* distincta. *Oculi* subtenuiter granulati, vix approximati. *Prothorax* subconicus, basi bisinuatus, lobis ocularibus nullis. *Scutellum* oblongum. *Elytra* subcordiformia, convexa. *Pectus* modice elongatum, canaliculatum. *Coxæ* anticæ basi contiguæ, intermediæ distantes; *femora* crassa, dentata; *tibiæ* anticæ et intermediæ rectæ, calcaratæ, apice (unco obliquo armatæ) posticæ subflexuosæ, versus apicem latiores; *tarsi* articulo tertio valde bilobo, quarto minusculo. *Abdomen* segmentis duobus basalibus ampliatis, tribus intermediis lateraliter arcuatis.

Except in the second abdominal segment, the curve at the sides is very slightly marked; still the sutures are not so straight as in *Diethusa.* The genus is closely allied to *Enide*; *L. subfasciata*, indeed, might be taken at first sight for the small variety of *E. æstuans*; but the character of the rostrum is essentially different.

Lybæba subfasciata.

L. ferruginea, squamis læte ferrugineis, nigro-variis, sat dense vestita; rostro nudo, subtestaceo, prothorace paulo longiore; funiculi articulo primo duobus sequentibus conjunctim æquali; prothorace apice paulo constricto, utrinque rotundato; elytris striatis, fasciis nigris indeterminatis tribus, ad suturam interruptis, notatis; corpore infra pedibusque sejunctim griseo-squamosis. Long. $1\frac{1}{3}$ lin.

Hab. Swan River (Albany).

This species has a longer prothorax than the following, narrower proportionally at the base and strongly constricted towards the apex; the scales also are more closely set.

Lybæba repanda.

L. castanea, squamis subfulvis castaneisque vestita; rostro prothorace longiore, ferrugineo, nudo, punctis linearibus sat confertim impresso; funiculo articulis duobus basalibus longitudine æqualibus; oculis minus tenuiter granulatis; prothorace magis transverso, apice vix constricto utrinque subfulvo, disco, macula triangulari basali excepta, castaneo-squamoso; elytris striatis, fasciis duabus latis indeterminatis castaneis, una ante, altera pone medium, ad suturam interruptis, ornatis; corpore infra pedibusque sat vage griseo-squamosis; coxis intermediis valde remotis; abdominis segmento secundo breviore. Long. 1 lin.

Hab. Swan River (Albany).

ENIDE.

Rostrum paulo arcuatum, apicem versus tenuius; *scrobes* præmedianæ, laterales, obliquæ. *Scapus* longiusculus, oculum attingens; *funiculus* 7-articulatus, articulis duobus basalibus longiusculis, reliquis obconicis, gradatim brevioribus; *clava* distincta. *Oculi* rotundati, tenuiter granulati, modice approximati. *Prothorax* subconicus, basi bisinuatus, lobis ocularibus nullis. *Scutellum* angustum. *Elytra* subcordiformia, singula basi emarginata. *Pectus* breve, canaliculatum. *Coxæ* anticæ basi contiguæ, intermediæ distantes; *femora* crassa, dentata; *tibiæ* apice mucrone calcariformi munitæ, anticæ et intermediæ arcuatæ vel subflexuosæ, posticæ fere rectæ, apicem versus crassiores; *tarsi* articulo tertio late bilobo, quarto longiusculo; *unguiculi* divaricati. *Abdomen* segmentis duobus basalibus ampliatis, intermediis lateraliter arcuatis.

The rostrum is bent and narrowed towards the apex; this will at once differentiate the genus from *Lybæba*, which has also a short pectoral canal. The three intermediate segments of the abdomen in *E. porphyrea* are slightly curved at the sides; but in *E. æstuans* it is difficult to decide either way: when the abdomen is at all convex there must be a corresponding curvature; but this is quite different from the little curved processes at the sides, which are the peculiarity in question. In this genus there is a broad excavation extending over the whole of the meso- and metasterna and the middle of the first abdominal segment; a similar excavation is found also in *Lybæba*, but not involving the abdomen. There is a considerable difference in the coloration of individuals of the same species in this and some of the allied genera.

Enide poryhyrea.

E. pallide ferruginea, squamis flavescentibus, supra plagiatim rufis vel rufo-ferrugineis, omnino dense vestita; rostro antennisque pallidioribus, illo prothorace paulo breviore, apice solo nudo, in medio leviter carinulato; funiculo articulis duobus basalibus longitudine fere æqualibus; prothorace subtransverso, basi fortiter bisinuato; elytris basi prothorace multo latioribus, lateraliter modice rotundatis, humeris callosis, striato-punctatis, punctis linearibus, interstitiis secundo, tertio, quinto et septimo carinato-elevatis. Long. $2\frac{1}{4}$–$2\frac{1}{2}$ lin.

Hab. Western Australia.

My specimens from Champion Bay are much paler than those from Albany.

Enide æstuans.

E. nigra, squamis rufo-ferrugineis, maculatim ochraceis dense vestita; rostro prothorace longiore, magis subulato, basi lineis elevatis tenuiter munito; funiculi articulo secundo quam primo longiore; prothorace transverso, utrinque modice rotundato, sæpe ochraceo-quadrimaculato; elytris parum brevioribus, postice magis latioribus, maculis ochraceis numerosis sæpe ornatis, striato-punctatis, punctis linearibus, interstitiis convexis, secundo, tertio, quinto et septimo elevatis, in medio linea lævigata instructis, basi singulatim late emarginatis; corpore infra sparse flavescenti-squamoso; femoribus crassis, anticis margine superiore arcuatis; tibiis anticis longiusculis. Long. $1\frac{3}{4}$ lin.

Hab. Swan River (Albany).

Prothorax more transverse, the elytra broader posteriorly, and the base of each less deeply emarginate, are among the most prominent diagnostic characters of this species.

Enide saniosa.

E. nigra, squamis saturate ferrugineis, maculatim nigris ochraceisque dense vestita; rostro ut in præcedente; antennis pallide ferrugineis; oculis minus tenuiter granulatis; prothorace transverso, utrinque modice rotundato, fere unicolori; elytris striato-punctatis, punctis linearibus, interstitiis vix convexis, æqualibus, maculis nigris ochraceisque indeterminatis notatis; corpore infra sat sparse flavescenti-squamoso; femoribus minus incrassatis, anticis margine superiore vix arcuatis; tibiis anticis breviusculis. Long. $1\frac{1}{4}$ lin.

Hab. Fremantle.

This dark-coloured little species will be readily known from the two preceding by the absence of raised lines on the elytra.

HEDYOPIS.

Rostrum tenuiter cylindricum; *scrobes* præmedianæ, fere infra rostrum currentes. *Scapus* oculum haud attingens; *funiculus* articulis duobus basalibus elongatis, cæteris gradatim brevioribus, ultimis obconicis; *clava* distincta. *Oculi* ovati, tenuiter granulati. *Prothorax* subconicus, basi bisinuatus, lobis ocularibus nullis. *Elytra* breviuscula, prothorace multo latiora. *Femora* incrassata, mutica; *tibiæ* anticæ et intermediæ arcuatæ, apice bicalcaratæ, posticæ rectæ, apicem versus crassiores, spinoso-mucronatæ; *tarsi* articulo tertio late bilobo. *Abdomen* segmentis duobus basalibus ampliatis, tribus intermediis ad latera arcuatis.

Allied to *Erytenna*; but without ocular lobes, and the anterior and intermediate tibiæ having two spurs at the apex, the inner one the ordinary mucro, the other being claw-shaped and arising within the rim of the apex, as in many Cryptorhynchinæ. The species here described is not unlike *Sibinia arenariæ*.

Hedyopis selligera.

H. ovata, nigra, sat dense albido-squamosa, in medio plaga magna communi ochracea postice atro-marginata ornata; rostro nitido, fere nudo, vage punctulato; antennis ferrugineis; clava breviter ovata; prothorace latitudine longitudini æquali, utrinque paulo ampliato; scutello triangulari; elytris subcordatis, prothorace multo latioribus, striatis, humeris subcallosis, apice rotundatis; corpore infra pedibusque argenteo-squamosis; tibiis anticis longiusculis. Long. $1\frac{3}{4}$ lin.

Hab. Champion Bay.

GERYNASSA.

Rostrum cylindricum, arcuatum, apice latius; *scrobes* medianæ, laterales, obliquæ. *Scapus* oculum attingens; *funiculus* 7-articulatus, articulo primo ampliato, secundo vix breviore, cæteris brevibus, ultimis transversis; *clava* distincta. *Oculi* subrotundati, fortiter granulati. *Prothorax* transversus, antice constrictus, basi subtruncatus. *Scutellum* triangulare. *Elytra* ampla, prothorace multo latiora. *Pectus* brevissimum, haud canaliculatum. *Coxæ* anticæ contiguæ, intermediæ approximatæ. *Femora* crassa, mutica; *tibiæ* subflexuosæ, apice mucronatæ; *tarsi* articulo tertio bilobo, quarto elongato. *Abdomen* segmentis duobus basalibus ampliatis, tribus intermediis ad latera leviter arcuatis.

The coarsely faceted eyes and subtruncated base of the prothorax are the diagnostic characters of this genus, by which it may at once be differentiated from *Erytenna*; both genera, from the breadth of their elytra, have a similar contour.

Gerynassa nodulosa.

G. rufo-ferruginea, squamis griseis silaceisque variegata, plagis nigris basi prothoracis et circa scutellum notata, aliquando maculis aliis adspersa; rostro nitide ferrugineo, basin versus utrinque linea elevata instructo; antennis dilute ferrugineis; prothorace pone apicem sat abrupte convexo, utrinque ampliato; scutello nigro, triangulari; elytris supra inæqualiter striato-punctatis, interstitiis tertio et quarto singulatim tribus vel quatuor nodulis nigrosquamosis munitis, in medio fascia pallidiore ornatis, humeris paulo callosis; corpore infra pedibusque sejunctim griseo-squamosis. Long. 2 lin.

Hab. West Australia; South Australia.

Gerynassa basalis.

G. nigra, squamis ferrugineis et nigrescentibus variegata; rostro nitide ferrugineo, prothorace longiore, versus apicem obsolete impunctato; antennis ferrugineis, scapo apice valde clavato; funiculi articulo primo quam secundo paulo breviore; clava nigra; prothorace ut in præcedente; elytris supra æqualiter convexis, striato-punctatis, singulis basi plaga nigra ornatis, in medio et parte apicali nigrescentibus; corpore infra pedibusque sejunctim griseo-squamosis. Long. $2\frac{1}{4}$–$2\frac{3}{4}$ lin.

Hab. South Australia (Gawler).

Dicomada.

Rostrum tenuiter cylindricum, apice latius et crassius, arcuatum; *scrobes* submedianæ (in *D. terrea* præmedianæ), rectæ. *Scapus* oculum haud attingens; *funiculus* 7-articulatus, articulis duobus basalibus elongatis, vel primo solo elongato; *clava* distincta. *Oculi* tenuiter granulati. *Prothorax* transversus, postice dilatatus, basi rotundatus, vel parum bisinuatus, lobis ocularibus nullis. *Elytra* subcordiformia, leviter convexa; prothorace paulo latiora. *Pectus* breviusculum. *Coxæ* intermediæ sat remotæ; *femora* incrassata, mutica; *tibiæ* flexuosæ, apice mucronatæ; *tarsi* lati, articulo quarto breviusculo. *Abdomen* segmentis duobus basalibus ampliatis, tribus intermediis ad latera arcuatis.

Of the three species here described, *D. terrea* has a shorter and proportionally stouter rostrum, with the scrobes more towards the apex; the rostrum, however, is in other respects essentially the same. *Cydmæa* has the rostrum attenuated throughout, and the apex compressed when viewed sideways.

Dicomada litigiosa.

D. fusca, squamis concoloribus argenteisque varie vestita; rostro prothorace sesquilongiore, vix squamoso, basi subtiliter lineatim punctulato; antennis subtestaceis, funiculo gracili; prothorace apice multo angustiore, utrinque rotundato; elytris oblongo-subcordiformibus, striato-punctatis, interstitiis convexis; corpore infra argenteo-squamoso; pedibus ferrugineis, parce squamosis. Long. $1\frac{1}{2}$ lin.

Hab. Fremantle.

In the individual here described there are three lightly marked stripes on the prothorax, and an ill-defined band on the middle of the elytra; but in others there is simply a faint mottling of brown only to be seen under a good lens.

Dicomada ovalis.

D. ferruginea, subtus prothoraceque nigrescentibus, squamis subaureis parce adspersa; rostro prothorace manifeste longiore, piceo, apice pallidiore, scrobibus paulo pone medium incipientibus; funiculi articulo primo quam secundo duplo longiore; prothorace antice latiore, utrinque pone apicem paulo dilatato, lateribus leviter rotundato; elytris breviter subcordiformibus, striato-punctatis, interstitiis haud convexis, in medio uniseriatim setulosis; pedibus rufo-ferrugineis, parce squamosis. Long. 1 lin.

Hab. Swan River (Albany).

The shorter elytra and somewhat subequilateral form of the prothorax are at once distinctive of this species.

Dicomada terrea.

D. nigra, subsilaceo-squamosa, medio prothoracis fusco; rostro minus tenui, prothorace vix longiore, basi lineis quinque elevatis munito; scrobibus apicem versus incipientibus; antennis ferrugineis; funiculi articulo primo quam secundo paulo longiore; prothorace apice multo angustiore, utrinque rotundato, in medio longitudinaliter fusco; elytris oblongo-cordiformibus, striis obtectis; corpore infra nigro, squamis albidis adsperso; pedibus ferrugineis, parce squamosis. Long. $1\frac{1}{2}$ lin.

Hab. Champion Bay.

The scales, without being very closely set, completely hide the narrow striæ of the elytra.

PARYZETA.

Rostrum tenuiter cylindricum, arcuatum, versus apicem gradatim latius; *scrobes* submedianæ, obliquæ. *Scapus* oculum attingens; *funiculus* 7-articulatus, articulo primo elongato, incrassato, cæteris minusculis; *clava* ampla, distincta. *Oculi* ovales, tenuiter granulati. *Prothorax* transversus, basi rotundatus, lobis ocularibus nullis. *Elytra* prothorace multo latiora, oblongo-cordiformia. *Femora* incrassata, mutica; *tibiæ* subarcuatæ, apice obsolete mucronatæ; *tarsi* articulo tertio late bilobo, quarto elongato. *Coxæ* intermediæ approximatæ. *Abdomen* segmentis duobus basalibus ampliatis, tertio quartoque ad latera paulo arcuatis.

The characters of the rostrum and the narrower elytra are those which principally distinguish this genus from *Xeda*. *Erirhinus infirmus* will give a good idea of the following species.

Paryzeta musiva.

P. ovata, ferruginea vel fusca, dense griseo-squamosa; rostro antennisque fulvo-testaceis, clava nigricante, illo prothorace sesquilongiore, basi sparse piloso, apice nudo, subtilissime vage punctulato; prothorace antice multo angustiore, utrinque fortiter rotundato; elytris basi parum convexis, lateribus ad medium subparallelis, deinde rotundatis, striatis, interstitiis planatis, fasciis duabus indeterminatis, aliquando obsoletis, ad suturam interruptis, una in medio, altera ante apicem sita; corpore infra pedibusque ferrugineis, sat dense albido-squamosis. Long. $1\frac{1}{2}$ lin.

Hab. Champion Bay.

XEDA.

Rostrum breviusculum, cylindricum, arcuatum; *scrobes* submedianæ, laterales, paulo obliquæ, ante oculos desinentes. *Scapus* in oculum impingens; *funiculus* 7-articulatus, articulo primo valido; *clava* distincta, acuminata. *Oculi* ovati, laterales, ampliati, tenuissime granulati. *Prothorax* transversus, subconicus, basi rotundatus; lobis ocularibus nullis. *Elytra* ampliata, paulo convexa. *Pectus* breve. *Coxæ* anticæ contiguæ, intermediæ approximatæ; *femora* incrassata, mutica; *tibiæ* paulo arcuatæ vel subflexuosæ, apice mucronatæ; *tarsi* articulo tertio bilobo, quarto elongato; *unguiculi* divaricati. *Abdomen* segmentis duobus basalibus ampliatis, tribus intermediis lateraliter paulo arcuatis.

This genus differs from *Cydmæa* (*antè*, vol. ix. p. 137) in its scape impinging on the eye, in the absence of ocular lobes, and in the approximation of the intermediate coxæ. The two species here described are somewhat remarkable for the large size of the elytra; of the first there is a small variety with more mottled elytra.

Xeda amplipennis.

X. nigra, varie griseo-squamosa; rostro prothorace vix longiore, nigro, punctulato, basi linea lævigata munito; antennis ferrugineis, clava nigra; funiculi articulo basali tribus sequentibus conjunctim vix breviore; prothorace basi longitudine fere duplo latiore, saturatim bivittato; scutello rotundato; elytris striato-punctatis, interstitiis haud convexis, pone medium fascia maculata nigra angusta ornatis; corpore infra femoribusque nigris, dense argenteo-squamosis; tibiis tarsisque ferrugineis, squamis angustis adspersis. Long. $1\frac{1}{2}$ lin.

Hab. Swan River (Albany).

Xeda bilineata.

X. picea, fusco-squamosa, prothorace elytrisque dorso linea interrupta albida utrinque ornatis; rostro prothorace paulo breviore, basi excepta, læte fulvo; antennis fulvo-ferrugineis, clava nigricanti; funiculi articulo basali duobus sequentibus conjunctim vix longiore; prothorace basi angustiore, utrinque rotundato, sejunctim punctato; scutello minuto; elytris striato-punctatis, interstitiis 4°, 5°, 6° plus minusve albido-squamosis, postice setulis albis raris munitis; corpore infra nigro, argenteo-squamoso; apicibus femorum, tibiis tarsisque fulvo-ferrugineis. Long. $1\frac{2}{3}$ lin.

Hab. Champion Bay.

One of my specimens, which I take to be a female, has a longer unicolorous rostrum.

Olanæa.

Rostrum paulo arcuatum, apicem versus tenuius; *scrobes* præmedianæ, obliquæ, infra rostrum cito currentes. *Scapus* longiusculus, oculo impingens; *funiculus* 7-articulatus, articulo primo majusculo, cæteris breviter obconicis; *clava* distincta. *Oculi* minusculi, tenuiter granulati. *Prothorax* angustior, postice rotundatus, basi subtruncatus, lobis ocularibus nullis. *Elytra* oblonga, prothorace multo latiora. *Femora* clavata, mutica; *tibiæ* subflexuosæ, apice mucronatæ; *tarsi* articulo tertio bilobo, quarto elongato. *Coxæ* intermediæ approximatæ. *Abdomen* segmentis duobus basalibus ampliatis, tribus intermediis ad latera arcuatis. *Corpus* setosum.

This genus is trenchantly differentiated by the direction of its scrobes and the absence of scales, except on the under parts. Its affinities are doubtful.

Olanæa nigricollis.

O. ovalis, ferruginea, capite, rostro basi, prothorace, elytrisque marginibus suturaque nigris; rostro prothorace paulo longiore, usque ad medium parce albido-setosis; antennis ferrugineis; funiculi articulo primo quam secundo fere duplo longiore; prothorace longitudine parum latiore, utrinque rotundato, crebre punctulato, setulis erectis adsperso; elytris oblongo-subcordiformibus, striato-punctatis, interstitiis uniseriatim setosis; corpore infra nigro, albo-squamoso. Long. $1\frac{1}{3}$ lin.

Hab. Swan River (Albany).

Antyllis.

Rostrum longiusculum, cylindricum, vel apicem versus paulo attenuatum; *scrobes* submedianæ, laterales, infra oculos desinentes. *Scapus* oculum attingens; *funiculus* 6-articulatus, articulis duobus basalibus breviusculis, cæteris transversis. *Oculi* minores. *Cætera* ut in *Xeda.*

In general appearance like *Xeda*, but very trenchantly differentiated by its six-jointed funicle.

Antyllis setosa.

A. fusca, pedibus rufo-ferrugineis, unguiculis nigris, supra sat denso griseo-, in medio cervino-squamosa; rostro griseo-setoso, dimidio apicali rufo-ferrugineo; antennis ferrugineis, clava nigricante; prothorace manifeste transverso, utrinque valde rotundato; elytris subcordatis, striato-punctatis, interstitiis uniseriatim albido-setosis; corpore infra albido-squamoso. Long. $1\frac{1}{2}$ lin.

Hab. South Australia.

Antyllis griseola.

A. picea, pedibus ferrugineis, unguiculis nigris, supra minus dense griseo-, in medio cervino-squamosa; rostro magis subulato, dimidio apicali ferrugineo; scapo articuloque basali funiculi ferrugineis, reliquis clavaque nigris; prothorace angustiore, longitudine latitudini fere æquali; elytris striato-punctatis, interstitiis haud setosis; corpore infra dense argenteo-squamoso. Long. $1\frac{1}{3}$ lin.

Hab. Swan River (Albany).

Differs from the last principally in its longer prothorax and absence of setæ from the elytra.

Antyllis aurulenta.

A. pallide ferruginea, dense aureo-rufescenti-squamosa, setulis albis numerosis adspersa; rostro prothorace paulo breviore, sparse albo-setoso, dimidio apicali nigro; antennis pallidis; clava nigricante; prothorace longitudine latitudini fere æquali, utrinque leviter rotundato; elytris breviter subcordatis, striato-punctatis, interstitiis uniseriatim sat confertim setosis; corpore infra pallide flavescenti-squamoso. Long. $1\frac{1}{4}$ lin.

Hab. Champion Bay.

A shorter species proportionally than either of the two preceding; under a Coddington the scales appear of a beautiful golden brown (reddish), but in certain lights a little hoary.

CYTTALIA.

Caput deflectum, angustum; *rostrum* cum capite gradatim confluens, subtenue; *scrobes* subapicales, infra rostrum cito currentes. *Scapus* ad marginem posticum oculi attingente; *funiculus* 7-articulatus, articulis duobus basalibus longiusculis, primo crassiore, cæteris gradatim brevioribus; *clava* distincta. *Oculi* prominuli, fortiter granulati. *Prothorax* transversus, antice paulo constrictus, basi truncatus, lobis ocularibus nullis. *Elytra* ovalia, prothorace latiora. *Femora* incrassata, postica dentata; *tibiæ* flexuosæ, apice inermes; *tarsi* articulo tertio lato, fortiter bilobo; *unguiculi* divergentes. *Coxæ* anticæ exsertæ, contiguæ. *Abdomen* segmentis duobus basalibus ampliatis. *Corpus* pilosum.

A very distinct genus, which agrees with *Phrenozemia* in its narrow head gradually passing into the rostrum; but it is pubescent or pilose and not scaly, and its hind femora only are toothed. The prothorax is unusually small compared with the elytra. The two species of the genus, the second of which is from New Zealand, are not unlike *Orchestes fagi*, but considerably larger.

Cyttalia griseipila.

C. oblongo-ovalis, fusca, subnitida, omnino subtiliter griseo-pilosa, supra setulis erectis adspersa; rostro prothoraci longitudine æquali, carinula in medio ante apicem desinente; antennis subtestaceis, scapo apice clavaque nigricantibus; prothorace latitudine paulo breviore, crebre punctato, utrinque modice rotundato; scutello minuto, triangulari; elytris quam prothorace ampliatis, et plus quadruplo longioribus, substriato-punctatis, punctis paulo approximatis; pedibus posticis longioribus; tibiis longiusculis. Long. 2 lin.

Hab. Sydney.

Phrenozemia lunata.

P. oblonga, fusca, squamositate sordide grisea tecta, squamulis piliformibus adspersa; rostro nigro, confertim punctato, basi squamoso; antennis ferrugineis, funiculi articulo primo valde incrassato, secundo tertioque conjunctim manifeste brevioribus; prothorace cylindrico; elytris striato-punctatis, interstitiis alternis fortiter elevatis, tertio quintoque singulatim versus apicem tuberculo parvo instructis, pone medium litera V-reversa, nigro-marginata, signatis. Long. $1\frac{3}{4}$ lin.

Hab. Western Australia (Fremantle).

Size and outline of *P. lyproides* (*antè*, vol. x. p. 95), but, *inter alia*, at once differentiated by the raised alternate interstices of the elytra; the coloration and, indeed, the general appearance can scarcely fail to recall our *Gronops lunatus*. In the generic formula, owing to some agglutination of the hairs in the specimen I examined, the second and third joints of the funicle were described as one; in reality, however, *P. lyproides* has the second joint considerably shorter than the first, as in this species.

Meriphus coronatus.

M. griseo-setulosus, vix nitidus; capite supra nigro; rostro capite fere duplo longiore, subferrugineo, apice nigro; antennis subferrugineis, funiculo clavaque infuscatis; prothorace basi minus dilatato, crebre rugoso-punctato, silaceo, margine antico nigro; elytris silaceis, scutello suturaque nigris, rude striato-punctatis, singulis basi emarginatis, humeris callosis; corpore infra nigro, squamis niveis rotundatis elongatis intermixtis adsperso; pedibus ferrugineis, femoribus in medio nigris. Long. 2 lin.

Hab. West Australia.

Besides the difference of colour, this species has the prothorax narrower at the base, and the elytra on each side of the scutellum are projected forward, the part between this and the shoulder showing a deep emargination.

Brexius lineatus.

B. oblongus, niger, squamulis piliformibus griseis adspersus; rostro prothorace breviore, antice carinulis quinque manifeste munito; scrobibus terminalibus; antennis subferrugineis, clava infuscata; prothorace paulo longiore quam latiore, confertissime granulato-punctato; elytris striato-punctatis, interstitiis in medio uniseriatim setosis, alternis paulo elevatis, sexto sordide albido; corpore infra nitide castaneo, parce setoso; femoribus infuscatis; tibiis tarsisque subferrugineis, longe pilosis. Long. 3 lin.

Hab. Melbourne.

A dark, almost black, species, notwithstanding its greyish scales; the scrobes are completely terminal. I placed *Brexius* with the Amalactinæ on account of its cavernous corbels, the only character apparently that separates it from the Erirhininæ.

Psepholax Mastersii.

P. ovalis, fuscus, opacus, disperse squamosus; capite inter oculos excavato; rostro brevi, antice et inter oculos dense ferrugineo-hirsuto; antennis ferrugineis; prothorace transverso, antice multo angustiore, utrinque fortiter rotundato, creberrime granulato-punctato; elytris striato-punctatis, interstitiis convexis, sat confertim granulatis; tibiis intermediis in medio dente magno instructis. Long. 4 lin.

Hab. Wide Bay (Queensland).

Differs from *P. barbifrons*, Wh. (Ereb. & Terr., Ins. p. 15), in its more closely punctured prothorax, with the intervals granuliform, the different form of the intermediate tibiæ, &c. This and the two following species are interesting as belonging to a genus hitherto supposed to be peculiar to New Zealand.

Psepholax egerius.

P. obovatus, fuscus, vix nitidus, rostro breviusculo, basi antice et inter oculos pallide barbato; antennis ferrugineis, longioribus; prothorace transverso, apice subito constricto, creberrime granulato-punctato; elytris oblongo-cordatis, striato-punctatis, interstitiis convexis, dense ferrugineo-squamosis, pygidio detecto; tibiis intermediis dente magno instructis. Long. $3\frac{1}{2}$ lin.

Hab. Queensland.

I am indebted to Dr. Howitt for my specimens of this species. It may be known at once from the preceding by its outline, dependent on its short prothorax, suddenly narrowed anteriorly, and its cordiform elytra.

Psepholax latirostris.

P. cylindricus, fuscus, parum nitidus, squamis concoloribus griseo irroratis vestitus; rostro brevi, latissimo, crebre punctato; oculis ovalibus, inter se valde remotis; antennis ferrugineis, scapo in oculum impingente; prothorace latitudine parum longiore, antice angusto, utrinque modice rotundato, confertim punctato; elytris longiusculis, striato-punctatis, interstitiis parum convexis, sat confertim granulatis; tibiis intermediis margine exteriore edentatis. Long. 4 lin.

Hab. Illawarra.

It would be better perhaps to consider this species the exponent of a new genus.

Poropterus satyrus.

P. oblongo-ovatus, convexus, niger, omnino pallide umbrino-squamosus; capite inter oculos foveato; rostro modice tenuato, basi irregulariter sat vage punctato; antennis piceis; funiculi articulo secundo quam primo fere duplo longiore; clava ovata, acuminata; prothorace modice convexo, apice vix producto, utrinque fortiter rotundato, basi versus scutellum paulo lobato, supra squamis erectis claviformibus adsperso; elytris convexis, pone medium latioribus, postice gradatim declivibus, apicibus rotundatis, epipleuris distinctis, supra tuberculato-fasciculatis, granulis nitidis paucis prope scutellum obsitis; segmento ultimo abdominis tribus præcedentibus conjunctim longitudine æquali; tibiis subtenuatis, manifeste flexuosis; tarsis articulo tertio sat fortiter bilobo. Long. 8–9 lin.

Hab. Tasmania.

A large coarse species, in outline like *P. antiquus*, Er., which has, *inter alia*, the first two joints of the funicle equal in length, and shorter, nearly straight, tibiæ.

Poropterus inominatus.

P. ovatus, minus convexus, niger, umbrino-squamosus; capite inter oculos foveato, fronte carinato; rostro basi confertim, apicem versus gradatim minus punctato; funiculi articulo secundo quam primo fere duplo longiore; clava ovata, obtusa; prothorace ut in *P. satyro*, sed apice parum bituberculato; elytris brevioribus, basi circa scutellum paulo depressis et squamulis concoloribus arcte adpressis, apicem versus magis constrictis, singulis fasciculis duobus nigricantibus (una subbasali, altera paulo pone medium) notatis, apice rotundatis; corpore infra pedibusque dense squamosis, squamis claviformibus erectis interjectis. Long. 7 lin.

Hab. Queensland.

This species resembles the preceding; but is shorter, less convex, the parts behind the carina, marking the upper margin of the epipleura, abruptly constricted, and the scales at the base of the elytra concolorous with and closely fixed to the derm, the part, except under a strong lens, appearing denuded.

Poropterus varicosus.

P. ovatus, convexus, niger, capite rostroque umbrino-squamosis; funiculi articulo secundo quam primo duplo longiore, cæteris rotundatis vel submoniliformibus; prothorace apice paulo producto, utrinque manifeste rotundato, tuberculis sex inconspicuis notato—duobus apicalibus, quatuor in medio transversim sitis; elytris pone medium latioribus, singulis interrupte bicarinato-fasciculatis, apice late rotundatis, epipleuris haud determinatis; tibiis brevibus, validis, manifeste flexuosis. Long. 5 lin.

Hab. Illawarra.

Much the same kind of outline as the two preceding, but more convex, the flanks of the elytra not marked off by a carina, shorter and stouter tibiæ, &c.

Poropterus oniscus.

P. ovatus, sat fortiter convexus, niger, capite rostroque squamis umbrinis tectus; rostro valido; scapo breviusculo, ante medium rostri inserto; funiculi articulo secundo quam primo sesquilongiore; oculis fortiter granulatis; prothorace antice modice constricto, apice paulo angustiore, vix producto, utrinque rotundato, tuberculis fasciculatis sex notato—duobus apicalibus, quatuor transversis; elytris ovalibus, in medio quam prothorace multo latioribus, seriatim punctatis, interspatiis subtuberculiformibus, squamis majoribus erectis adspersis, basi paucifasciculatis, apice rotundatis; segmentis duobus basalibus abdominis valde ampliatis; tibiis breviusculis, flexuosis. Long. 4 lin.

Hab. Queensland.

The antennæ in nearly all the species of *Poropterus* are inserted not far from the tip of the rostrum; in this one the insertion is nearer the middle.

Poropterus tumulosus.

P. ovatus, modice convexus, fuscus, omnino squamis pallide umbrinis dense tectus; rostro valido; funiculo articulis duobus basalibus haud elongatis, primo quam secundo fere æquali, cæteris transversis; clava ovali; oculis tenuissime granulatis; prothorace antice multo angustiore, apice producto, crebre punctato, in medio longitudinaliter excavato, tuberculis duodecim instructo—duobus apicalibus, decem in seriebus duabus transversis sitis; elytris breviter ovatis, pone medium prothorace multo latioribus, postice fortiter declivibus, singulis tuberculis validis circa viginti subseriatim positis, apicibus rotundatis; segmentis duobus basalibus abdominis valde ampliatis; tibiis brevibus, anticis flexuosis, reliquis rectis. Long. 3 lin.

Hab. South Australia; Tasmania.

This little species will be easily recognized by the numerous tubercles on the elytra.

Rhinoncus nigriventris.

R. ovatus, subnitidus, supra pedibusque ferrugineus, parce subtiliter pilosus, sternis abdomineque nitide nigris; rostro breviusculo, sat valido; prothorace crebre punctato, basi nigro-marginato; elytris cordiformibus, striato-punctatis, interstitiis valde convexis, sutura basi albido-squamosa; corpore infra modice punctato. Long. $1\frac{1}{3}$ lin.

Hab. Queensland (Gayndah).

Rhinoncus was, with one exception, a purely European genus; there are, however, a number of European genera with representatives, not yet described, in Australia; some of them are also found in the Malasian region. This species is very distinct, and, with all the others from Gayndah mentioned above, have been kindly sent to me by Mr. Masters, whose successful explorations I have had so often to mention.

Erratum.

In vol. ix. p. 139, under *Ochrophabe*, "scrobes antemedianæ" should have been "scrobes postmedianæ."

XXII.—*On the Silurus and Glanis of the Ancient Greeks and Romans.* By the Rev. W. Houghton, M.A., F.L.S.

There appears to be no doubt that the sheatfish (*Silurus glanis*, Linn.), which has of late years attracted some attention in this country, was known to the ancient Greeks and Romans under the names of *silurus* (σίλουρος) and *glanis* (γλανίς), although some of the writers make a distinction between the names, and the silurus of one author does not necessarily represent the silurus of another. "The controversies and concessions of perplexed critics," as the late Dr. Badham remarks, "caused by this confusion in the ancient nomenclature is amusing. Poor Scaliger, having first asserted that the glanis and silurus were different fish, and the silurus certainly the sturgeon, nexts doubts, and lastly becomes convinced, that the silurus was unknown to Aristotle; and after breaking his head to reconcile what was quite irreconcilable, he offers Cardan, at last, to give up the controversy altogether, on one condition—

viz. that if he himself consents no longer to dispute the identity of the glanis and silurus, Cardan on his side must forbear to teach or listen to others who would make him believe that the silurus was the sturgeon. 'Itaque,' says he (laying down the conditions), 'silurus sane esto qui et glanis, modo ne glanim quis dicat sturionem.'" (Prose Halieutics, p. 305, note; see also Scaliger, Exerc. ad Card. 218. n. 3.)

Let us note what classical writers have written as to the silurus and glanis.

Aristotle, in his 'History of Animals,' does not once mention the silurus by name; but speaks of a fish called glanis, which he says has a tail like a cordylus (newt), that it produces its ova in a mass (*συνεχὲς ἀφιᾶσι τὸ κύημα*) like perch and frogs, that large individuals deposit them in deep water, but the smaller ones in shallow water near the roots of willows amongst weeds and aquatic plants, that the male glanis is very careful of the young fry and continues to watch by the eggs and young for forty or fifty days to protect them from other fish, that the ova of the glanis are as large as the seed of the orobus, that it has four branchiæ on each side, all divided except the last, that the female glanis is better to eat than the male (an exception, Aristotle thinks, to fish in general in this respect), that this fish, from swimming near the surface, is sometimes star-struck and stupified by thunder, that, if it has ever once swallowed a hook, it will bite and destroy the hook with its hard teeth. This is, I believe, all that the Stagirite has written about the glanis; and with the exception perhaps of the male of this fish guarding its eggs and young fry, there is hardly any thing left by means of which the glanis can be identified. Aristotle nowhere speaks of the great size to which the sheatfish grows, though he mentions large and small individuals; again, the glanis is represented as swimming near the surface, whereas the sheatfish, like the Siluridæ generally, inhabits the bottom of the water.

Ælian appears to consider the glanis and silurus distinct species of the same family. He speaks of the glanis as being found in the Mæander (Mendere) and Lycus (Tchoruk-Su), rivers of Asia (Minor), also in Europe in the Strymon (Struma or Carasou), and says it resembles the silurus. He mentions the fondness of the male for its eggs, but here, perhaps, is only quoting Aristotle.

Of the silurus, however, Ælian gives us some interesting and definite information. He tells us that "in the Egyptian city of Bubastis there is a pond in which are preserved a great number of siluri, which are quite tame and gentle; the people throw them pieces of bread; and the fish jump about one before the other in their desire to seize the morsels. This fish is also found in rivers, as in the Cydnus (Tersoos) in Cilicia; but here it is small, the reason of which is that the clear pure water of this river, which is moreover very cold, does not supply the fish with abundant food, the siluri loving disturbed and muddy water, in which they fatten. The Pyramus (Jihun) and Sarus (Sihun), also Cilician rivers, produce much finer specimens. The siluri are also found in the Syrian Orontes (Nahr el Asy), in the river of the Ptolemies (Belus, the modern Nahr N'mân, which enters the Mediterranean near Ptolemais in Palestine), and in the lake of Apameia, where they grow to a large size." (Nat. Hist. xii. 29.)

Ælian is probably correct in all that he has stated here. The Siluridæ are still found in the Syrian rivers, as we learn from Russell, in his 'Natural History of Aleppo,' and from Häckel, who enumerates three genera. The lake of Apameia, in which the siluri are said by Ælian to grow to a large size, appears to be identical with Ayn el Taka ("a large spring issuing from near the foot of a mountain, and forming a small lake which communicates with the Orontes"), visited and described by Burckhardt in 1812. This traveller says that the temperature of the spring is "like that of water which has been heated by the sun in the midst of summer; it is probably owing to this temperature that we observed such vast numbers of fish in the lake, and that they resort here in the winter from the Orontes; it is principally the species called by the Arabs the black fish, on account of its ash-coloured flesh; its length varies from 5 to 8 feet." The fishery was in Burckhardt's time in the hands of the governor of Kalât el Medyk (*i. e.* castle of Medyk), the ancient Apameia, capital of the province of Apamene, which Seleucus Nicator fortified and called after the name of his wife. The fish were principally caught during the night in small boats, with harpoons, in enormous quantities; they were salted on the spot and carried all over Syria and to Cyprus, for the use of the Christians during their fasts. The governor of Kalât el Medyk derived income from this fishery amounting to about £3000. The lake is about 10 feet deep; "its breadth is quite irregular, being seldom more than half an hour; its length is about one hour and a half." There seems to be no doubt that the species of Siluroid spoken of by Ælian as inhabiting this lake is the *Silurus anguillaris* figured by Russell (Aleppo, ii. pl. 8), who says the market is plentifully supplied with this fish from winter till March; it comes, he says, from the Orontes and stagnant waters near that river. "Though it has a rank taste, resembles coarse beef in colour, and by the doctors is considered unwholesome, it is much eaten by the Christians. It is vulgarly called the black fish (*Simmak al Aswad*); but the natives affirm the proper name to be Siloor." (ii. p. 217.) It would be interesting to know whether modern travellers have visited this lake and reported on its fish. The *Silurus anguillaris*, Linn., is perhaps the *Clarias Orontis* mentioned by Dr. Günther.

In chapter 25 of Ælian's 14th book there is the following account of a curious method of catching siluri, pursued by the ancient Mysian inhabitants of Scythia and the Danubian districts, which is interesting and amusing. The species of fish here referred to is, I presume, the large European *Silurus glanis*. "An Istrian fisherman drives a pair of oxen down to the river-bank, not, however, for the purpose of ploughing; for as the proverb says there is nothing in common between an ox and a dolphin, so we may say, what can a fisherman's hands have to do with the plough? If a pair of horses are at hand, then the fisherman makes use of horses; and with the yoke on his shoulders down he goes and takes his station at a spot which he thinks will make a convenient seat for himself, and be a good place for sport. He fastens one of the ends of the fishing-rope, which is very strong and suitable, to the middle of the yoke, and supplies either the horses or the oxen, as the case may be, with sufficient fodder, and the beasts take their fill. To the other end of the rope he fastens a very strong and sharp hook baited with the lung of a wild bull; and this he throws into the water as a lure to the Istrian silurus (a very sweet lure for the fish), having previously attached a piece of lead of sufficient size to the rope near the place where the hook is bound on, for the purpose of regulating its position in the water. When the fish perceives the bait of bull's flesh, he rushes immediately at the prey, and, meeting with what he so dearly loves, opens wide his great jaws and greedily swallows the dreadful bait; then the glutton, turning himself round with pleasure, soon finds that he has been pierced unawares with the hook, and being eager to escape from his calamity, shakes the rope with the greatest violence. The fisherman observes this, and is filled with delight; he jumps from his seat, and—now in the character of a fisherman, now in that of a ploughman (like an actor who changes his mask in a play)—he urges on his oxen or his horses, and a mighty contest takes place between the monster (κῆτος) and the yoked animals; for the creature (the foster-child of the Ister) draws downwards with all his might, while the yoked animals pull the rope in the opposite direction. The fish is beaten by the united efforts of two, gives in, and is hauled on to the bank."

The sheatfish, it is well known, still occurs in the Danube, and often grows to an enormous size; so that Ælian's account of fishing for it may hardly be exaggerated. Some years ago there was an amusing drawing in 'Punch's Almanac' of an angler, whose fishing-apparatus consisted of a portable crane on wheels with ropes and pulleys, fishing for these same siluri, in case of their ever growing to a gigantic size in the rivers of this country.

It is not quite certain whether Pliny meant to distinguish between the silurus and the glanis. Of the latter he only says, "cautius qui glanis vocatur, aversos mordet hamos, nec devorat sed esca spoliat" (Nat. Hist. ix. 43). He may here be referring to what Aristotle says in the passage I have quoted above. Of the silurus he says that it inhabits a lake called Nilides, formed by the Nile (v. 9), also that it occurs in the rivers of the Fortunate Islands (Canaries) (vi. 32). He enumerates the silurus of the Nile amongst the fish which grow to an enormous size, speaks of the devastation it commits, and adds that it sometimes drags horses under the water as they swim (ix. 15); the male takes care of the eggs (ix. 51). Athenæus quotes old writers who appear to regard the glanis and silurus as distinct fish; the glanis is always much esteemed as a dainty dish. Matron, the parodist, mentions this fish, with numerous others, as one of the choice items at an Attic banquet (Athenæus, iv. 136, c). Athenæus compares a large fish found in the Nile to the fish called glanis which is found in the Danube (vii. 311, f). He mentions the silurus four times. In one passage he merely names it as one he remembered when he was in Egypt (vii. 312, b); in another passage (vii. 287, b) he asks "why people do not call the fish *σείουρος* instead of *σίλουρος*, as he has his name from constantly shaking his tail (*ἀπό τοῦ σείειν τὴν οὐράν*)." In other passages the word silurus is used with the epithet "bad" or stinking, as Sopater the parodist writes (vi. 230, e):

Σαπρὸν σίλουρον ἀργυροῦς πίναξ ἔχων

("a stinking silurus on a silver dish"); and Diodorus of Sinope, speaking of flattering parasites, says that if a man were to eat cabbages and stinking siluri they would immediately say that his breath smelt delightfully of violets and roses:

οἷς ἐπειδὴ προσερύγοι,
ῥαφανῖδας ἢ σαπρὸν σίλουρον καταφαγὼν,
ἴα καὶ ῥόδ' ἔφασαν αὐτὸν ἠριστηκέναι.
(vi. 239, e.)

And the bad quality attributed to the silurus by Athenæus reminds one of what Juvenal has said to the same effect. He reminds Crispinus of his low birth and former low occupation, when he used to hawk about siluri for sale in the streets of Alexandria:—

> Iam princeps Equitum, magna qui voce solebat
> Vendere municipes fricta de merce siluros.
> (*Sat.* iv. 32, 33.)

And the miser puts by for to-morrow's dinner the summer bean, a bit of lizard-fish, with half a stinking silurus:—

> nec non differre in tempora cænæ
> Alterius conchem æstivam cum parte lacerti
> Signatam vel dimidio putrique siluro.
> (*Sat.* xiv. 130.)

Several kinds of *Siluri* are now found in the Nile; and it is probable that Juvenal is referring to some small-sized fish of that family which was much used by the poor people. Both the lacertus and the silurus were salted and sent over to Rome, just as we have seen the black fish from the lake of Apameia were salted and sent to Aleppo, as recorded by Burckhardt and Russell. The "fricta de merce" appears to allude to the mode in which the fish were prepared. "Pisces fricti," says Apicius, "ut diu durent, eodem momento quo friguntur et levantur, aceto calido perfunduntur." Both Diodorus and Lucian tell us that the Egyptians used to export large quantities of salt fish. "The Nile," says Diodorus (i. 36), "produces all kinds of fish in great abundance; it not only supplies abundant food which is eaten fresh by the natives, but an endless number (πλῆθος ἀνέκλειπτον) which are salted and sent abroad." Lycinus (in Lucian, Navigium, cap. xv.) implores his friend "by Isis, to remember to bring him from Egypt the little salted fish of the Nile, or ointment from Canopus, or an ibis from Memphis, or" (he jocularly adds) "if his ship was big enough, even one of the pyramids."

The "stinking siluri" of Athenæus and Juvenal therfore no doubt allude to salted fish which, from being often hastily and carelessly prepared and hawked about the streets of Rome or other towns in the hot month of September, would merit the epithet applied to them.

Pausanias (Græciæ Descrip. iv. cap. xxxiv.) says that "the Grecian rivers do not produce creatures destructive to man, as the Indus, the Egyptian Nile, the Rhine, the Ister, Euphrates, and Phasis; for these rivers nourish creatures which devour men, and in form they resemble the *glanides* of Hermus and the Mæander, excepting that they are blacker and stronger."

From the passages quoted it seems that various kinds of *Siluri* were known to the ancient Greeks and Romans, sometimes under the name of silurus, sometimes under that of glanis.

They do not mention them as fishes either of Greece or Italy; and I believe no species of this family is now found in the rivers of those countries. With regard to the male (*Silurus glanis*) protecting its fry, I am not aware whether any modern observer has recorded this circumstance. It is well known that some male members of the Siluridæ make nests and watch over their eggs and young ones, like the sticklebacks of this country. Dr. Hancock has described two species of the genus *Doras* (the round-headed and flat-headed hassars of Demerara) which evince great care for their young; and I believe Agassiz has noticed the same thing in two other genera of the same family. The males of *Arius fissus* and *A. Commersonii* carry the eggs in their mouth, the latter species even hatching them there. The peasants of Wallachia say that the males of *Silurus glanis* protect their young.

There is one more passage which requires a little consideration. In this one it is certain that the name *silurus* does not stand for any of the Siluridæ, but must mean a sturgeon. Even at the risk of disturbing the manes of J. C. Scaliger and Cardan I maintain that the silurus of the Moselle as sung of by Ausonius can be nothing else than a sturgeon.

Here are Ausonius's lines :—

> Nunc pecus æquoreum celebrabere magne Silure:
> Quem velut Actæo perductum tergora olivo
> Amnicolam Delphina reor; sic per freta magnum
> Laberis, et longi vix corporis agmina solvis
> Aut brevibus defensa vadis, aut fluminis ulvis:
> Aut cum tranquillos moliris in amne meatus,
> Te virides ripæ, te cærula turba natantum,
> Te liquidæ mirantur aquæ: diffunditur alveo
> Æstus, et extremi procurrunt margine fluctus.
> Talis Atlantiaco quondam Balæna profundo,
> Cum vento motuve suo telluris ad oras
> Pellitur, exclusum fundit mare, magnaque surgunt
> Æquora, vicinique timent decrescere montes.
> Hic tamen, hic nostræ mitis Balæna Mosellæ,
> Exitio procul est, magnoque honor additus amni.
>
> (Auson. *Id.* x. 135–149.)

Hardly a single sentence in this description can apply to the *Silurus glanis*: the arrow-like dartings of the unbending body cannot possibly refer to the sluggish, slow-swimming, mud-loving sheatfish; the voracious silurus can never be called "mitis Balæna:" but the whole description is well suited either to the common sturgeon or to the huso. The name river-dolphin is applicable not only in some degree to the general form of the sturgeon, but especially to the shape of its head; the "pecus æquoreum" may refer to the gregarious habits of that fish; "mitis Balæna" is equally applicable to the mild and inoffensive sturgeon, while the "agmina defensa corporis" seem to allude to the bony plates on that fish's body. There are, it is true, other classical designations for the sturgeon more generally used, such as acipenser and helops; but in this passage of Ausonius, *silurus* certainly stands for that fish. Whether sturgeons are now found in the Moselle I am unable to say.

The flesh of the silurus formed part of the ancient pharmacopœia. Dioscorides (Mat. Med. ii. 29) says that in a fresh state it is nourishing and good for the bowels; but when salted it has no nutriment, though it is good for clearing the bronchial tubes and for the voice; used as a poultice it draws out thorns, while the brine from it is good in early stages of dysentery.

XXIII.—*Remarks on certain Errors in Mr. Jeffreys's Article on "The Mollusca of Europe compared with those of Eastern North America."* By A. E. Verrill, Professor of Zoology in Yale College, New Haven, Conn., U. S. A.

In the October number of the 'Annals and Magazine of Natural History' Mr. Jeffreys published an article upon this interesting subject, in which many important errors occur, due, no doubt, to the fact that the distinguished author is much less familiar with American than with European shells. But as the dredgings in connexion with the investigations of our fisheries by the U. S. Fish Commission were under my superintendence during the two past seasons, and Mr. Jeffreys alludes to the fact (though rather indefinitely) that he, by invitation of Professor Baird, accompanied us on several dredging-excursions in 1871, it seems necessary that I should point out some of the more important of these errors, lest it be supposed by some that the same views are held by me.

It is not my intention to discuss at this time the numerical results presented by Mr. Jeffreys; but I would remind the readers of his article that the regions compared are in no respect similar or parallel, and that it is scarcely fair to compare the shells from the entire coast of Europe with those from about 200 miles of the coast of New England, where the marine climate is for the most part more arctic than that of the extreme north of Scotland—and, moreover, that the last edition of Gould's 'Invertebrata of Massachusetts' contains only a part of the species added to our fauna since the first edition was published in 1841, and very little of the great mass of facts in regard to distribution, &c., which have been accumulated by American naturalists during the last thirty years. Consequently that work is far from being a good "standard of comparison." To make a just comparison, all the shells on our coast, from Labrador to Florida, should be compared with those of Europe.

And without going into a long discussion of his peculiar views on the geographical distribution of our shells, I would remark that, to an American, it seems rather singular that most European writers, whether zoologists or botanists, find it necessary to trace back to a European origin all the existing species of this country, and to suppose that they have "migrated" from Europe to America and other countries in spite of opposing currents and all other obstacles. Thus Mr. Jeffreys can imagine that our land and freshwater shells could have migrated from Europe all the way across Asia, the Pacific Ocean and North America in order to reach Canada and New England; but he does not seem to think it possible that they may have *originated* in America, and thence crossed to Europe in the direction of the prevailing currents and winds. Nevertheless geology teaches us that America was a great continent, in very early ages, when Europe was only a group of islands, that no other country is richer in the remains of terrestrial animals and plants connecting the Tertiary and Cretaceous ages with the present, that many of these supposed European forms (whether terrestrial or marine) can be traced back into our Tertiary formations quite as far (if not further) than they can in Europe, and that many of the genera of animals, and especially of plants, now found living in both countries can be traced back to the Cretaceous in America and only to the Tertiary in Europe. Moreover the great number and diversity of the land and freshwater shells of America (*e. g.* of Unionidæ, *Melaniæ*, &c.), and the peculiar facts in their geographical distribution, cannot but convince any one familiar with the subject that they have *originated* in America at a very remote period; which is confirmed by the fact that many of these can be traced far back into our Tertiary formations. Nor are there sufficient reasons for supposing that those of our species living also in Europe have had a history different from those that are still peculiar to America.

Of course no one will deny that certain species of land-shells have been introduced from Europe in modern times by human agency; but, so far as most of the identical species are concerned, it seems to us far more probable that America gave them to Europe, rather than the contrary, and this whether animals or plants, terrestrial or marine.

But the special errors to which I wish to call attention occur in the table of species, showing their geographical distribution. These relate both to the names and specific identity of certain shells, and to the geographical distribution. Although not agreeing with the author in regard to many of his remarks concerning the generic relations and names of species, I do not propose to discuss them here; for there seems to be no danger of their general adoption either in Europe or America.

The following marine species (named as in Gould) which Mr. Jeffreys puts down as belonging to the region north of Cape Cod, actually belong properly to the region south of Cape Cod, extending in most cases to the Carolina coasts or beyond, while north of Cape Cod they are rare or local, viz.:—*Cochlodesma Leanum*, *Mactra lateralis*, *Petricola pholadiformis*, *P. dactylus*, *Gouldia mactracea*, *Cytherea convexa*, *Venus mercenaria*, *V. notata*, *Gemma gemma*, *Liocardium Mortoni*, *Arca transversa*, *Modiola plicatula*, *Pecten irradians*, *Ostrea virginiana*, *Anomia electrica* (not of Linn.), *Diaphana debilis*, *Cylichna oryza*, *Placobranchus catulus*, *Crepidula fornicata*, *C. plana*, *C. convexa*, *C. glauca*, *Ianthina fragilis*, *Bittium Greenii*, *Odostomia bisuturalis*, *O. seminuda*, *Turbonilla interrupta*, *Pleurotoma bicarinata*, *P. plicata*, *Nassa obsoleta*, *Buccinum cinereum*, *Diacria trispinosa*, *Loligo Pealii*.

The following, to which a northern distribution is likewise given, are also found far south of Cape Cod, and many of them belong quite as much to the southern as to the northern division; and some of them are decidedly southern, extending even to the Gulf of Mexico:—*Teredo navalis*, *T. megotara*, *T. chlorotica*, *Solen ensis*, *Machæra costata*, *Pandora trilineata*, *Lyonsia hyalina*, *Mactra solidissima*, *Kellia planulata*, *Macoma fusca*, *Tellina tenera*, *Astarte castanea*, *A. quadrans*, *A. sulcata*, *Nucula proxima*, *Yoldia limatula*, *Mytilus edulis*, *Elysia chlorotica*, *Crucibulum striatum*, *Littorina rudis*, *L. tenebrosa*, *L. palliata*, *Lunatia heros*, *L. triseriata*, *Nassa trivittata*, *Melampus bidentatus*, *Alexia myosotis*.

Many others, not named in the above lists, are not limited by Cape Cod; but as they belong properly to the northern division, they are here omitted.

As an offset to these numerous instances in which he has unduly exaggerated our northern fauna, we find not one undoubted instance of an error on the other side, among the marine shells.

The distribution indicated for our land and freshwater shells is even more erroneous. It is sufficiently evident that Cape Cod is in no sense a proper boundary between the northern and southern fluviatile and terrestrial species; but, disregarding this, there are no reasons whatever for most of the special indications that he gives.

Thus he gives the northern distribution to all of the sixteen species of *Sphærium* and *Pisidium*; but most of them are well known to be widely distributed over the eastern, middle, and western parts of the United States, some even extending to the southern parts. *Unio complanatus*, *U. nasutus*, *Margaritana arcuata*, and *Anodon implicatus* are indicated as distributed north of Cape Cod; but all these are found over most of the northern and middle states and some in the western, while the last one is somewhat rare at the north. But *Unio radiatus*, *U. cariosus*, *U. ochraceus*, *Margaritana undulata*, *M. marginata*, *Anodon fluviatilis*, and *A. undulatus* are put down as southern. It would certainly be difficult to show that these, as a group, are more southern than the previous lot; for most of them have nearly the same wide distribution, and all of them, except *U. cariosus*, occur even in Maine. Some of them (as *U. radiatus*, *M. undulata*, and *A. fluviatilis*) are the most abundant species in all the waters of northern New England and New Brunswick. The distribution given for the species of *Valvata*, *Melantho*, and *Amnicola* is equally faulty.

All of the eighty-one species of *Helix*, *Hyalina*, *Macrocyclis*, *Limax*, *Pupa*, *Vertigo*, *Succinea*, *Arion*, *Zonites*, *Tebennophorus*, *Limnæa*, *Physa*, *Bulinus*, *Planorbis*, and *Ancylus* are set down as having the northern distribution, except *Hyalina Binneyana*, *Pupa fallax*, *Limnæa catascopium*, and *Physa ancillaria*. But every American conchologist knows that nearly all of those species are very widely distributed over North America, east, west, north, and south, many of them being limited only by the Gulf of Mexico on the south and California or the Pacific on the west. Nor is there any reason for the distinction made in the case of the four species named above; for these, though differing among themselves, have the same distribution as many of those put down as northern, while *H. Binneyana* and *P. ancillaria* certainly have a very northern range, for they are abundant in Maine, New Brunswick, and Canada.

It is evident that such numerous errors of this kind render the paper, so far as geographical distribution is concerned, quite worthless; for it is sure to mislead.

Most of these errors might have been easily avoided had the author depended less on Gould's work and more on the recent works of American conchologists; for there is no lack of data in regard to the distribution of most of our shells. Even Dr. Stimpson's 'Shells of New England' (1851), if consulted, might have saved most of the errors in regard to the distribution of the marine shells.

The fact that there is in the southern and shallower parts of the Gulf of St. Lawrence an isolated colony of southern shells may have misled Mr. Jeffreys in many cases, especially as he evidently consulted the Canadian collections much more than those of the United States, many of the largest of which he did not see at all. In respect of erroneous identifications and the reduction of certain species to varieties, there is also much to be said; but this article is already so long that it will be necessary to refer only to some of the more obvious and important errors of this kind, leaving the rest to be discussed more fully elsewhere.

Every naturalist should be willing to allow his fellow naturalists full liberty of opinion with respect to the specific identity or difference of closely allied forms; and no one can claim to be infallible in such matters. Some of the errors to be mentioned do not, however, come under this head; for the species united have only remote affinities. Nevertheless the naturalist who has collected and carefully studied animals in their native haunts, under various circumstances, in many localities, and in great numbers, has, other things being equal, a very great advantage in these matters; and therefore I believe that Mr. Jeffreys would in most cases agree with me had he collected and studied as many American shells as I have during the past fifteen years, or if he were as familiar with them as he is with the British species. In most of the cases to which I refer, my own conclusions are in harmony with those of Dr. Stimpson, who devoted so many years to collecting and carefully studying our shells, and who is well known for his accuracy in such matters. And it would be strange indeed if all American naturalists, as well as many eminent foreign ones, have always been making such ridiculous blunders in regard to some of our most familiar shells as Mr. Jeffreys would have us believe.

Thus he states (p. 240) that "*Gemma gemma*" (or *Tottenia gemma*) is the young of *Venus mercenaria*! But it has long been known to European as well as American conchologists that the animal of *gemma* is very different from that of *mercenaria*, and quite peculiar; that the hinge is constructed on a very different type is well known; and Prof. G. H. Perkins has shown (Proc. Bost. Soc. N. H. 1869, p. 148) that *gemma* is *viviparous*, producing about three dozen young with well-formed shells at one time. Moreover the young shells of *mercenaria*, smaller than the adult *gemma*, are sufficiently abundant on our shores, and may be seen in many American collections; they are certainly very unlike the *gemma* in form, sculpture, and hinge, as has been well known for more than thirty years.

Again, he states that *Arca transversa* is a variety of *Arca pexata*, the former being put down as northern, the latter as southern. That these shells are widely different in form and in the structure of the hinge is well known; for Dr. J. E. Gray many years ago established a new genus (*Argina*) for the latter on account of its very peculiar hinge. That the animals are also quite different I can assert from personal observation. Moreover the differences in the hinge, epidermis, and form are remarkably constant; and, finally, the two species have the same geographical range from Cape Cod to South Carolina, and are often found together. Both are very common in Long-Island Sound and New-Haven harbour; and I have examined hundreds of specimens of both species without finding the slightest evidence in favour of Mr. Jeffreys's views. Indeed they are only distantly related, and evidently belong to distinct genera, *Argina* and *Scapharca*, where several writers have placed them.

He also states that *Mactra ovalis* is a variety of *M. solidissima*. He may not have seen a specimen of the true *ovalis*, for it is not common in collections; but the genuine *ovalis* is certainly a very well-marked species, widely different from the *solidissima*. They differ greatly in the hinge, epidermis, form of shell, and position of the umbos; moreover the animals are also quite different. Both occur together of equal size in the Bay of Fundy; but the former is not known south of Cape Cod, while the *solidissima* is abundant everywhere along our sandy shores to South Carolina.

Concerning *Astarte castanea* he says, "Perhaps a variety of *A. borealis*, Ch.;" but *castanea* is one of the best-defined species in this difficult genus, varies comparatively little, and does not extend far north, its range being decidedly *southern*. It is perfectly distinct from *A. borealis*. He reduces *A. quadrans* to a variety of *A. castanea*, and gives it a name that is quite uncalled for, even if this view were correct. He then makes *A. portlandica* a variety of *A. compressa*; but I have already shown (Amer. Journ. of Science, April 1872) that it is a variety of *A. quadrans*. His arrangement of the other species of *Astarte* is equally objectionable, but it is not necessary to discuss them here.

The *Pecten fusus*, Linsley, is given as the young of *P. irradians*, from which it is very distinct; but the writer has shown (Amer. Journ. of Science, vol. ii. p. 361, and vol. iii. p. 213, 1871–72) that it is really the young of *P. tenuicostatus*.

Dekay is given as the authority for *Æolis salmonacea* and *Æ. gymnota*; but they were both described by Couthouy in

1838, from whom Dekay borrowed both the descriptions and figures five years later.

He states that *Dentalium dentale* (non Linn.) is a variety of *Entalis striolata*, and that the latter is a variety of *D. abyssorum*, Sars; but both of these statements are incorrect. The first is the *Dentalium occidentale*, Stimpson, and is a true *Dentalium*, entirely different, generically and specifically, from the *striolata*; and the latter is also quite distinct from *abyssorum*. Possibly Mr. Jeffreys has not seen perfect specimens of all the American species; otherwise I cannot understand how he could have made these statements.

He is correct in considering *Crepidula glauca* a variety of *C. fornicata*, as others have done before him; but he has adopted a serious mistake, made by several other writers, in regarding *C. plana* (or *unguiformis*) also as a variety of *C. fornicata*, from which it is really very distinct. It is a very common error to suppose that this species always inhabits the inside of dead univalve shells; for it very often occurs on the *outside* of such shells, on stones, the back of *Limulus*, &c., and is frequently associated intimately with *fornicata* in all these situations; but nevertheless it always retains its essential characters under all circumstances. The typical *fornicata* is also often found with it, plentifully, on the *inside* of dead shells.

Nor can *Margarita acuminata* be the young of *M. varicosa*; for in our collection there are full-grown specimens of both, equal in size, from Labrador.

There is no sufficient reason for adopting the name *Lacuna divaricata* in place of *L. vincta*; for it is not the *Trochus divaricatus* of Linné (1767), although it is the shell described under the same name by Fabricius in 1780, as shown long ago by Dr. Stimpson and others. Fabricius made a mistake which we have no right to perpetuate; nor does "usage," to which Mr. Jeffreys so often appeals, sanction the change.

The *Lunatia triseriata* is not, as Mr. Jeffreys thinks, the young of *L. heros*, but only a colour-variety, as the writer had previously shown (April 1872). Both varieties occur together, from the smallest to the largest sizes; but the former sometimes becomes plain-coloured before reaching maturity. There is no evidence that *Natica clausa* is the *Nerita affinis* of Gmelin, but quite the contrary; for the latter was placed in the section of *umbilicated* species, was described as *silvery within*, and came from New Zealand! It is probably one of the Trochidæ, and certainly could not have been this *imperforate Natica*.

In this place I shall not enter into a discussion of te numerous cases in which the author has reduced the American shells to "varieties" of the European species, because in many of these cases there must long be great diversity of opinion, and for most purposes it matters little whether these closely related forms be called "varieties" or "species," so long as the actual differences are recognized. But since Mr. Jeffreys has evidently made so many important mistakes in his article in regard to the identity of species, and has united those that have no near affinities, as already shown, it is logical to conclude that he may have made other mistakes in the case of more critical species. He must therefore pardon us if we regard his decisions in all these cases as at least doubtful, until confirmed by other evidence.

XXIV.—*Remarks on* Cervus chilensis *and* Cervus antisiensis. By P. L. Sclater, M.A., F.R.S., Secretary to the Zoological Society of London.

I beg leave to offer to the readers of the 'Annals' a few remarks upon the paper "On the Guémul (*Huamela leucotis*)" by Dr. Gray, which appeared in the number for December last (Ann. Nat. Hist. ser. 4, vol. x. p. 445). The acquisition of the male sex of the deer proposed by Dr. Gray to be called *Huamela leucotis* is of much interest. But Dr. Gray seems to have overlooked the fact that this deer had been named *Cervus chilensis* by Gay and Gervais in 1846 (Ann. des Sci. Nat. ser. 3, vol. v. p. 91), three years before he published a description of it as *Cervus leucotis* (P. Z. S. 1849, p. 64). Under these circumstances *Cervus chilensis* is the oldest name for this animal, under which name it has also been figured and described in Gay's 'Historia de Chile.' It may be objected that the name *chilensis* is inappropriate, as the animal is more particularly Patagonian than Chilian. But Dr. Philippi, as will be seen by reference to his remarks (Wiegm. Arch. 1870, pt. i. p. 46), says that the Guémul, or *Cervus chilensis*, though now rare, *is* found in Chili, and gives notices of several places called after its name, from its having formerly occurred there.

As regards the allied species of deer of which Mr. Whitely has sent specimens from Tinta in Peru, and which Dr. Gray has called *Anomalocera huamel*, *Xenelaphus huamel*, and *Xenelaphus leucotis*, and now proposes to call *Xenelaphus anomalocera*, I may state that I have examined the specimens now in the British Museum, and have convinced myself that they are referable to *Cervus antisiensis* of D'Orbigny. Tschudi

('Fauna Peruana,' Mamm. p. 241) has already recorded the existence of this deer in the Andes of Peru. The horns of the male specimen figured in P. Z. S. 1869, p. 497, are, in my opinion, monstrous or diseased; such distorted specimens are not unfrequently met with in several species of deer.

I am therefore of opinion that, although Dr. Gray is correct in distinguishing his so-called *Huamela leucotis* from his *Xenelaphus anomalocera*, the former (from Patagonia and Chili) should stand as *Cervus chilensis*, and the latter (from Peru and Bolivia) as *Cervus antisiensis*. If a generic or subgeneric name is required for these two closely allied species, *Furcifer* of Wagner (Säugeth. Suppl. vol. iv. p. 384, 1844) is the first given, and should be employed.

XXV.—*Further Remarks on the Guémul of Patagonia* (Huamela leucotis). By Dr. J. E. Gray, F.R.S. &c.

In the 'Annals' for December 1872, p. 445, I gave an account of the skins of a male and female Guémul from Patagonia, presented by Don Enrique Simpson, and stated that it was the same animal that I had described and figured under the name of *Capreolus leucotis* (P. Z. S. 1849, p. 64, t. xii.), which Lord Derby had received from Patagonia.

Dr. Philippi, who lives at Santiago, says that the animal I figured as *C. leucotis* does not live in Chili, I suppose thereby meaning that it cannot be the Guémul of Molina; but Molina refers to the animal which Captain Wallis saw at the Magellan Straits, and Lord Derby's specimen was received from Magellan Straits.

The Earl of Derby in 1840 received an imperfect skin of a female in thick winter fur from his brother-in-law Admiral Hornby, who obtained it on the coast of Chili; but no other particulars were to be obtained about it. I thought it probable that it was another specimen of *Capreolus leucotis* (Cat. Mamm., Ungulata, p. 227); but it shows so much more white on the abdomen and inner side of the legs, and appears to belong to a smaller animal, that I now think that it is probably a specimen of the same species that we received from Mr. Whitely, jun., from Tinta in the Peruvian Andes, or probably the winter coat of another species.

In 1869 we received a male, female, and fawn in summer fur of a deer, which were collected by Mr. Whitely, jun., at Tinta, in South Peru. As the skin of the male showed some thick dark fur like the female in Lord Derby's collection, I thought that it was probably the summer state of the same animal, and perhaps a smaller variety of it. I first gave a notice of these skins in 'Scientific Opinion' for October 6, 1869; and as the horns of the male showed that it was different from any known deer, I proposed the name *Anomalocera* for it; but (recollecting that this name had several times been used) in the longer account of the deer which I gave in the 'Proc. Zool. Soc.' 1869, pp. 496–499, with figures of the horns of the male and skull of female, I altered the name to *Xenelaphus leucotis*. But as it is now found that the original *Capreolus leucotis* from the Straits of Magellan is a different species with very different horns, and was a larger-sized animal, I have called this, in the 'Ann. & Mag. Nat. Hist.' Dec. 1872, p. 445, *Xenelaphus anomalocera*.

The animal to which the skins of the male and female now received from Don Enrique Simpson through Mr. Bates belong, and which appears to be called the Guémul in Patagonia, is certainly different from the animal which we received from Tinta, South Peru, being of a *larger size*, and uniform dark colour as much below as above, and the males having very different horns, which are simple, with a long subbasal frontal snag, indeed very like the horns of a fawn of the common stag (*Cervus elaphus*); but, like the other American deer, it has no gland and pencil of hair on the outside of the metatarsus; and therefore I propose to describe it in the catalogues as *Huamela leucotis*.

In Dr. Hawkesworth's account of the voyages for making discoveries in the Southern Hemisphere (3 vols. 4to, 1773), Captain Wallis (vol. i. p. 388, Jan. 1767) says, when in Cordes Bay, Royal Reach, Magellan Straits, "we saw an animal that resembled an ass; but it had a cloven hoof, as we discovered afterwards by tracking it, and it was as swift as a deer. This was the first animal we had seen in the streight, except at the entrance, where we found the guanicoes, that we would fain have trafficked for with the Indians. We shot at this creature, but we could not hit it; probably it is altogether unknown to the naturalists of Europe."

Molina, in his 'Saggio sulla storia nat. del Chile' (Bologna, 1782, 8vo), p. 320, speaks of the "Guémul or Huamel" as "*Equus bisulcus*," but thinks it ought to be a separate genus; he quotes in a footnote a French translation of Captain Wallis's observation. In the second edition of the work, published in quarto at Bologna in 1810, p. 262, the account of Captain Wallis is embodied in the text, the whole of the account of the animal is rather altered, and the name *Equus bisulcus* is left out.

In the first edition (p. 322) he says it lives on the less steep rocks of the Andes; in the second edition (p. 262), it is a rare wild animal which inhabits Chili. It is seldom seen except on the precipices and rocks of the Cordilleras, and rarely descends to the lower valleys; so the hunter considers himself fortunate who manages to surprise one. In both editions he observes this is the unnamed animal which Capt. Wallis says he saw in passing the Straits of Magellan (p. 321).

This account has been a fertile source of errors, and perhaps he confused two animals in it; but at any rate I have no doubt that the animal I described as *Capreolus leucotis* from Magellan Straits is the one mentioned by Captain Wallis.

Molina himself thought the Guémul was a horse, and called it *Equus bisulcus*, but he has left this name out in the second edition. It is referred to *Auchenia* by Col. Hamilton Smith, to *Camelus* by Leuckart and Treviranus, and made into a genus, under the name of *Hippocamelus*, by Leuckart, and *Cervequus* by Lesson, and is mentioned as a new genus without a name by Gay; and MM. Gay and Gervais, in the 'Ann. Sci. Nat.' 1846, p. 91, thought it was *Cervus chilensis*; but Dr. Philippi (in Wiegm. Archiv, 1870) says that Gay's animal is the same as *Cervus antisiensis* of D'Orbigny (Voy. d. Amér. mérid. tom. xx.), the *Furcifer antisiensis* of my 'Catalogue of Ruminant Mammalia in B. M.' (8vo, 1872, p. 88).

According to Gay, the Guémul is *Furcifer antisiensis* from Bolivia and Peru; this may be the Chilian animal which Molina confounded with the Magellan-Straits one. I thought it might be the *Xenelaphus anomalocera*, which is also a Peruvian animal; and now we have identified Wallis's Magellan-Straits animal as *Huamela leucotis*.

It is impossible to use any of the generic names given to Molina's Guémul, because they all convey a false impression as to the relationship of the animal; one is not sure whether they belong to the Chilian or Patagonian genus, or, in fact, a combination of both.

The Guémul or Huamel is mentioned in Viduare's 'Chil. Reiseb.' published in Hamburg in 1782; but I have not been able to lay my hands on it. Is it the animal mentioned by Molina?

"Guemul, q. du Chili, qui ne peut être le Poco," appears in Ray's 'Zoologie Universelle et Portative' (Paris, 1787); but there is no such word as "Poco" in his dictionary. Perhaps he means "Paco," a name which occurs under "Lama," p. 300.

Fischer in his 'Synopsis,' p. 433, puts in *Equus bisulcus* of Molina, the cloven-footed horse of Shaw's 'Zoology' (ii. p. 441), adding, "In inaccessis montium Andium. Num generis Lama?" The universal reference to the animal being an inhabitant of Chili misled me until I consulted the original work.

HUAMELA.

Head elongate; ears acute. Horns nearly erect, simple, rather converging together at the tip, with a well-developed subbasal anterior branch; beam tapering to a point; the front of the right horn is keeled; and rather below the middle there is a compressed tubercle, probably indicating a branch in the adult state; but there is no appearance of this on the other horn. Fur very close, thick, formed of quills like those of the roebuck and the Peruvian deer.

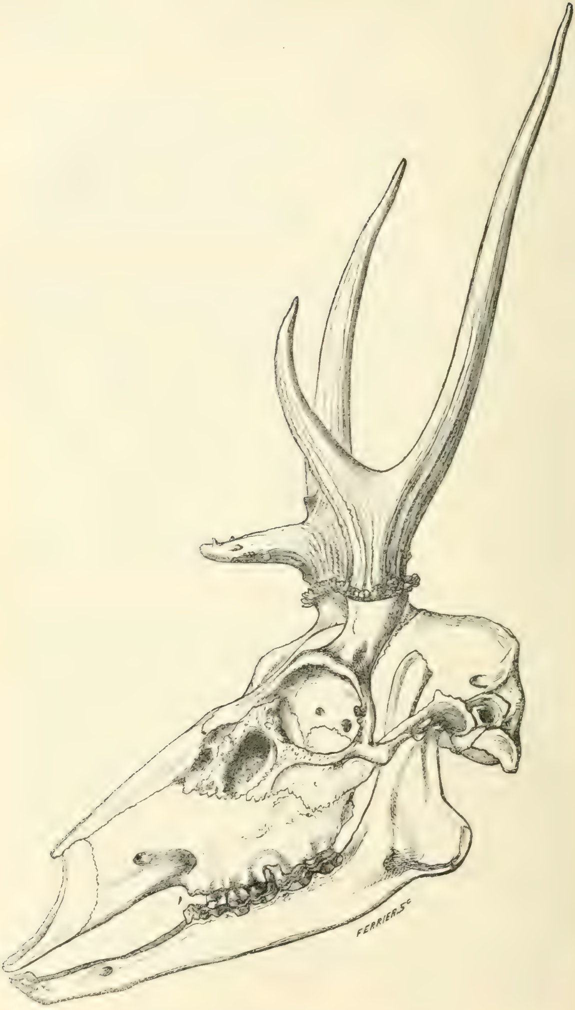
Skull with the intermaxillary bones broad, and extending up to and terminating with a truncated end on the sides of the nasal bones, which are broad, with parallel sides for two thirds their length, and truncated at the front end. Lachrymal pit elongate, triangular, very deep, with a rounded bottom at the hinder end, quite close to the front edge of the orbit. The horns with a well-developed rugose burr, with many irregular tubercles round the base. The subbasal front branches are placed some distance above the base, the one on the right horn being the smallest, and projecting straight forwards, with denticles on its surface; the branch on the left horn is much higher up from the base, longer, and ascending at a rather acute angle, and smaller at the tip. Length of the skull, from nose to condyles, $11\frac{1}{4}$ inches; width at back edge of orbits, which is the widest part, $5\frac{1}{4}$ inches.

Lower jaw very slender, with a straight lower edge not more than an inch broad in the widest part, narrower in front, and becoming wider behind the middle, with a sinuous margin and a thin rounded angle. The part in front of the grinders much produced, about double the length of the symphysis.

Tail short and bushy, coloured like the back above, and whitish beneath. The line from the anus to the groin is white, and the upper part of the inside of the thighs is pale; the rest of the underside is considerably darker than the back. The inside of the legs is coloured like the rest of the back, perhaps a little lighter; there is a well-developed pencil of rigid hair, which is of a dark colour. No indication of any glands on the outside of the legs.

The false hoofs are surrounded with rather longer darker hair. The lips are blackish, with two small white spots on the upper lip, and a narrow white edge on the under one.

To correct the synonyma, it is better to give the following revision of them :—



Skull of male *Huamela leucotis.*

Huamela leucotis.

"*Hoofed Animal*," Hawkesworth's Voyages, vol. i. p. 388.
Equus bisulcus, Molina's Chili, p. 320, 1782 (from Hawkesworth and other copiers of Molina).
Capreolus leucotis, Gray, Proc. Zool. Soc. 1849, p. 64, t. xii. (female).
Capreolus (?) *huemula*, Knowsley Menag.
Furcifer huamel, Gray, P. Z. S. 1850, p. 236.
Xenelaphus leucotis (part.), Gray, Cat. Ruminant Mamm. p. 89.

Hab. Magellan Straits (*Capt. Wallis*, 1767; *Molina*, 1782; *Lord Derby*, 1849); Patagonia (*Don Enrique Simpson*, 1872).

Male and female (Brit. Mus.).

This animal is most likely the one mentioned by Captain Wallis, as (1) it inhabits the Magellan Straits; (2) it is the only hoofed animal on the west coast of America nearly the size of a donkey; (3) it was sent to the British Museum from Don Enrique Simpson with the name of "Guémul" used by Molina.

I have not been able to trace the origin of this name, and do not know if it is Patagonian or Chilian. It has been applied by zoologists to different animals which thay have discovered. Gay applies it to *Furcifer antisiensis*. I, thinking that it was the animal mentioned by Molina, applied it to *Xenelaphus*, and, in the Knowsley Menagerie, thought it might be the animal I described as *Capreolus leucotis*, which I now think is the most correct determination.

The horns are very unlike those of any other American deer, and are more like those of the young stag, or *Cervus elaphus*, but very distinct from it, and probably more different from it in the adult state, if those we have belong to a young animal. It is the only South-American stag that has a basal snag, the absence of which is a peculiarity of those animals.

Probably the fur of this animal, like that of the roebuck kind, is formed of shorter, more slender hair in summer.

It is not necessary to figure the animal, as the figure by Wolf, given in the P. Z. S. (1849, p. 64, t. xii.) is very characteristic and accurate. I observe in the description that it is at least three times as large as the usual European roebuck, is much darker, and has not the white spots extending over the upper part of the side of the haunches.

The height at the shoulders of Lord Derby's specimen is 38 inches; and the length of the body is 40 inches, of the head 12 inches, of the ears 7 inches, of the tarsus, from the false hoof to the hock, 12½ inches.

Xenelaphus.

Anomalocera, Gray, Scientific Opinion, 1869; Philippi, Wiegm. Archiv, 1870, p. 46.
Xenelaphus, Gray, P. Z. S. 1869, p. 498, fig. (horns & skull); Cat. Ruminant Mamm. p. 89.

Xenelaphus anomalocera.

Anomalocera huamel, Gray, Scientific Opinion, 1869, p. 385.
Xenelaphus huamel, Gray, P. Z. S. 1869, p. 497, fig. (horns), p. 498, fig. (skull, female).
Anomalocera leucotis, Philippi in Wiegm. Archiv, 1870, p. 46.
Xenelaphus leucotis, Gray, Cat. Rumin. Mamm. p. 89.

Hab. Peruvian Andes, Tinta (*Mr. Whitely, jun.*).

Male, female, and young (Brit. Mus.).

The adult male from Tinta is 28 inches high to the withers, and the body from the chest to the tail is 34 inches long. Length of head 10 inches, of the ears $5\frac{1}{2}$ inches, of the tarsus from the false hoof to the hock $9\frac{3}{4}$ inches.

XXVI.—*On the Peregrine Falcon of the Magellan Straits.* By R. Bowdler Sharpe, F.L.S., F.Z.S., &c., Senior Assistant, Zoological Department, British Museum.

Mr. Gurney has already (Ibis, 1867, p. 465) drawn attention to the differences existing in the Peregrine from the Straits of Magellan and Chili, which he considers to be undescribed. He writes as follows:—"South of Chili, in the southern part of Patagonia and about the straits of Magellan, a really distinct race does occur, closely allied to *F. melanogenys* of Australia, from which, indeed, it only differs in its slightly larger size. It is worthy of remark that the three southern races of Peregrine Falcons, viz. this Magellan race, to which, I believe, no specific name has yet been given, *F. melanogenys* of Australia, and *F. minor* of South Africa, all agree between themselves, and differ from the true *F. communis* in having much narrower spaces than occur in that bird, between the dark transverse abdominal bars which characterize the adult plumage of all these Falcons."

Mr. G. R. Gray considered the Magellan bird to be the same as *Falco nigriceps* of Cassin from Western North America. Mr. Cassin, in describing the latter species, gives Chili as an additional habitat, suggesting that its range may extend throughout the whole of the western side of America. I am unable to determine by internal evidence whether Mr. Cassin had adults or young of the Chilian birds, on which to found his opinion. He could hardly have united the Magellan species if he had had adults, while he might have been easily misled by the rufous character of the young birds into supposing that the two birds are identical. I agree, however, with Mr. Gurney in supposing that the Magellan bird is a distinct species, being, in fact, the American representative of *Falco melanogenys*, from which it differs not only in its slightly larger size, but in the less rufous plumage of the female; and neither male nor female has the very narrow closely set bars of the Australian Falcon, though they are more narrowly barred than the true *Falco nigriceps*. I propose, therefore, to separate the Falcon of Chili and the Magellan Straits as

Falco Cassini, sp. n.,

and append a description of the bird.

Adult. Above dark bluish ashy, everywhere transversely spotted or barred with black; bars very broad and closely set on the upper part of the back, further apart and more sagittate in shape on the lower back, rump, and upper tail-coverts; a frontal line tinged with whitish, very indistinct; entire head and hind neck, cheeks, ear-coverts, and moustachial streak (that is to say, the *whole* of the face) deep black, extending on to the interscapulary region; least wing-coverts blackish like the latter, the others coloured and barred like the back; quills deep brownish black, the primaries with obsolete grey spots near the base, the inner secondaries uniform with the back; tail bluish ashy, with black bars, which become merged towards the tip of the tail, so that this is conspicuously black for about a quarter of its length; throat itself creamy buff, unspotted; fore neck and chest pale buffy fawn-colour, with very narrow black shaft-lines, the shade of fawn extending slightly on to the breast; rest of the under surface creamy white, with a very strong grey shade on the lower parts, crossed with closely set bars of black; under wing-coverts buffy white, thickly crossed with black bars; the inner web of the quills with numerous buffy white bars, becoming smaller and more obsolete towards the tips of the quills; bill orange at the base, inclining gradually to bluish horn-colour towards the tip; feet yellow, claws horn-brown. Total length 15·5 inches, culmen 1·1, wing 12, tail 7, tarsus 2.

Female. Similar to the male, but larger, and without the bluish shade on the lower parts (probably not so old a bird); the head, neck, and sides of the face black. Total length 20 inches, culmen 1·35, wing 13·5, tail 7·8, tarsus 1·9.

Young male. Above deep blackish brown, the nape tinged with chestnut, all the feathers more or less distinctly margined with the same colour, except the upper tail-coverts and inner secondaries, which are tipped with buff; quills blackish, the inner webs half barred with clear rufous; tail blackish, tipped with creamy buff, and crossed with several indistinct grey bars, becoming rufous on the inner web; forehead whitish, the feathers under the eye, fore part of the cheeks, and moustachial stripe deep black; throat creamy buff; rest of the under surface deep ferruginous, paler on the lower abdomen, all the feathers mesially streaked with a longitudinal black spot, much larger and more arrow-shaped, on the flank-feathers. Total length 16 inches, wing 12.

Mr. Gurney, in writing to me on the subject, observes that he has seen two distinct Falcons from Chili, one being my *F. Cassini*, and the other coming from the north, and called by Cassin *F. nigriceps*, but which he considers to be only *F. communis*. I agree with Mr. Gurney in considering that *F. nigriceps* does not go to Chili; and the migratory bird is therefore probably the common Peregrine, which visits South America, as it does India and Africa in the Old World, while the resident southern form is *F. Cassini*.

The typical specimen of the latter is mounted in the national collection.

I may add a few words as to the Peregrine Falcons and their geographical distribution. No two ornithologists agree as to whether the Peregrines of the world are to be considered races or subspecies of one particular form, or whether there are several species to be designated by different specific names. I incline to the latter view, as rendering the subject less intricate than by merging some of the very different forms under one name. Taking, then, *F. communis* as the typical form, I would characterize the various allied Falcons as follows. Adult specimens of all the birds, excepting *F. minor* (of which there is at present only a young one), are to be seen in the British Museum.

1. *Falco communis.* (The Peregrine Falcon.)

The whole of the Palæarctic region, migrating into India, to the Malay archipelago, and South Africa (more rarely). The entire Nearctic region, except the western coast of North America, where replaced by *F. nigriceps.* I cannot find any difference in the North-American Peregrine, and consider *F. anatum* to be identical with the European bird.

2. *Falco Brookii.* (The Sardinian Peregrine Falcon.)

Very much smaller than *F. communis*, with the bars on the under surface very numerous, and broader than in any other species.

Hab. Sardinia.

3. *Falco nigriceps.* (The Western Peregrine Falcon.)

Rather smaller than *F. communis* and darker. The young different; much more rufous and richly coloured. The adult creamy white on the breast, without a single sign of a shaft-stripe.

Hab. Western side of North America from California to Vancouver's Island, probably further north.

The two birds procured in Japan, and mentioned by Mr. Whitely (Ibis, 1867, p. 194), are in the British Museum, and are unfortunately both young birds. They are of a more slender build than is usual with the young female Peregrine of Europe, and, from the strong wash of tawny buff on the under surface, might be supposed to belong to *Falco nigriceps.* They are not, however, quite so rufescent underneath, and the centres to the breast-feathers are not nearly so dark; thus I at present prefer to keep them distinct from this bird, although it is by no means improbable that they may ultimately turn out to be the same. Latham's Oriental Falcon coming from Japan, it can do no harm to keep these Japanese specimens, which agree well with his descriptions, under that title, until the arrival of an adult bird shall enable us to define the species accurately. The late Mr. G. R. Gray referred both these examples and the young Vancouver-Island specimens to *Falco orientalis*, with which he joined *Falco anatum.* I think, however, that *Falco anatum* is nothing but the European Peregrine, and the Vancouver birds are really the young of *Falco nigriceps*, which Mr. Brown identifies as the species found there (Ibis, 1868, p. 418).

4. *Falco micrurus.* (The Himalayan Peregrine Falcon.)

With this bird Dr. Jerdon identifies Mr. Hume's lately described *Falco atriceps*; and two specimens in the national collection belong to this species. They are closely allied to *F. communis*, but are remarkable for their very nearly obsolete barring underneath, and very pale coloration.

Hab. Himalayas.

5. *Falco peregrinator.* (The Indian Peregrine Falcon.)

Blacker in all stages than any other allied species. When fully adult, deep rufous underneath, against which the clear blue of the rump and upper tail-coverts contrasts strongly.

Hab. The whole of India; nowhere common.

We now come to the three southern forms with jet-black hoods, viz.:—

6. *Falco melanogenys.* (The Australian Peregrine Falcon.)

A very distinct species, distinguished by its black face and close-set narrow barring.

Hab. Australia northwards to Java (judging by Schlegel's figure in the 'Vogel van Nederlandsch Indië').

7. *Falco minor.* (The South-African Peregrine Falcon.)

The smallest of all Peregrines.

Hab. South Africa and Madagascar.

8. *Falco Cassini.* (The Chilian Peregrine Falcon.)

Allied to *F. melanogenys* of Australia, but differing as above mentioned. The young deeper rufous than in any of the other Falcons.

Hab. Straits of Magellan and Chili.

BIBLIOGRAPHICAL NOTICE.

Dr. Ehrenberg's Microgeological Studies. ["Mikrogeologische Studien, &c.," Monatsbericht kön. preuss. Akad. Wissensch. Berlin für April 1872, pp. 265–322: 1872.]

This is the abstract of a memoir which the veteran, and now nearly octogenarian, naturalist of Berlin has laid before the Academy as the results of his long-continued methodical researches on the microscopic life of the sea-bottom of all zones, especially in its relationship to past life and its influence on geological studies. From 1836 to 1871 Ehrenberg has given to the world numerous descriptions and hundreds of good figures (all magnified 300 diameters) of microscopic objects, recent and fossil, the latter mainly in his 'Mikrogeologie' (1854). However numerous the shore-sands, dredgings, and deep-sea soundings he has examined, yet, says he, the spots are so widely scattered over the map as to show how much more we have to learn of the sea-bed.

The distribution of warm and cold currents is now beginning to be understood, he remarks; and the dispersion and relative abundance of deep-sea life, and the formation of siliceous and calcareous ooze and muds, are still to be more deeply studied. At all events, the sounding-line has never gone so deep but the microscope shows that nature is rich there also with life. We know not, he says, what forms of being, minute or gigantic, exist throughout the abyssal depths; and "the abundant occurrence of *Peridinia* in the flint of the deep-sea chalk, as well as the living luminous animals on the ocean's surface, and even at the deep bottom off Florida, point to a possibly periodic, and even permanent, strong light in those depths, enabling the creatures of the abyss to have the use of their visual organs."

Dr. Ehrenberg then enumerates the organisms which he has himself determined from the shallow and deep waters of oceans and inland seas, namely:—I. (Independent organisms) 724 Polygastrica, 287 Polycystina, 585 Polythalamia, 22 Mollusca, 30 Pteropoda, 1 Annulatum, 2 Entomostraca, 6 Radiata, 9 Bryozoa, 1 Anthozoum; II. (Not independent, but named for convenience of recognition) 226 Phytolitharia (including 142 Spongolitha), 50 Geolithia, 37 Zoolitharia, and 23 soft parts of plants. Of living marine shelled animals [including Diatomaceæ] thus observed, he reckons 1645; and of the derivative forms mentioned above under the second heading he has 336; altogether 1981.

For the North Polar Zone he has 71 definite organisms out of the list, for the North Temperate 918, for the Equatorial 487, for the South Temperate 47, and for the South Polar Zone 24, the greater numbers going with the larger researches.

In six stages of depth from 101 to 20,000 feet the calculation is as follows:—

Feet.	Definite Forms.	All observed Organisms.
101– 500	88	315
501– 1000	72	240
1001– 5000	141	437
5001–10000	146	408
10001–15000	130	344
15001–20000	115	236

The shallow-water forms are not here taken into consideration, as freshwater organisms are mixed with them by geographical accidents.

Ehrenberg points out that the abundance of independent forms inhabiting the deep-sea bed is against the old notion, born of Bory de St. Vincent, and resuscitated of late years, that a living pulp pervades the sea and sinks in decay to the bottom; nor, says he, are the small the fry of the larger organisms.

Prof. Ehrenberg's researches in microscopic fossils were begun in 1836 (with sliced flint and semiopal) and 1838 (with the Chalk), and are chiefly exhibited in the 'Mikrogeologie,' 1854. Enumerating the subjects of these researches, he arrives at the following numbers: —independent forms, 1435; derivative fragments and parts, 172; altogether 1607. Adopting the following five great periods, he arranges his microscopic results* thus:—

	Definite Forms.	All observed Organisms.
Quaternary	419	652
Tertiary	362	807
Chalk	292	445
Jura	7	11
Carboniferous and Grauwacke ..	52	60

* In relation to this table of the geological distribution of Prof.

Ehrenberg finds that the notion of there being partially, or even altogether, different life-conditions in the superficial and the deep sea is weakened by his numerous observations.

Polycystina, *Actinophrys*, Coccoliths, and *Bathybius*, besides the relationships of animals, and development, as treated by Darwin and others, are subjects also dwelt upon, in a conservative manner, in the memoir of which the abstract is before us; and the author recommends cautious limitation of subject, restriction of hypothesis, and uniformity of method, as the only foundation for good work among naturalists.

The diagnoses of a great number of living genera and species of Polythalamia, Polygastrica, Polycystina, Spongolithides, Geolithia, and Zoolitharia follow (pp. 276–322).

A review of Prof. Ehrenberg's genera and species of Foraminifera having been lately offered in the 'Annals of Nat. Hist.' (Nos. 51, 52, 57, 58, and 60, vols. ix. & x. 1872), it is convenient to add in this place some results from a study of the new notices before us.

To the Polythalamia [Foraminifera] Prof. Ehrenberg adds, as genera:—1. *Aspidodexia* (apparently some Rotaline). 2. *Bolbodium* (possibly a *Pullenia*). 3 and 4. *Hemisterea* and *Hemisticta* (probably *Rotalinæ*, of which there are several genera which have the spiral or upper surface porose, whilst the umbilical or lower face has an extra-thick glassy coat). 5. *Otostomum* (probably a dimorphous *Virgulina*, such as is indicated under the name *Bifarina* in Ann. Nat. Hist. Sept. 1872, p. 198). Lastly, No. 6. *Pylodexia* [1859], which is intended to comprise the *Globigerinæ* which have the spire on the left and the large aperture on the right side, the true *Globigerinæ* having these features reversed—characters which appear to be of little or no value.

Of Foraminifera 90 are described as new species, chiefly from great depths in the Arctic and Atlantic oceans, with several from the Agulhas Bank (at about 400 feet depth) off the Cape of Good Hope, and a few from the Pacific. Of "Polygastrica," 39 are diagnosed; of Polycystina, 123; Spongolithides &c., 7.

Ehrenberg's Microzoa &c., we must refer to the several lists of local species of Foraminifera, determined according to the revised nomenclature, in the review of his figured fossil specimens in the 'Annals of Nat. Hist.' Nos. 51, 52, 57, 58, and 60, vols. ix. and x. 1872; and we must add that in the classified list of fossil Foraminifera figured by Ehrenberg down to 1858, in the 'Annals of Nat. Hist.' Dec. 1872, pp. 454–457, there are enumerated, besides 20 undetermined forms, only 138 species and noticeable varieties, most of which are living at the present day, and of which 81 had been named by other observers.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Dec. 19, 1872.—Sir George Biddell Airy, K.C.B., President, followed by Mr. Busk, Vice-President, and Dr. Sibson, Vice-President, in the Chair.

"On the Organization of the Fossil Plants of the Coal-measures. Part IV. *Dictyoxylon*, *Lyginodendron*, and *Heterangium*." By W. C. Williamson, F.R.S., Professor of Natural History in Owens College, Manchester.

In 1866 Mr. Binney gave the name of *Dadoxylon Oldhamium* to a fossil stem of a plant from the Lower Coal-measures of Lancashire, believing it to belong to the same class of Gymnospermous Exogens as the *Pinites* of Witham and the *Dadoxylon* of Endlicher. In 1869 the author pointed out that the reticulated markings upon the surface of its vessels were modifications of the spiral fibre of fibro-vascular tissue, and not the disks of what is often designated glandular fibre. He consequently separated the plant from the Dadoxylons under the name of *Dictyoxylon Oldhamium*. At the Edinburgh Meeting of the British Association in 1871 he gave a brief account of the structure of this plant, as also of what appeared to be a second species from the Lower Coal-measures of Burntisland in Fifeshire, which he called *D. Grievii*, after its discoverer, D. Grieve, Esq. A detailed exposition of the organization of these two plants is given in the memoir.

Dictyoxylon Oldhamium.—This was a stem composed of the three divisions of pith, wood, and bark. The pith consisted of regular parenchyma without divisions or cavities of any kind. In very young plants it was surrounded by an irregular ring or medullary cylinder of reticulated vessels, not arranged in radiating laminæ. This cylinder broke up at an early period into several detached vascular bundles, which, as the stem enlarged, became widely separated from each other, the intervening space being occupied by medullary parenchyma. But before this change was completed, the true ligneous zone appeared as a thin ring of vessels arranged in radiating vertical laminæ, separated from each other by large and conspicuous medullary rays, composed of mural cellular tissue. Additions were made to the exterior surface of this zone by the agency of a delicate cellular layer of cells, which constituted the innermost layer of the bark. These additions demonstrate their exogenous nature in several specimens in which the vessels of the outermost zone have not attained to half their normal size, resembling in this respect some of the Lepidodendroid plants described in the author's last memoir (Part III.). Through these successive exogenous growths the vascular axis of the stem ultimately became arborescent. One specimen is described in which such a vascular axis, though imperfect and waterworn, is fully six inches in diameter, independent of the bark; other specimens have been obtained intermediate in size between the above example and the small stems more usually met with. The vascular laminæ increased in thickness as they proceeded from within outwards, and then subdivided, in the ordinary exogenous manner, through the intercalation of new medullary rays. These rays are remarkable for the great vertical range of each one, as well as for the large number of cells which enter into their composition. In tangential sections they appear as elongated lenticular masses of parenchyma.

The Bark.—This organ is separable into three, if not four layers. The innermost one is a delicate parenchyma closely investing the ligneous zone, its cells being continuous with those of the medullary rays. At its outer surface this tissue passes gradually into another parenchymatous layer of greater thickness than the inner one. Both of them have patches of dark-coloured cells scattered through their tissues. But the most remarkable part of the bark is the third or prosenchymatous layer, which presents very different features according to the aspect in which it is regarded. In the transverse section it consists of radiating bands of parenchyma alternating with narrower and very dark-coloured ones of woody prosenchyma, the latter looking very like the Roman numerals upon the face of a clock. Tangential sections show that the black bands are fibrous laminæ, which pursue an undulatory course as they ascend through the stem, and which, as they alternately approach and recede from one another, divide this part of the bark into a series of lenticular or rhomboidal areas, occupied by various forms of parenchyma. No vascular bundles enter these areolæ; hence they are something altogether different from the leaf-scars of the *Lepidodendra*. Externally to this prosenchymatous layer some specimens exhibit detached traces of a very thin external layer of parenchyma, apparently derived from the cells of the rhomboidal areolæ, which have extended beyond the fibrous laminæ and spread themselves over the surface of the bark as a continuous layer; but this condition appears to be confined to very young stems.

Vascular bundles of large size ascend vertically through the two inner parenchymatous layers of the bark. In some instances each of these bundles exhibits, in the transverse section, an oval outline, with faint traces of a vertical division into two parts. But ordinarily the two halves of the bundle have separated, forming two distinct bundles, which are some distance apart. They exhibit little or no tendency to diverge from the ligneous cylinder as they ascend, and in some instances actually become incorporated with it. It is remarkable that the position of each of these double bundles, at the *exterior* of the ligneous zone, corresponds with the spaces intervening between the detached masses of the medullary cylinder *within* it, as if the former were designed to act as buttresses strengthening these weaker points in the vascular axis. It not unfrequently happens that exogenous additions are made to such of these bundles as are encompassed by the innermost layer of the bark, in the shape of a few radiating laminæ of vessels developed on their outer or peripheral surfaces.

One specimen of the vascular axis is, as already mentioned, so large as to demonstrate that the plant became arborescent.

Though *Dictyoxylon* was not a dichotomizing plant, like *Lepidodendron*, it gave off lateral bundles of vessels. Some of these are simple bundles, consisting of numerous vessels intermingled with some cellular tissue. Others have this central bundle invested by a thin ring of radiating laminæ with intervening medullary rays; this exogenous ring sometimes becomes developed into a relatively large and distinct woody zone, like that of the parent axis. The vessels of these lateral growths appear to be wholly derived from the radiating woody zone.

A second form of lateral appendage appears to spring from the medullary rays, and consists of a cylindrical mass of reticulated cells, which are chiefly prosenchymatous, but of an elongated type. It is suggested that this structure may have been prolonged into an adventitious root.

The structure of the central or medullary vascular axis of the former of these two kinds of lateral appendages seems to indicate that the history of the development of the medullary vascular cylinder in these plants corresponds with what the author described in his preceding memoir (Part III.) as taking place in the similar parts of the *Lepidodendra*, viz. that some of the cells of the central part of the axis underwent rapid fission, and thus developed a distinct cellular medulla, which forced the medullary vessels outwards where at first they constituted a ring, but which ring soon broke up into the detached vascular masses already referred to as adhering to the inner surface of the exogenous zones.

The enlargement of the exogenous woody cylinder by the peripheral intercalation of new radiating vascular laminæ, and the repeated subdivision of these laminæ by a corresponding intercalation of new medullary rays, demonstrates the close resemblance between the growth of the ligneous zone in these plants and that of ordinary exogenous stems. A fine series of specimens collected by the Rev. H. Higgins, of Rainhill, near Liverpool, and which exhibit various modifications of the type figured by the late Mr. Gourlie under the name of *Lyginodendron Landsburghii*, are shown to be merely casts of the exterior surface of the bark of some species of *Dictyoxylon*. They may actually belong to *D. Oldhamium*; but this is not yet proven.

Dictyoxylon Grievii.—This plant has many points of affinity with *D. Oldhamium*; nevertheless it has very distinct features of its own. Its central or medullary axis is very large in proportion to the thickness of its exogenous ring; the former consists of cellular parenchyma, throughout which are scattered numerous bundles of exquisitely reticulated vessels unprovided with any special sheaths. The largest vessels are nearest the centre of the axis, the peripheral ones becoming smaller, more numerous, and grouped in more continuous masses. Immediately surrounding this vasculo-cellular axis is a thin ring of similar vessels, but arranged in radiating laminæ, separated by well-defined medullary rays. This zone is generally of unequal thickness on opposite sides of the plant, and contains some barred vessels amongst its reticulated ones; the medullary rays are composed of mural cells.

The bark consists of three very distinct layers. The innermost one is very thin, consisting of delicate parenchyma, but which nevertheless has formed a very clearly defined flexible layer; outside this is a thick stratum of coarser but regular parenchyma subdivided in the transverse section into vaguely defined areas by thick wavy lines of condensed cells. The peripheral outline of this zone is very irregular, frequently projecting outwards in large angular masses. It is bounded by a prosenchymatous external layer, which is a dwarfed representative of the corresponding one of *D. Oldhamium*. In the transverse section it exhibits dark radiating bands of fibres, longitudinally disposed, alternating with similar bands of parenchyma; but it differs from *D. Oldhamium* in the narrowness of the latter, and consequently in the more linear form of the cellular areolæ of the outer bark. In longitudinal sections of the bark its innermost layer appears as in transverse ones. The middle parenchyma, on the other hand, exhibits remarkable differences from its aspect in the transverse section: its cells are arranged in vertical columns; but these are intersected at intervals of nearly $\frac{1}{50}$ of an inch by horizontal and parallel bands of very dark-coloured cells of a special nature.

Seven or eight large vasculo-cellular bundles exist in each transverse section of the bark. Some of these are located within the exogenous layer of the wood, being obviously detached portions of the cells and vessels of the medullary axis; others occur, in various specimens, at every point between the wood and the outer bark. The author finds that these bundles remained for a time in the immediate neighbourhood of the innermost bark, but that they successively became detached and moved more rapidly outwards, until each one emerged at the periphery of the bark in one of the prominent angles of the latter, already referred to; when one bundle has thus reached the periphery, another begins to follow the same centrifugal course. The inference is, that these are foliar bundles, supplying large leaves or petioles, sparsely grouped round the stem. A single example of a similar centrifugal bundle was found in *D. Oldhamium*. The seemingly irregular projections of the bark of *D. Grievii* thus appear to represent angular petioles, and are not the result of merely accidental pressures. A second kind of cylindrical bundle is noticed, consisting of reticulated prosenchymatous cells. It is connected at its central extremity with the medullary parenchyma, whilst its peripheral end passes outwards through the bark. It appears to have had the same character as the similar one of *D. Oldhamium*, having probably been an adventitious root-bundle.

Somewhat triangular twigs or petioles of the above plant are numerous. They consist of a single vascular bundle, located excentrically near the cordate base of the triangular transverse section, and surrounded by the three bark-layers seen in the older stems.

The structure of these layers, as seen in the longitudinal sections, is identical with, though less complex than, that of the matured stems; but no cortical vascular bundles are seen in them.

Having identified his *Dictyoxylon Oldhamium* with the older genus *Lyginodendron*, the author abandons his own generic name, and proposes that the plant shall henceforth be designated *Lyginodendron Oldhamium*. He establishes in the same way the generic identity of *Dictyoxylon Grievii* with the *Heterangium* of Corda; hence that plant must now take the name of *Heterangium Grievii*. Whilst having no doubt that the above were two Cryptogamic plants, it appears impossible for the present to determine to what class of Cryptogams they belong. Many of their features indicate Lycopodiaceous affinities; but this point can scarcely be determined until the actual fronds are discovered. This has not yet been done. The *Lyginodendron* is from the horizon of the Ganister beds of Lancashire and Yorkshire; the Burntisland deposit belongs to the middle portion of the calciferous sandstones of the Burdiehouse Carboniferous strata.

MISCELLANEOUS.

On Whales in the Indian Ocean. By H. J. Carter, F.R.S. &c.

(In a letter to Dr. J. E. Gray, F.R.S.)

I have been much interested in the perusal of your paper in the 'Annals' for February "On the Geographical Distribution &c. of Whales and Dolphins;" and, with reference to Captain Maury's observation that the sperm-whales inhabit a belt of sea in or on each side of the tropics, would communicate to you the following facts, which, if not already known to you, will, I am sure, be acceptable.

Within twelve years, while I was at Bombay, the mutilated carcasses of two dead whales drifted on shore there. One I went to see: it was an enormous mass, and supposed to have belonged to a whale 80 feet long. The bodies of the vertebræ were as large, I think, as the bodies of any whale-vertebræ that I ever saw. Not being interested in any further detail, and the stench of the putrid blubber being so great that it was full a month before it left my shoes, I went no further than to witness the sight.

It is very common for whales to be seen off the coast of Khattyawar, a little north of Bombay, but still in the tropics, by those who are making the voyage between Bombay and Kurrachee, in Sind. And if at Bombay, within the space of twelve years, two dead whales drift in, it may be assumed that such must occur at many other places on this coast, and therefore that the number of dead whales which thus become stranded must be considerable.

While on the survey of the south-east coast of Arabia (that is, the northern boundary to the Indian Ocean), for two years we never saw a whale; but in the Bay of Măskat one used to come in every day in the afternoon, plough his way among the boats and vessels there, and then go out again. He appeared to me to be about 20 or 30 feet long; and when I pointed him out to the officers of the vessel, they said "that is 'Muscat Tom;' he pays a visit to the bay every day, and has been known to do so from time immemorial." We saw schools of porpoises, sometimes perhaps two miles long, on the south-east coast; and one of the perquisites of the Shaykh of Raidah, a town on the coast about sixty miles north-east of Măkalla, is the unborn young of the porpoise when a female is caught in this condition. Once, also, when we were sailing down the coast, in a stiff breeze, towards Aden, two or more "blackfish," as the sailors called them, accompanied us for twenty-four hours, keeping close to the side of the vessel and sporting round her. They appeared to me to be about 12 feet long.

But, if we did not happen to see any whales on this coast, we heard that the fishermen (who go to the most unfrequented parts yearly to catch small and large shark, the former to salt-in for provision, which is a staple commodity on this coast, and the latter for their fins for the China market) often pick up portions of ambergris, which, I think, at Măskat, sells for more than its weight in gold, chiefly for its fancied aphrodisiacal power.

One day, one of these fishermen came alongside our vessel, and handed me in, through my scuttle, a piece half as big as my head. It was formed of concentric layers like cholesterine, in which were imbedded an innumerable quantity of cuttlefish-beaks. Of course, I only regarded it in a scientific point of view; and, fancing that it was analogous to the "hair-ball" in the ox's stomach (the horny beaks of the cuttlefish forming the ingesta), I took a little bit as a specimen, gave the man a dollar, and told him to take the rest to the Măskat market.

On another occasion, while fishing in the jolly-boat with a midshipman and one of our Beni-Bo-Ali pilots in the channel between the mainland of Arabia and the island of Masira, we saw some large fish biting at something on the surface of the water, when, to our astonishment, the Beni-Bo-Ali pilot leapt over and, swimming up to it, laid hold of it and brought it on board, when it turned out to be a dead cuttlefish. Our pilot said, "Ah! I thought it had been a piece of ambergris which the sharks were eating; for they are very fond of it, and it is often found under such circumstances."

All this goes to prove that there are many whales in this part of the Indian Ocean just within the tropics, and that they are the sperm-whale. Of course they cannot get very far out of the tropics to the north without getting into the land-locked waters of the Red Sea and Persian Gulf respectively.

I know that Cephalopoda *abound* on this coast, and that American whalers used to capture the sperm-whale there; for our captain had saved the crew of an American whaler there which had become injured, and took them all up to Măskat.

On a new Subclass of Fossil Birds (Odontornithes). By O. C. Marsh.

The remarkable extinct birds with biconcave vertebræ (Ichthyornidæ), recently described by the writer from the upper Cretaceous shale of Kansas *, prove on further investigation to possess some additional characters, which separate them still more widely from all known recent and fossil forms. The type species of this group, *Ichthyornis dispar*, Marsh, had well-developed *teeth in both jaws*. These teeth were quite numerous and implanted in distinct sockets; they were small, compressed, and pointed, and all of those preserved are similar. Those in the lower jaws number about twenty in each ramus, and are all more or less inclined backward. The series extends over the entire upper margin of the dentary bone, the front tooth being very near the extremity. The maxillary teeth appear to have been equally numerous, and essentially the same as those in the mandible.

The skull was of moderate size, and the eyes were placed well forward. The lower jaws are long and slender, and the rami were not closely united at the symphysis; they are abruptly truncated just behind the articulation for the quadrate. This extremity, and especially its articulation, is very similar to that in some recent aquatic birds. The jaws were apparently not encased in a horny sheath.

The scapular arch, and the bones of the wings and legs, all conform closely to the true ornithic type. The sternum has a prominent keel, and elongated grooves for the expanded coracoids. The wings were large in proportion to the legs; and the humerus had an extended radial crest. The metacarpals are united, as in ordinary birds. The bones of the posterior extremities resemble those in swimming birds. The vertebræ were all biconcave, the concavities at each end of the centra being distinct and nearly alike. Whether the tail was elongated cannot at present be determined; but the last vertebra of the sacrum was unusually large.

This bird was fully adult, and about as large as a pigeon. With the exception of the skull, the bones do not appear to have been pneumatic, although most of them are hollow. The species was carnivorous, and probably aquatic.

When the remains of this species were first described, the portions of lower jaws found with them were regarded by the writer as reptilian †; the possibility of their forming part of the same skeleton, although considered at the time, was not deemed sufficiently strong to be placed on record. On subsequently removing the surrounding shale, the skull and additional portions of both jaws were brought to light, so that there cannot now be a reasonable doubt that all are parts of the same bird. The possession of teeth and biconcave vertebræ, although the rest of the skeleton is entirely avian in type, obviously implies that these remains cannot be placed in the present

* Amer. Journ. of Sci. and Arts, vol. iv. p. 344, Oct. 1872, and vol. v. p. 74, Jan. 1873. 'Annals,' Jan. 1873, p. 80.

† Amer. Journ. of Sci. and Arts, vol. iv. p. 406, Nov. 1872.

groups of birds; and hence a new subclass, *Odontornithes,* is proposed for them. The order may be called Ichthyornithes.

The species lately described by the writer as *Ichthyornis celer* also had biconcave vertebræ and probably teeth. It proves to be generically distinct from the type species of this group, and hence may be named *Apatornis celer*, Marsh. It was about the same size as *Ichthyornis dispar,* but of more slender proportions. The geological horizon of both species was essentially the same. The only remains of them at present known are in the museum of Yale College.

The fortunate discovery of these interesting fossils is an important gain to palæontology, and does much to break down the old distinctions between Birds and Reptiles, which the Archæopteryx has so materially diminished. It is quite probable that that bird, likewise, had teeth and biconcave vertebræ, with its free metacarpals and elongated tail.—*Amer. Journ. of Science and Arts,* vol. v., Feb. 1873.

On two new Free Sponges from Singapore. By Dr. J. E. Gray, F.R.S. &c.

Dr. A. B. Meyer has sent to the British Museum five specimens of free sponges (four of them belonging to one species, and the other to a separate one), which I believe were obtained in the neighbourhood of Singapore.

The one is very like *Tetilla polyura* of O. Schmidt ('Spongienfauna des atlantischen Meeres,' t. vi. f. 8), which is the type of my genus *Lophiurella*, but differs from it in several particulars; and the other is a form which has not hitherto occurred to me.

It has been thought that these free sponges are only the young and free state of sponges which become attached in their older state; but this theory wants further confirmation. *Tetilla polyura* of Schmidt might be young, as it is only $\frac{1}{3}$ inch long; but the specimens from Singapore are more than 2 inches in diameter and length.

The four specimens, which I have called *Psetalia globulosa*, exhibit four different states of growth, the sponge being considerably modified in its general form as it enlarges.

The youngest specimen, about $\frac{1}{3}$ inch in diameter, is half-oblong, with a few conical projections on the lower part, each ending in a tuft of spicules, and with a flattened upper surface having a small central opening leading to the inner surface.

In a larger specimen, about $1\frac{1}{2}$ inch in diameter, the conical prominences on the under surface, each ending in a tuft of elongate spicules, are more numerous, and the upper surface is produced, conical, and ending in a much larger central opening.

In the largest specimen, about $2\frac{1}{2}$ inches in diameter, the sponge is irregularly conical below, the surface being covered with distinct, rather prominent, tubercles, each containing a tuft of elongate filamentous spicules, ending below, as in the other specimens, in three or more recurved anchoring spines. The upper surface is deeply concave, with only a broad convex margin, incurved, edging the concavity. This, like that of the interior of the other specimens, has a series of rounded oscules, that are small near the margin and gradually increase in size as they approach the centre, where the oscules become united into two very large oblong rather sinuous holes. The outer surface of this sponge exhibits a quantity of small circular holes interspersed among the tubercles which bear the bunches of spicules.

The other sponge I have named *Labaria hemisphærica*. It is hemispherical, about 2 inches in diameter, and rather more than 1 inch high, with a rather smooth outer surface and a rather deep regular concavity on the upper surface, which seems formed of interlacing spicules, leaving considerable spaces between them. The outer surface and its margin are scattered with distant, but rather regularly placed, cylindrical perforations, from the centre of which are emitted tufts of elongated filiform spicules, diverging in all directions from the surface of the sponge. The middle of the underside deeply concave, with a well-defined edge, from which is emitted a very large tuft of very numerous crowded spicules, forming a kind of brush, each filament when perfect ending in three short recurved spines.

Mr. Carter will give a further account of these sponges, with descriptions of the spicules of which they are formed, in his account of the sponges in the British Museum.

On the "Capreolus" of Zonites algirus. By E. Dubreuil.

In our anatomical and historical investigation of the generative apparatus of the *Helices*, we have noticed the presence of a spermatophore in *Zonites algirus*, and described the *capreolus* of that species, which had not been indicated by any malacologist.

This body, 26 millims. in length and 1 millim. in breadth at its most inflated portion, is of a tubular form, diminishing in size on both sides from its inferior third. It is a complete canal, furnished with numerous spiral channels. A transverse section made about its middle has the aspect of a cogged wheel furnished with from twelve to fourteen little teeth. Its superior extremity terminates in a tube with a capillary aperture, where the lamellæ disappear; whilst the other, where they are more distinct, is shorter and presents a wider orifice. It is covered with an albuminoid membrane.

When the introduction of the *capreolus* is completed, its inferior extremity, curving into the arc of a circle, inserts itself for three, four, or five millimetres into the neck of the oviduct, which, in this species, is destitute of a transverse muscle. This extremity is enveloped by a whitish viscous matter, which escapes from the interior of the spermatophore, and contains an infinity of spermatozoids. The issue of these from the interior of this appendage is due to the action of the muscular membrane of the copulatory canal.

A part of the inferior deferent duct is destined to the production of the *capreolus*. This duct, which measures 50 millims. in extent, has not the same volume throughout its length. From its point of junction with the deferent channel for a distance of 31 millims. its diameter is $\frac{1}{3}$ or at most $\frac{1}{2}$ millim., whilst in the second half of its course, which terminates at the penis, it is $\frac{1}{4}$ or sometimes $\frac{1}{3}$ millim. The narrow portion of the duct is pellucid; the dilated portion, of an opaque white, is composed of the same layers which are met with in the *flagellum* of the *Helices*. Beneath an external cellular membrane we find a muscular membrane, followed in its turn by a glandular layer, which does not exist in the narrow part of the duct.

In the wide portion of the same organ we observe numerous lamellæ arranged like the spiral fibre of the tracheæ of plants. These lamellæ extend in an oblique spiral between the two margins of this portion of the canal, their obliquity increasing towards the point of junction of the two portions of the latter, in the neighbourhood of which they finally become longitudinal. At the breeding-time they are covered with solid white particles, which effervesce with hydrochloric acid.

In its movement of retroversion the penis is followed by the inferior deferent canal, which contains the *capreolus* until the moment when this body is expelled.—*Comptes Rendus*, November 4, 1872, tome lxxv. pp. 1126, 1127.

On the Developmental History of Petromyzon. By A. Schneider.

Since August Müller published his fine discovery of the transformation of *Ammocœtes* into *Petromyzon* (Müller's Archiv, 1856; see also Ann. & Mag. N. H. ser. 2, vol. xviii. p. 298), every zoologist must certainly have been desirous of witnessing this wonderful metamorphosis. Here in Giessen the opportunity seemed to offer itself to me; for, in the Bieberbach, *Ammocœtes branchialis* occurs in such abundance that in the course of two years I obtained about two hundred *Ammocœtes* and a dozen of *Petromyzon Planeri*. But I never obtained the transition-stages, nor could I succeed in getting full-grown specimens of *Ammocœtes* to undergo any further development in tanks. I must therefore acknowledge with thanks that Prof. von Siebold had the kindness to give me two specimens of the transition-stage which were in his possession. As I was sufficiently familiar with the structure of *Ammocœtes* and *Petromyzon*, these sufficed to give me an insight into some of the most important processes.

On the ventral surface of the *Ammocœtes* there is an elongate-oval organ, already mentioned by Rathke, which was regarded by A. Müller as the rudiment of the tongue, but the structure of which has hitherto remained entirely unknown. It is a gland which opens into the œsophagus in the ventral line between the third and fourth branchial clefts. Its structure differs from that of all other known glands. The orifice leads into two tubes lying close to one another, and which extend forward to the end of the branchio-œsophageal cavity, and backward to the boundary between the fifth and sixth branchial clefts. Just at the orifice another tube branches off on each side, passes a short distance backward, and then, bending upward and forward, reaches the vicinity of the orifice of the gland, then again bends downward and backward, and again downward and forward, so that it describes about $1\frac{1}{2}$ spiral convolution. In the part situated in front of the orifice of the gland, there are on each side four cords consisting of nucleated cells. The cells are cuneiform, with a polyhedral transverse section; they stand with their bases at the surface of the cord; and all converge towards a longitudinal central surface. The whole mass appears as if finely striated; but the striation does not seem to be due to fibrillæ, but only to the edges of the rather thin cells.

These four cords are united by vascular connective tissue into a thick compact cord, which, lying upon the tube, projects into its lumen. The inner surface of the tube, including the compact cord, is covered by a ciliated epithelium. The four distinct cords lie at the surface of the compact cord something like four cylinders which are enveloped by a larger cylinder touching them. At the line of contact the ciliated cells are deficient, and the subjacent glandular substance appears freely towards the lumen of the tube. These places are also those towards which the cells converge. Of the four cords, two run into the portion of the tube which extends directly backward, whilst two pass into the spirally convoluted part and follow its convolutions. In other respects the structure in the hinder part is exactly as in the anterior part. No trace of a neutral fluid is to be found in the gland.

From this gland the tongue certainly does not originate, as has been concluded from its position, but during the metamorphosis the striated cell-substance disappears. The connective tissue and the epithelial lining of the tubes remain; the latter separates from the wall, and in part remains tubular, but in part constricts itself into balls. In short, there is produced from it an organ which, both in position and structure, agrees with the thyroid glands of the developed vertebrate. The organ described as the thyroid gland in *Petromyzon* by Wilhelm Müller (Jenaische Zeitschr. vi. p. 433), I cannot regard as the same, either in structure or position. I have found the true thyroid gland both in *P. Planeri* and *P. fluviatilis*; and it will certainly not be deficient in the other species. In *Ammocœtes* consequently we find for the first time, and hitherto alone among all Vertebrata, *the thyroid gland in function during a long period of life and in a high state of development.*

The branchial clefts in *Ammocœtes*, as is well known, open into the œsophagus—but in *Petromyzon* into a free tube, closed posteriorly, the bronchus, above which there is an œsophagus which unites the intestinal canal with the buccal cavity. From the mere comparison of *Ammocœtes* and *Petromyzon* we cannot see how the new state is produced from the old one. This takes place as follows:—The œsophagus is formed in the dorsal median line of the branchial cavity as a solid cord, consisting of round, closely approximated nuclei, only separated by a little interstitial substance; and into this a cavity penetrates from the front and gradually renders it permeable. At the same time an increase of the blood-vessels commences in the connective tissue which surrounds the branchial cavity and the œsophagus. The vessels finally coalesce, so that both the bronchus and the œsophagus lie free in a great blood-space, extending from the so-called pericardium to the point of the head. In this are also situated the branchial artery, the tongue, and the branchiæ themselves.

The above-mentioned foundation of the œsophagus is not indicated at all in *Ammocœtes.* It must not be confounded with the fold which hangs down from the dorsal median line into the branchial cavity of *Ammocœtes.*

One of the first processes of the metamorphosis must be the formation of the tongue; in both my specimens it was already formed, whilst the œsophagus was only permeable for a few millimetres, and the mouth still possessed the narrow opening figured by Von Siebold (Süsswasserfische von Mitteleuropa, p. 381).—*Oberhessischen Gesellsch. für Natur- und Heilkunde*, January 11, 1873.

On the Parasites of the Cetaceans of the N.W. Coast of America, with Descriptions of New Forms. By W. H. Dall, U. S. Coast Survey.

Among the parasites most widely known as infesting the Cetacea, two classes may be recognized, viz. those which are true parasites, deriving their subsistence from the animal upon which they are found, such as the Pycnogonoids and *Cyami*; and those which are merely sessile upon the animal, and derive no nourishment or other benefit from it which might not equally well be furnished by an inanimate object, such as the various Cirripedes.

No Pycnogonoids have yet been reported from the Cetacea of this coast. Brief descriptions of the species of *Cyamus* found upon the California grey, the humpback, and the Arctic bowhead whales were submitted by me to the Academy at a recent meeting. I may here add to those descriptions a few facts since obtained, and bearing upon the species described. I have, through the courtesy of Capt. Scammon, been able to examine a large number of *Cyami* obtained at Monterey, Cal., from the humpback (*Megaptera versabilis*, Cope). They are all of the same species as that (*C. suffusus*) described by me as parasitic upon that whale—a fact which tends to confirm the hypothesis that each species of whale has its own peculiar parasites, and that there is rarely more than one species of *Cyamus* found upon one animal. The females, which were unknown at the date of my description, now prove to resemble the male in every respect, except in regard to the sexual organs, and in being a trifle more slender in form.

Among the Cirripedes, *Tubicinella* has not been reported from these waters, nor is the *Chelonobia* known to have been obtained from any of the whales of this coast. The genera known from the north Pacific waters are *Coronula*, an allied form which I believe to be uncharacterized, and *Otion* or a closely allied form.

SESSILIA.

CORONULA, Lam.

Coronula, Lamk. An. s. Vert. v. p. 387.

Coronula balænaris, Linn. sp.; Lamk. Ann. du Mus. i. p. 468, pl. 30. figs. 2–4.

This species, or one very closely allied to it, was obtained by the late Mr. Bridges, probably from the coast of Central America; but the identification of the exact locality and the species of cetacean from which it was obtained was prevented by the premature and lamented decease of that energetic field naturalist.

Coronula diadema ?, Lamk.

It is quite possible that the species here indicated under the above name may be distinct from the true Atlantic *diadema*; but materials for exact comparison are wanting, and the figures given by Reeve and others very closely resemble the form before me. The radiating ridges are six in each group, often slightly bifurcated at their bases, and strongly sculptured with transverse, fluctuating, slightly elevated beaded lines. The interspaces are sharply transversely grooved. The superior membranous surface is brown, the pallium or hood surrounding the cirri is slightly purplish. The scuta are subtriangulate, with the posterior prolongation longest, slightly keeled above, with sharply pointed adjacent umbones at the anterior angle of the occludent margin. No vestiges of the terga are present. Adult specimens are over two inches in diameter at the base. In such a specimen the dimensions of the scuta are as follows:—length of occludent margin ·215 in., posterior margin (slightly arcuated) ·28 in., anterior margin ·175 in. Colour of scuta white; concave below, stout, solid. This species has been obtained from the humpback whale (*M. versabilis*) from Behring Strait to the Gulf of California, and may also be found on other species. It is especially abundant on the flippers and on the under lip of these animals.

CRYPTOLEPAS, n. g.

Scuta and terga both present, minute; valves six; externally produced below the surface of the whale's skin in thin radiating laminæ, with their planes perpendicular to the vertical axis of the animal, and bifurcating and enlarged toward their distal edges. Parasitic on Cetacea.

Type *Cryptolepas rhachianectis*, Dall, n. sp.

Valves subequal, rostrum radiate, not alate. Lateral valves anteriorly alate, posteriorly radiate; carina alate, not radiate. Each valve internally transversely deeply grooved, and furnished externally with six radiating laminæ vertically sharply grooved, the adjacent terminal laminæ of each two valves coalescing to form one lamina of extra thickness; all the laminæ bifurcated and thickened toward their outer edges, with two or more short spurs on each side, irregularly placed between the shell-wall and the bifurcation. Superior terminations of the valves (bluntly pointed?) usually abraded, transversely striate. Scuta subquadrate, adjacent anteriorly, very slightly beaked in the middle of the occludent margin; terga subquadrate, small, separated from the scuta by intervening membrane; both very small in proportion to the orifice. Membranes very thin and delicate, raised into small lamellæ between the opercular valves. All the calcareous matter pulverulent, and showing a strong tendency to split up into laminæ. Antero-posterior diameter of large specimen 1·62 in., ditto of orifice ·63 in.; transverse diameter of orifice ·58 in.; length of scuta ·17 in., breadth ·08 in.; length of terga ·07 in., breadth

·07 in. Colour of membranes, when living, sulphur-yellow; hood extremely protrusile.

This species is found sessile on the California grey whale (*Rhachianectes glaucus*, Cope). I have observed them on specimens of that species hauled up on the beach at Monterey for cutting off the blubber, in the bay-whaling of that locality. The superior surface of the lateral laminæ being covered by the black skin of the whale, was not visible; and the animal, removed from its native element, protruding its bright yellow hood in every direction to a surprising distance, as if gasping for breath, presented a truly singular appearance.

PEDUNCULATA.

OTION, Leach.

Otion, Leach, Encycl. Britannica, Suppl. vol. iii. p. 170.

Otion Stimpsoni, Dall, n. sp.

Scuta only present, beaked, with the umbones on the occludent margins; anterior prolongation the longer, pointed, rather slender; posterior prolongation rounded, wider; external margin concave. Colour (in spirits) light orange with a dark purple streak on the rostral surface and on each side of the peduncle, while the lateral surfaces of the body-case and lobes are mottled with dark purple. The lower lip of the orifice is transversely striated and translucent, the upper margins, slightly reflexed internally, white; in some specimens with two prolongations or small lobes above, which are wanting in other specimens. The tubular prolongations very irregular and variable in size and form, usually unsymmetrical; one sometimes nearly abortive. Length of peduncle 2·8 in., of body 2·16 in., of lobes 2·0 in., of orifice 1·18 in., of scuta ·55 in.; width of scuta ·16 in.

Hab. On the "humpback" (*M. versabilis*), sessile on the *Coronulæ* which infest that species, but never, so far as I have observed, on the surface of the whale itself.

Dr. Leach describes five calcareous pieces, namely the scuta, terga, and rostrum, in the typical species (*O. Cuvieri*, Leach); and they are figured by Reeve; but this species has certainly only the scuta. Whether this difference is of more than specific value I am not able to decide, owing to the great paucity of works of reference here. I should be unwilling to describe the species, were it not that it was submitted to the late lamented Dr. Stimpson for examination, and was pronounced by him to be new.

A variety, or perhaps another form, was observed by me in Behring Strait in 1865, which was blotched all over with rose-pink, and had the scuta narrower and more slender; it was also smaller than the specimens before me; but as it is not at hand, I am unable to decide with certainty.

I am indebted to Capt. C. M. Scammon and R. E. C. Stearns, Esq., for specimens and facilities furnished in the preparation of this paper. Most of the specimens were collected by the former gentleman, and will be figured in his forthcoming monograph of the Cetaceans of the N.W. Coast.—*Proceedings of the California Academy of Sciences*, Dec. 18, 1872.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 65. MAY 1873.

XXXV.—*On the Primitive Cell-layers of the Embryo as the Basis of Genealogical Classification of Animals, and on the Origin of Vascular and Lymph Systems**. By E. RAY LANKESTER, M.A., Fellow and Lecturer of Exeter College, Oxford.

A "NATURAL" classification in modern zoology—in the zoology which recognizes in the various forms of living things the expression of one part of the general result proceeding from the continuous operation of physical forces—is a genealogical tree. In this tree, as in a family pedigree, no arbitrary arrangement is admissible, no association or separation of organic forms in harmony with theories of types, or with reference to symmetry and the vested interests of subkingdoms, classes, and orders. The simple questions are:—Have we grounds for believing this lot of forms to have a common ancestry with that lot? Which of these, again, give evidence of closer kinship? and which represent diverging lines of descent?

The evidence at our disposal for answering these questions satisfactorily, with regard to the innumerable varieties of plants and animals, is at the present time small indeed, but is increasing with great rapidity.

The fact that we are able to classify organisms at all in accordance with the structural characteristics which they present is due to the fact of their being related by descent; and the

* The substance of the following pages formed part of a course of lectures on the classification of animals, commenced in the University Museum, Oxford, during Michaelmas term, 1872.

classifications in vogue before the recognition of the origin of organic forms by descent may be regarded as unconscious attempts to answer the questions above put before they had been rightly formulated.

The chief means which the naturalist at present possesses of making out the genealogical tree of the animal kingdom lie in the fact that the individual animals living at the present day, in the process of reproduction, revert to the original simple condition (or nearly so) from which they have in the course of long ages been evolved as specific forms. The doctrine of evolution teaches us that at a certain period in the history of this planet such albuminoid substances as protoplasm came, by gradual building-up, into existence. From such protoplasm, by slow continuous development, due to its properties of heredity and adaptation, all living forms have proceeded by direct descent. Strangely enough, a simple spheroid of protoplasm (nucleated or not) is the form under which the detached reproductive particle of each living organism makes its appearance, and from such a spheroid every individual living thing has been more or less directly developed within the space of a few days or weeks. In passing from this simple condition to its adult form the individual goes through a series of changes, which are now explained by what may be termed "the recapitulation hypothesis," which supposes that the individual organism in thus developing repeats more or less completely the successive series of forms which its ancestry has presented in the course of past ages; in fact the development of the individual is an epitome of the development of the species. This tendency to recapitulate, which is the fullest expression of the phenomenon termed heredity, is liable to be masked in its effects in two chief ways, due to adaptation—namely, the tendency to develop directly to the adult form without exhibiting any ancestral phases, and the tendency to develop evanescent organs for the temporary wants of the young organism. The discrimination of the appearances due to these distinct factors is the task of modern embryology. It is clear that in proportion as this can be effected we have in our hands in the recapitulation hypothesis the means of determining the pedigree of all organisms.

Comparative anatomy (the morphology of adult organisms), so far as it establishes identity of structure in certain groups of organisms, widens the significance of a developmental history worked out in *one* member of such a group, and furnishes suggestions of the highest value in the disentanglement of the hereditary and adaptational factors of such a history.

The remains of extinct forms have a specially suggestive value; but palæontology as a whole, taken in connexion with the study of geographical distribution, furnishes, with regard to such groups of organisms as have been preserved in the condition of fossils, a distinct and independent mass of evidence, enabling the naturalist to sketch out parts of the genealogical tree, thus supplementing and independently reiterating the conclusions drawn from embryology.

It is only within the last ten, or, we may almost say, the last five years that the development of animals, especially of the Invertebrata, has begun to be studied with the requisite minuteness. Stimulated by the Darwinian theory and the recapitulation hypothesis, naturalists are beginning to apply the highest powers and new methods* of examination to the study of the development of all kinds of organisms, so as to trace out cell by cell the complete history of the elaboration of the complex adult from the simple ovum. It is only now that the first changes in the egg (the first dispositions of the embryonic cells) are becoming known in a sufficiently widely varied series of forms to enable the naturalist to form generalizations. It is only by slow degrees that those species are being found out which conserve precious records in their pregnant infancies, often not even hinted by the uneventful life-histories of their nearest congeners. A commencement only has been made, but one of great promise, by the researches of Fritz Müller ('Für Darwin'), Weissman†, Kowalewsky‡, Ed. van Beneden§, Häckel‖, and others, from which we may, I think, draw conclusions of the greatest importance for genealogical classification.

It would not be surprising if the facts of development were to lead to another primary grouping of the animal kingdom than that indicated in the four Cuvierian types or the six or seven types now generally adopted, or should assign to those great divisions unequal significance. They are confessedly groupings based upon the anatomy of the adult or-

* The method of hardening the developing egg, imbedding it in a matrix, and then cutting thin sections, has only quite recently been applied to Invertebrata, chiefly by Russian naturalists.

† Embryology of the Diptera (Zeitschr. für wiss. Zool. 1865–66).

‡ A series of papers, in the Memoirs of the Imperial Academy of St. Petersburg (1867–71), on the development of Ctenophora, Ascidia, *Amphioxus*, *Sagitta*, *Euaxes*, *Lumbricus*, *Apis*, and *Hydrophilus*.

§ A series of papers on the development of the *Gregarina* of the lobster and of various Crustacea (*Nebalia*, *Mysis*, *Sacculina*, &c.), in the Bulletins of the Belgian Academy, 1869–72. Also prize memoir, in the same Academy's Transactions, on "The Signification of the Parts of the Egg."

‖ Monograph of the *Monera*, Jenaische Zeitschr. 1868; Generelle Morphologie, 1867; The Organization of the Sponges and their Relationship to the Corals, Jenaische Zeitschr., and Ann. & Mag. Nat. Hist. 1870, v. pp. 1 & 107.

ganism; and therefore necessarily there has been a tendency in forming them to attach great importance to distinct plans of structure due to a secondary adaptation, whilst the fundamental community of organization has been ignored with something like intention. Von Baer's coincidence with Cuvier in his establishing four modes of development, marking out groups of the same value as the latter's "embranchements," is due to the fact that fifty years ago the condition of biological science did not allow even the great philosophic student of embryology to go more deeply into the problem. He pointed out four modes in which the later adaptation of animals may proceed; but he was unable at that time to bring into consideration the details of the previous stages of the history. It was under his immediate influence that the invaluable memoirs of Kowalewsky have been produced.

It is, then, to be borne in mind that the four types of Baer and Cuvier represent essentially four modes of mechanical adaptation, and might be assumed, as, indeed, in some cases they are, by organisms exhibiting divergent characters of an earlier and more fundamental character. The doctrine of "unity of type," which has from time to time been put forward by opponents of Cuvier, seems to be in closer agreement with the facts made known by recent embryological study than the more widely received dogma of a plurality of types. Already the most eminent of German anatomists, Professor Gegenbaur, has, in the second edition of his Comparative Anatomy (1870), adopted an arrangement of the seven great divisions of the animal kingdom which indicates this inequality in their relative value as branches of a genealogical tree. Whilst the Protozoa stand at the base of the main trunk, and the Cœlenterata diverge from this as a primary branch, the Mollusca, Vertebrata, Arthropoda, and Echinodermata are depicted as springing as four distinct secondary branches from the primary branch, represented by the heterogeneous and feebly marked group Vermes. This filiation of the five highest groups of the animal kingdom is supported on grounds which are chiefly anatomical; and in the pages of this inestimable book facts are continually pointed out tending to demonstrate the homogeny of the various organs of all these large groups—in short, exhibiting them as modifications of one type.

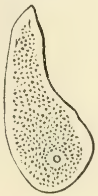
The early history of the developing embryo tends conclusively to establish this mode of representing the main features of the family tree of the animal kingdom; whilst, further, the hypothesis of unity of type (which is to be preferred as a preliminary hypothesis on account of its greater simplicity as compared with that of a plurality of types) is, in its application to the five higher groups of animals, continually receiving new support from observation, and seems likely to lead into most productive lines of research.

The early changes in the developing spheroid of protoplasm leading to the formation of organs may be summarily stated as follows, so as briefly to put in view the fundamental characteristics which they present in different groups of the animal series.

Fig. 1.

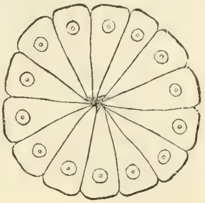
Cytode.

Fig. 2.



Cell.

Fig. 3.



Polyplast without central cavity. (Optical section.)

A. The reproductive spheroid is a non-nucleated particle of protoplasm (*Cytod*, Hck.), which either acquires a nucleus and becomes a true cell (Hck.), or remains in the non-nucleated condition; this latter condition characterizes the Monera or Protozoa homogenea, whilst the former is what is observed in all the other groups commonly classed as Protozoa (from which, however, the Spongida are excluded, since they appear in the next section). By differentiation of the primitive substance of the plastid (cell or cytode), *without fission* of the original mass, a cuticle and cuticular appendages, muscular fibrous layers, cilia, contractile cavities, and, by the segmentation of the nucleus, a reproductive germ- or sperm-mass may be former. Division of the primary spheroid, when it does take place, gives rise to new and separate individual spheroids, or to a loosely aggregated colony of such spheroids, to be termed a *polyplast*. In this polyplast there is no arrangement of the units into definite layers.

The organisms whose mode of growth is thus described may be distinguished as Homoblastica.

Notes to A.—The stock of the Homoblastica thus coincides with the Protozoa with the exclusion of the Sponges, and contains the following chief groups, the genetic affinities of which must be hereafter discussed:—1. *Homogenea* (embracing

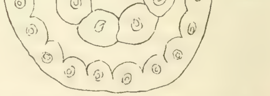
Häckel's *Monera* as *Nuda* and the Foraminifera as *Testacea*); 2. *Nucleifera* (embracing *Amœboidea*, *Gregarinida*, and *Catallacta*); 3. *Radiolaria* or *Cytophora* (embracing the *Heliozoa* or freshwater Radiolaria, and the *Radiolaria* proper or marine forms); 4. *Infusoria* (embracing the *Suctoria* and *Ciliata*, excluding the so-called Flagellate Infusoria, which, it seems, should be referred to the Volvocinean Algæ); 5. *Noctilucida* (*Noctiluca* and *Peridinium*).

We are indebted to Häckel's monograph in the 'Jenaische Zeitschrift' (and translated in 'Quart. Journ. Micr. Sci.' for 1869) for the knowledge of the Monera and their reproduction. Prof. Ed. van Beneden, of Liège, has given a valuable account of the development and structure of a *Gregarina* from the lobster (Quart. Journ. Micr. Sci. 1870 & 1871), from which it appears that the reproductive spheroid appears first as a *cytode*, and subsequently acquires a nucleolus and nucleus, whilst considerable tissue-differentiation also goes on, though the unicellular condition is maintained. The high differentiation of the Ciliate Infusoria is thus no evidence against their unicellular character.

The development of the Radiolaria is not properly known in any case. Häckel, in his great monograph, and more recently Cienkowski (Schultze's Archiv, 1871, and Quart. Journ. Micr. Sci., Oct. 1871) have given some account of the formation of spores, which demonstrate the central capsule to be reproductive like the nucleus in other groups. If the yellow cells should prove to be parasitic, as Cienkowski suggests, then, as in colonies of *Monera* or *Catallacta*, all the units, with the exception of the central reproductive body, would be of coordinate value.

B. The reproductive spheroid is at first a nucleated particle of protoplasm; in some cases it develops from a non-nucleated stage. In many cases the nucleus disappears before fertilization. Division of the spheroid then gives rise to a *polyplast*. By the growth of this polyplast either a hollow sphere bounded by a single layer of cells is produced, into which a portion of its own wall becomes invaginated or tucked, as by the adjustment of a

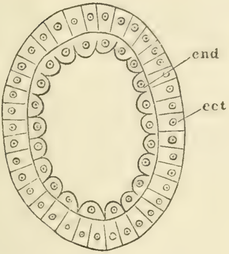
Fig. 4.



Planula formed by invagination of a part of the wall of a polyplast with central cavity. (Optical section.)

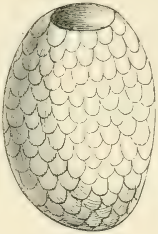
woven nightcap from its pulled-out to its cap-like condition, or the cells arrange themselves in two definitely marked

Fig. 5.



Planula, without orifice, formed by direct growth. (Optical section.)

Fig. 6.



Planula with orifice, which has broken through. (Surface view.)

layers, the inner of which bounds a cavity which subsequently, by a breaking through at one pole, communicates with the exterior. In either case the result is an organic form characterized by being constructed of two layers of cells, the inner of which lines a cavity opening to the exterior. This cavity is the primitive gastric cavity; and the organic form thus characterized may be known as the *Planula**.

The production of such a *Planula*, recognizable under extreme modifications of non-essential general shape (one of the most common causes of which is the admixture of a large mass of secondary yelk with the original egg-cell), is *common to the developmental history of all animals above the Protozoa.* But after this there is a divergence; for whilst there is a further development of primitive cells in the Vermes, Mollusks, Echinoderms, Arthropods, and Vertebrates, in the Cœlenterata (including herein the Sponges) these two layers of cells, the endoderm and ectoderm, remain throughout life as the basis of further histological differentiation, even though in the larger forms the ectoderm may largely develop deep layers of a special muscular or skeletal nature. The series of forms thus branching off from the genealogical tree may be termed Diploblastica.

The endoderm and ectoderm of the polypes and corals was recognized first by Professor Huxley, who at the same time

* It may be advantageous to use the term *Gastrula* for that condition of the *Planula* when the orifice is present, as Häckel has proposed since the above scheme was drawn up.

pointed out the similarity of these layers to the two primitive layers of the Vertebrate embryo.

Notes to B.—The difference in the two modes of origin of the *Planula* may be due to the dropping of the invagination-process as a shortening of the developmental process—that is to say, in obedience to the tendency to a *direct* as opposed to a *recapitulative* development. It is, however, to be noticed in connexion with this that in the later development of special organs we have examples where development occurs sometimes by invagination and sometimes by simple accretion, and where the bulk of the developing structure appears to determine the invagination. Such, for instance, is the case with the otocysts or auditory capsules of mollusks. In the Nudibranchiates I have satisfactorily determined that their cavity does not arise by invagination. On the other hand, in the Cephalopod *Loligo* I have found (what was previously suspected but undemonstrated) that the otocyst *is* formed by an invagination, the ciliated canal connected with it being a remnant of its external communication. The development of the nerve-centres also furnishes examples. In *Loligo* I have observed that the cephalic ganglia originate each by invagination and formation of a groove and cavity. In Gasteropods the corresponding ganglia form by simple thickening of the outer layer of cells. The origin of the cerebro-spinal nerve-centre of Vertebrates and certain Tunicates, as compared with that of Arthropods and notably of certain Annelids (*Lumbricus*, and *Euaxes* as described by Kowalewsky), offers the same contrast.

It is remarkable that the origin of the primitive gastric cavity by invagination has been more widely observed in the higher groups, and that in most Cœlenterata as yet studied the cavity is formed directly. There are exceptions to this among Cœlenterata; but in this subject it must be remembered that we have as yet very few adequate observations. Among the higher groups the observations of Kowalewsky have especially established the occurrence of this primitive invagination in *Amphioxus*, in Tunicates, and certain Vermes; my own observations (as yet unpublished) have proved its wide-spread occurrence in Mollusca, viz. in the Lamellibranch *Cyclas pusilla*, in several Nudibranchs (*Polycera*, *Eolis*, *Doris*, *Pleurobranchus*), in the Pulmonates *Arion* and *Limax*. The presence of accessory yelk is what, more than any thing else, appears among the Mollusca to be associated with the suppression of the invagination-process. The anus of Rusconi in the developing Batrachia among Vertebrata represents the orifice of invagination in a somewhat modified condition.

The observations of Miklucho-Macleay*, which have been followed up in a masterly way by his teacher Professor Häckel of Jena, first demonstrated the relationship of Sponges and Cœlenterata. The *Planula*-embryo of a calcareous sponge (*Guancha blanca*) is made known in Macleay's paper; O. Schmidt has figured that of another (*Dunstervillia*). The embryo of *Spongilla*, as described by Lieberkühn, is also a *Planula*.

The retention of the Diploblastic constitution throughout life by the Cœlenterata serves as an important fact in determining the homogenies of the perigastric and canal systems of the corals and medusoids. It is clear enough that they are merely diverticula, or portions of the primitive gastric cavity. As such they can have no homogenetic, but merely a homoplastic, agreement with the vascular and perivisceral systems of higher animals, the origin of which will be pointed out below. The fluid which they contain will also be seen to be of a different nature from chyle or blood, and, in fact, is merely a diluted chyme. In the histological differentiation of Cœlenterata the outer layer of cells gives rise to muscular fibre, and also represents a nervous system; in the case of *Hydra* the fibres are continuous with the large ectodermal cells (Kleinenberg), whilst in others (*Medusæ* &c.) deep-lying cellular elements of the nature of muscular and connective tissue develop from the ectoderm. The endodermal cells are confined to vegetative functions. The origin of generative products will be discussed below.

C. Development having proceeded, as in the Diploblastica, to the production of an ecto- and endoderm, or an epi- and hypoblast, with primitive gastric cavity bounded by the latter, a third layer of cells makes its appearance between these two, whence taking its precise origin is not yet determined. A portion of this middle layer becomes more especially adherent to the ectoderm, another portion more especially to the endoderm. The separation between these two portions of the new mid layer may be complete so as to leave a wide cavity, or it may never be carried to any extent; but whatever extensive cavity or partial channels make their appearance, or whatever mesh-bearing or sponge-like character the mesoblast takes on, so as to produce an imperfect continuity between its more superficial and deeper parts, connected and bound together, it may be, by branched cells—such cavity, channels, or spongy tissue are more or less complete representatives of the *blood-lymph* system. The organisms characterized by the presence of these

* Jenaische Zeitschrift, 1868, p. 221.

three primitive layers of cells, which furnish the original material for further histological differentiation, may be termed TRIPLOBLASTICA.

In all Triploblastica (Vermes, Echinodermata, Mollusca, Vertebrata, Arthropoda) it appears that of the three layers the outer (*epiblast*) gives rise to epidermic structures, sense-organs, and the great nerve-centres; the mid layer (*mesoblast*) to muscular tissue, skeletal tissue (varieties of connective tissue and cartilage), blood and lymph, and the walls of the cavities in which they are held; the innernost layer (*hypoblast*) to the lining of the gastric or alimentary tract and its diverticula, in the form of glands. The primitive orifice of invagination (mouth of the *Planula*) does not persist, either as mouth or, as has been erroneously supposed, as anus, but becomes entirely closed up, and a new mouth and an anus eat their way into the gastric cavity from the exterior, developing thus pharynx and terminal intestine. The origin of the generative products is, as in the Diploblastica, not ascertained to be *exclusively* from either epiblast or hypoblast. The communication of the mesoblastic blood-lymph-cavity, or a part of it, with the exterior occurs in all Triploblastica, and is accompanied by an ingrowth of the epiblast, which, appearing in the simplest worms as the pair of segmental organs or "ciliated excretory tubes," persists in all the subsequent modifications of the type (Echinoderms, Arthropods, Mollusks, Vertebrates).

Notes to C.—The above generalization must be understood as resting on a limited number of facts, which, however, are being daily increased in number. Attention has been already drawn in the notes to B to the frequent masking of the *Planula* stage and invagination-process in this group as well as in the preceding one. In the early stages of development of the few Vertebrata as yet carefully studied (viz. a few fish, Batrachia, and the common fowl) it is only in the Batrachia that evidence of the invagination, and that in a modified condition (see Stricker's valuable paper in 'Zeitschr. für wiss. Zoologie,' vol. xi., 1861), is obtained. It is yet a question, on which there is a considerable divergence of opinion, supported in each case by careful observation, whether the mesoblast has uniformly the same essential origin in the various groups of the Triploblastica. The hypothesis that it has is justifiable in the present condition of knowledge as the simplest. We have to look for a reconciliation of the opinions based upon interpretation of observations carried out with different animals, which variously point to the derivation of the mid layer from cells of the epiblast, from cells of the hypoblast, from original cells of the primitive polyplast, or from a new cell-formation in the yelk distinct from the cleavage-process (free-cell formation). A further comprehension of the accompanying conditions and mode of carrying out of the *suppression* of steps in the historical epitome of the individual's development will, more than any thing else, tend to this result. The non-identity of the mouth in Diploblastica and Triploblastica is one of the most curious divergences which a comparison of the two groups brings out.

There is on the whole a satisfactory concordance of testimony with regard to the chief tissues and organs to which the three layers respectively give rise, if we except the generative products. The hypoblast of the Triploblastica retains the characters and significance of the Diploblast's endoderm. The fundamental properties of the latter's ectoderm (musculo-sensorial layer of Kleinenberg) become distributed between the tissues differentiated from epiblast and mesoblast—a fact which, whether rightly or wrongly, suggests the ectoderm as the true source of origin of the mesoblast; and, in the case of the earthworm, Kowalewsky's researches demonstrate this origin conclusively.

That the generative products arise from cells of the ectoderm in *Hydra* is certain, from Kleinenberg's careful observations. Häckel, on the other hand, has found them derived from the endoderm in certain Medusæ and in Calcareous Sponges, whilst Allman makes the same statement as to some Hydroid polyps. That the ovaries and testes in higher animals arise from the outer layer is not inconsistent with the fact that they may first definitely appear within the limits of the mesoblast. An ingrowth and intercalation of the cells of the epi- and mesoblast at an early period, such as Waldeyer has pointed to, sufficiently explains the position of the vertebrate ovary and testis, even though they be developed from the epiblast. The position of the generative masses of Oligochætous Annelids in their earliest phase, as buds of the tissue in immediate contact with the nerve-cord, to which I have drawn attention in *Chætogaster** and *Tubifex*†, is in complete agreement with the view of their derivation from cells of the epiblast, when considered in the light of Kowalewsky's admirable demonstration of the ingrowth of the epiblast to form the ganglion-chain of *Lumbricus* and *Euaxes*.

A true blood-system, or blood-lymph-system as it is better to call it in view of the present signification of words, is only possible where a mesoblast is developed—that is, in the Triploblastica. In all Triploblastica it is represented by lacunæ or channels, or by mere wide-setting of the cellular elements

* Quart. Journ. Microsc. Science, July 1870.
† Ann. & Mag. Nat. Hist. 1871, vii. p. 90.

of the mesoblast, between and around which the movement of a fluid, so-called lymph, is possible.

A blood-lymph-system or series of channels appears in its simplest form in the flat-worms, where the main portion of those channellings in the mesoblast, sometimes spoken of as "water-vascular system," must be regarded as the commencing differentiation of the blood-lymph vascular system. The true nature of these channels is well seen in a transverse section, such as that of *Bothriocephalus* given by Landois (Zeitschr. f. Zool. 1872), or such as that of the Planarian *Bipalium* to be described by my friend Mr. Moseley, who assigns to them the same importance as is done here. The channels of the water-vascular system in these cases are seen in section to be intersected by long branching cells; they are, in fact, only partial excavations of the mesoblastic tissue. Such excavation, carried to a greater extent and widened out, ultimately forms the "perivisceral space" seen in many Nemerteans, and in all the Gephyrea, Chætopoda, Echinodermata. When parts of this excavation remain shut off from parallel parts, and either communicate or do not communicate with the larger sinus-like spaces, the conditions are given for the further modification of this primitive vascular channelling into distinct blood-vessels, lacunæ, and pericardial sinus-system, as in Mollusks, or into a closed vascular system lying within a perivisceral sinus, as in Chætopoda, or (no perivisceral sinus being apparent) into closed vessels containing hæmoglobin surrounding organs, as in some leeches, or, lastly, into great sinus-spaces opening through a "lymph-system" into a closed system of blood-vessels, as in Vertebrates.

The orifices of the water-vascular system of the Planarians, Cestodes, and Trematodes are, no doubt with reason, looked upon as representing exactly the orifices of the "segment-organs" of the Chætopoda; but we have no warrant for assuming that more than the aperture and a first portion of the "canal" in the flat-worms corresponds with the little trumpet-mouthed tube which hangs freely in the large perivisceral space of a Chætopod, or such a leech as *Branchiobdella*. The observed facts of development are not conclusive as they at present stand as to the origin of the segmental organ of Chætopoda. Kowalewsky derives them from the middle layer in the case of *Euaxes*; but in view of the difficulties of the observation, and of adverse considerations furnished by the facts of development of apparently homogenous parts in Mollusks and Insects, an argument cannot be based upon their mode of development; nor do the facts of development at present established lend themselves to the decision of the question whether the flat-worms possess in their vascular system the commencement of a body-cavity. The most conclusive evidence which can be adduced on the matter is the analogy of such a mollusk as *Phyllirhoë*, where, as in other Mollusca, the perivisceral cavity is developed only as a series of sinuses, of which the pericardium is one, or where, as we may say, the perivisceral space is *reduced* to the *pericardium*. This pericardium is produced at one end into a tube or canal ciliated at one part, which opens to the exterior. The ciliated tube represents a segment-organ, as must be admitted for the renal organ of Mollusca generally, and especially for the so-called "hearts" or "oviducts" of Brachiopoda. In *Phyllirhoë* we have, it seems to me, as in the flat-worms, the imperfect channellings and spaces of a "parenchymatous" body placed in relation with the exterior by the segment-organ, the wall of which is not discontinuous with that of the channels. It is when the perivisceral space becomes large and expanded that the segment-organ floats in it with a trumpet-like inner orifice; on the other hand, when the blood-lymph-space is *canal-like*, then the segment-organ is merely its continuation to the exterior.

Ciliation and contractility, both exhibited by the "water-vascular system" in Trematodes, are both familiar characters of the perivisceral space when developed on a more capacious scale. Contractility is of course in the nature of the case, the walls of the perivisceral space being muscular. Cilia occur in the perivisceral cavity of some Chætopoda and in that of Gephyrea, in the primitive mesoblastic cavity of the developing Lamellibranch *Pisidium* and of *Aplysia*, also in the peritoneal (perivisceral) space of the frog.

The condition of the vascular system in different genera of leeches is instructive, tending, as it seems, to bridge over the gulf between a simple perivisceral primitive blood-lymph-space and the more complicated differentiations of lymphatic systems, pleuro-peritoneal cavity, and blood-vascular system to which it simultaneously gives rise in higher organisms. The blood-lymph-space exists in the common leech as four chief longitudinal canals, in one of which the nerve-cord lies. The apertures of the segment-organs lead into closed pouches, whose cavity is also to be reckoned to the blood-lymph-space, though not in continuity with its longitudinal portions. In other leeches (e. g. *Branchiobdella*), whilst two of the longitudinal canals are retained, excavation is carried on in the mesoblastic parenchyma in such a way as to leave the segment-organs floating trumpet-like in a great perivisceral sinus, in which also the nerve-cord lies. The longitudinal canals may, as in *Hirudo*, contain a liquid impregnated with hæmoglobin, and remain closed from communication with the rest of the blood-lymph-system. This is very generally the case in Annelids; not so, however, in the Gephyrean *Sipunculus*, where the tentacular vessel communicates periodically with the perivisceral space. In Vertebrates the hæmoglobin-bearing or respiratory system and the lymph-bearing sinus-system communicate at various points, so that the fluid in the former is complex, being comparable to the respiratory fluid of an Annelid *plus* its perivisceral fluid. It is hence hæmochyle or blood-lymph, if we limit the significance of "blood" to that which it really connotes, namely the *red* part of the vascular fluid. If such a nomenclature be admissible, viz. the limitation of "blood" to the respiratory element, then the fluid in the closed vascular system of Annelids would be blood, the perivisceral fluid lymph; the perivisceral fluid of *Glycera* with its red corpuscles would be blood-lymph or hæmochyle; the circulatory fluid of Mollusca and Arthropods would also be hæmochyle, since there is no separation of a respiratory element in separate vessels, and in exceptional cases (*Solen*, *Planorbis*, *Chironomus*, *Chirocephalus*, *Daphnia*) hæmoglobin does appear in the common circulatory fluid; the fluid of the pleuro-peritoneal cavity, lymphatic canals, and vessels in Vertebrates would be "lymph," and its corpuscles, *derived, as throughout the triploblastic series, from the proliferation of the connective-tissue corpuscles lining the walls of the lymph-spaces*, would be lymph-corpuscles or leucocytes; the fluid in the arteries and veins, on the other hand, would be blood-lymph or hæmochyle, being lymph added to other liquid and corpuscular elements, the latter of which are respiratory and impregnated with hæmoglobin, whence they may be termed "pneumocytes."

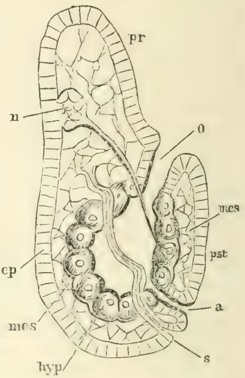
As an illustration of the point which I wish to urge—viz. that the various vascular and sinus systems of Triploblastica are not to be regarded as important differentiations, but are rather parts of one and the same primary blood-lymph-cavity slightly modified or isolated—let me point to two facts. First, among polychætous Annelida we have generally a closed vascular system and a perivisceral space; in *Glycera*, however, the shutting off of a part of the blood-lymph-space as a closed system does not occur, but we have only the one great perivisceral chamber, with pneumocytes added to its corpuscular contents, this change being unaccompanied by any other great structural modification; and it is a fact that "anangian genera" occur in the same family with others possessing the closed set of vessels, *e. g.* Aphroditacea. Secondly, in a parasitic crustacean as yet undescribed, discovered by Prof. Edouard van Beneden of Liège, there is developed a closed vascular system lying within the regular blood-sinuses, and containing, as in the case of Annelids, hæmoglobin. The exceptional development of such a subdivision of the blood-lymph-space, unparalleled throughout the whole group of Arthropoda, is additional evidence in favour of the view that the primitive blood-lymph-space readily lends itself to the development of variously distributed and communicating vascular systems, even systems as special as the ambulacral and respiratory systems of Echinoderms.

The relation of the segment-organs to the primitive blood-space has already been spoken of. There is considerable ground for regarding it as constant throughout the Triploblastica, as the blood-lymph-space itself is constant. It appears under various modifications as a canal, often ciliated and funnel-like, forming a communication between part of the blood-lymph-space and the exterior—as, for example, the brown tubes and the cloacal tree of Gephyrea, the organ of Bojanus, the Fallopian tubes and seminal ducts of sharks, and more doubtfully in Echinodermata and Arthropods.

The Triploblastica not only exhibit this unity of type as regards their chief viscera, but there are certain regions of the body which must be considered identical in all; especially must the prostomium or region in front of the mouth, the axis of anterior growth, where it is persistent, be held to be homogenous throughout the series. It is in relation with this "head-flap" that the primitive nerve-centres are developed and always make their appearance as the great sensorial ganglion-masses. Already in the free-swimming larvæ of some Diploblastica, such as *Actinia*, the prostomium is indicated, having a necessary mechanical relation to bilateral symmetry when the mouth is placed anteriorly and locomotion is parallel with the alimentary axis, though here we must not overlook the distinct character of the Diploblastic and Triploblastic mouths. The large primitive tentacle of the young *Actinia* is a prostomium, and only loses its superior overhanging character as regards the mouth when the animal, abandoning locomotive habits, fixes itself and develops other processes around the mouth which soon equal the first in size. The prostomium in Triploblastica is liable to be suppressed altogether in the course of individual development, the mouth becoming terminal or other modifications arising; but where it does appear it constantly carries the chief organ of sight, whilst the auditory sac is prostomial in Turbellarians, but metastomial in Tunicates, Vertebrates, and Mollusca.

The production of individuals of an increased complexity of organization among Triploblastica, by the linear aggregation of zooids, produced by budding in the posterior or metastomial axis of growth (tertiary aggregates of Herbert Spencer) among Annulosa, and probably (though not according to Spencer) among Vertebrata, and even some Mollusca—the process occurring at a very early period and its results being *obscured*, or even *entirely resolved*, by later "integrating" development in the two latter cases—does not affect the prostomium, which always has an axis of *anterior* growth. When a zooid-segment of a linear tertiary aggregate develops a prostomium or axis of anterior growth, the chain necessarily breaks at that point (*Microstomum*, *Tænia*, Naididæ, Syllidæ). The segmentation of the prostomial axis in Arthropoda and some Annelids, which has an appearance of being a zooid-segmentation comparable to that of the metastomial axis, on account of the identity in the character of the appendages with those of the metastomial axis, has yet to be explained. It may be suggested that it is due to a distinct breaking up of this axis like the posterior one into zooid-segments or zoonites: there is much against this supposition (see Trans. Linn. Soc. 1869, "On *Chætogaster* and *Æolosoma*"). Much more likely, it seems, is the explanation that the oral aperture shifts position, and that the ophthalmic segment alone in Arthropoda represents the prostomium, the antennary and antennular segments being aboriginally metastomial and only prostomial by later *adaptational shifting of the oral aperture.*

Fig. 7.



Archiscolex (optical section): *pr*, prostomium; *pst*, metastomium; *o*, mouth; *a*, anus; *s*, segmental or excretory aperture; *ep*, epiblast; *n*, nerve-centre; *mes*, mesoblast; *hyp*, hypoblast.

The assumption of such a shifting of the oral aperture is fully warranted by what has been demonstrated in the case of Vertebrata through Kowalewsky's researches on *Amphioxus*. It is certain from those observations that the mouth of *Amphioxus* is the first gill-slit or pharyngeal perforation of the left side, and has no relation to a mouth such as that which appears at an earlier phase of development in the allied Ascidian larva, which latter mouth is that of Vermes generally. *Amphioxus*, then, and the Vertebrata have a new oral aperture, the old one having been gradually suppressed. Comparative osteology and the embryology of higher Vertebrata have long made it clear that the vertebrate mouth belongs to the series of visceral clefts; but the significance of this in the comparison of Vertebrata and Invertebrata has yet to be fully appreciated. The identification of the neural and hæmal aspects of Vertebrata and Vermes, in the light given by this demonstration of Kowalewsky's as to the distinct character of the mouth in the two cases, must lead to most valuable results *.

The triple basis of histological differentiation, the nerve-centres, the alimentary tract, the blood-lymph-spaces, the segment-organs, the prostomial and metastomial regions being recognizable as homogenous under varied adaptative modifications throughout the Triploblastica, is it not probable that other parts may still further exhibit that unity of type of the included groups which forms our hypothesis? Whilst it is necessary always to be on guard against mistaking homoplastic agreements such as clearly must and do exist † for homogenetic agreements, yet, since the working hypothesis must be that of uniformity, as the simpler, we ought to assume homogeny or unity of type as explaining similarity in organs until research proves it necessary to regard this or that particular case as due to coincidence of adaptative causes. Hence it may fairly be suggested that the appendages of Triploblastica, appearing under two chief forms as locomotive and respiratory, (external gills) are homogenous throughout the series.

Such an hypothesis opens a very large field for discussion; but within certain limits it will not, perhaps, meet with strenuous opposition. The gills of Mollusca generally, of Brachiopods, the tentacles of Polyzoa, and the gill-tufts of Annelids—again, the locomotive appendages of Annelids and Arthropods—or, again, the external gills of Vertebrata (embryo Selachians, Batrachians, &c.) and those of Annelids, offer themselves as likely enough to prove homogenous; but since many further embryological inquiries have to be made, and no doubt will be made in consequence of these possibilities presenting themselves to the imagination of many students of embryology, it will not now be useful to discuss them upon the limited evidence at hand.

Note.—Professor Häckel, in the final part of his newly published splendid monograph of the calcareous Sponges, has entered into speculations on the significance of the polyplast and planular stages of development and the development

* I am indebted to my friend Anton Dohrn for first drawing my attention to some of the legitimate consequences of Kowalewsky's observations as to the mouth of *Amphioxus*.

† Ann. Nat. Hist. 1870, vol. vi. ("On the use of the term Homology").

of a body-cavity, which are of the utmost value. He adopts a more detailed nomenclature than I have used here, and does not take the same view of the water-vascular system of flat-worms as I have done; but to some extent there is naturally coincidence, due to the fact that the material here used in the form of facts has been mainly drawn from his other writings and those of other German and Russian embryologists. I have not attempted to discuss Professor Häckel's views nor referred to his terms, chiefly because the substance of this paper was drawn up before the 'Kalkschwämme' appeared.

XXXVI.—*On a new Australian Species of* Thyrsites. By Prof. Frederick M'Coy.

The common Barracoota of the Cape seas is very abundant in the Melbourne market from the adjacent coast, and has long been known; but an equally large and important species for food is brought in great quantities from Tasmania to the Melbourne fish-shops, usually split open and dried; and, as far as I can see, it has been overlooked by naturalists. It is easily distinguished at a glance from the *Thyrsites atun* or Barracoota by the much greater depth of the body, fewer finlets, shorter dorsal, larger teeth, and double lateral line; but the mode of preparation usually obscures the still more striking character of the ventrals being almost absent, or at least very minute and rudimentary. I subjoin a description of the species.

Thyrsites micropus (M'Coy).

D. 17 | 4+12 | VI. A. 2+11. IV. V. 1+1 (bifurcate). P. 14. C. $22\frac{4}{4}$.

Height of body five times in total length to centre of caudal fin; head four times to end of lobes of caudal. Lower jaw projecting in advance of the upper; diameter of orbit one fifth the length of the head, and one half the length of the muzzle. Ventrals each with one spine and one bifurcate ray, slightly in advance of base of pectorals; about one third the diameter of the eye in length. Lateral line bifurcate: upper branch extending from a little above the operculum, a little below the dorsal line, as far as the third finlet; lower branch coming off from upper one under base of fifth dorsal spine, and descending with an abrupt curve nearly to the middle of the side, continuing nearly straight to opposite middle of anal fin, from which to middle of tail it describes three upward undulations.

Colour brilliant lead-grey, whitish below; fins brownish. Surface of body smooth, with very minute scales imbedded in the skin.

	ft.	in.
Total length	2	$6\frac{1}{2}$
Length of head from chin	0	$8\frac{1}{2}$
Length of pectoral	0	$3\frac{1}{2}$
Greatest height of body	0	$6\frac{1}{2}$
Greatest height of first dorsal fin	0	$2\frac{1}{2}$
Diameter of orbit	0	$1\frac{1}{2}$

There are about sixteen compressed teeth of moderate size (about 2 lines) on each intermaxillary, and a group of three on each side of the upper jaw in front, very large (about 6 or 7 lines) and curved backwards. As in *Gempylus*, the ventrals are so reduced as to be scarcely visible; but there is a row of seven or eight small conical teeth on each palate-bone, as in *Thyrsites*. *T. prometheus*, *T. Solandri*, and *T. prometheoides*, all have the ventrals reduced to one small spine; and the latter Amboyna species has also, according to Bleeker, the double lateral line; but the proportions of the head and body and number of the fin-rays completely distinguish the present fish from them.

The popular name is Tasmanian kingfish.

Melbourne National Museum, January 30, 1873.

XXXVII.—*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. vii. p. 436.]

[Plates VII., VIII., IX., & X.]

1335. *Agaricus* (Armillaria) *aurantius*, Schæff.; Fr. Ic. tab. 27.

Forres, Rev. J. Keith. Pine-woods.

Varying a good deal in the nature and frequency of the scales. One or two of the specimens exactly accorded with the figure of Fries.

1336. *A.* (Tricholoma) *pessundatus*, Fr. Ic. tab. 28.

Street, J. A. Clark, Esq., Oct. 1871.

Smell like that of new meal.

**A.* (Tricholoma) *sordidus*, Fr. Ic. tab. 45.

On the naked soil in gardens, as at Coed Coch.

Like Fries, we had formerly considered this a mere form of *A. nudus.*

1337. *A.* (Tricholoma) *resplendens*, Fr. Ic. tab. 29.

Amongst grass on the borders of woods. Coed Coch, Sept. 10, 1872. It has, however, occurred in other localities, as at Reading.

**A.* (Clitocybe) *maximus*, Fr.

Abundant. Coed Coch, Sept. 11, 1872.

Pileus 15 inches across, squamulose; margin lobed and crisped; stem 2–3 inches high, $1\frac{1}{2}$–2 thick, very blunt, fibrilloso-striate or grooved.

1338. *A.* (Clitocybe) *ericetorum*, Fr.

Coed Coch, Sept. 10, 1872, Mrs. Lloyd Wynne.

Exactly Bulliard, tab. 551. fig. 1.

1339. *A.* (Collybia) *succineus*, Schæff.

Amongst grass. Coed Coch, &c.

1340. *A.* (Collybia) *aquosus*, Bull.

Coed Coch.

1341. *A.* (Collybia) *tylicolor*, Fr.

Coed Coch.

1342. *A.* (Entoloma) *Wynnei*, B. & Br. Pileo primum plano, fuligineo, velutino, dein convexo, squamuloso, hygrophano; margine striato, sæpe undulato; stipite fuligineo-cæruleo, compresso, basi gossypino; lamellis latis, transversim costatis, pallidis, margine crenulatis; odore cimicino.

In fir-woods. Coed Coch, Sept. 16, 1872.

Allied to *A. costatus*, with which it agrees in size.

1343. *A.* (Nolanea) *mammosus*, L.

On lawns. Coed Coch, Sept. 10, 1872.

1344. *A.* (Hebeloma) *relicinus*, Fr.

Stannage Park, C. E. Broome, 1871.

1345. *A.* (Hebeloma) *Clarkii*, B. & Br. Pileo campanulato, albo, sericeo; stipite subæquali, flocculoso, farcto; lamellis adnexis, albo marginatis.

Street, J. A. Clark, Oct. 20, 1871.

Allied to *A. sindonius.* Pileus $\frac{2}{3}$ inch across, 1 inch high; stem $1\frac{1}{2}$ inch high, 2 lines thick, slightly incrassated at the base.

1346. *A.* (Hebeloma) *truncatus*, Fr.

On the grassy base of a bank. Dangstein, Sept. 25, 1872.

Pileus $1\frac{1}{2}$-2 inches across, plane, rigid, slightly viscid, rufous, depressed in the centre, smooth; margin crisped, inflexed, the extreme edge pruinose; stem $2\frac{1}{2}$ inches high, $\frac{3}{4}$ thick, claviform at the base, stuffed, fibrilloso-striate, pale rufous, less deeply coloured below; gills narrow, adnexed, with a tooth. Smell rhaphanoid.

1347. *A.* (Naucoria) *pusiolus*, Fr.

West of England, J. Renny.

1348. *A.* (Naucoria) *sobrius*, Fr., var. Pileo convexo, ochraceo, subtiliter punctulato; margine furfuraceo; stipite sursum incrassato v. æquali, furfuraceo, fistuloso; annulo appendiculato; lamellis pallidis, adnatis, planis.

On lawns amongst short grass. Sibbertoft, July 7, 1871.

Pileus 3–4 lines across; stem $\frac{3}{4}$–1 inch high, 1 line thick. Margin of gills white. *A. dispersus*, P.

1349. *A.* (Psalliota) *inunctus*, Fr., Saund. & Sm. tab. 29.

Ely, W. Marshall, Esq. It has also occurred at Epping.

1350. *A.* (Psalliota) *merdarius*, Fr.; Saund. & Sm. tab. 25.

In a grass-field. Sibbertoft, Norths.

**Cortinarius* (Phlegmacium) *triumphans*, Fr.

Exhibited at South Kensington, Oct. 2, 1872.

This is clearly the same as Mrs. Hussey's *C. sublanatus.*

1351. *C.* (Phlegmacium) *porphyropus*, Fr.

Coed Coch, Oct. 1871.

1352. *C.* (Dermocybe) *cinnabarinus*, Fr.

Street, J. A. Clark, Oct. 1871.

1353. *C.* (Telamonia) *torvus*, Fr.

Coed Coch, Oct. 1872.

1354. *C.* (Telamonia) *armillatus*, Fr.

Near Reading, B. J. Austin.

The species figured by Mrs. Hussey is clearly the plant of Bull. t. 527. fig. 1, and is therefore *C. hæmatochelis.* This has occurred at Coed Coch.

1355. *C.* (Telamonia) *helvolus*, Fr.

Coed Coch, Sept. 1872.

1356. *C.* (Hygrocybe) *decipiens*, Fr.

Leigh woods, Bristol, Oct. 25, 1871. Hoffm. Ic. An. t. 9. f. 12.

**Hygrophorus chrysodon*, Fr., var. pube candida.

Street, J. A. Clark.

**H. pratensis*, Fr., var. Pileo infundibuliformi, pallido; margine undulato, deflexo; stipite sursum dilatato, fibrilloso-striato; lamellis distantibus, decurrentibus, ramosis, pallidis.

Coed Coch, Oct. 1872. We have also received it from M. Terry.

1357. *H. livido-albus*, Fr.

Street, J. A. Clark, Oct. 1871.

1358. *H. Clarkii*, B. & Br. Fragilis; pileo convexo, subumbonato, livido-cinereo, viscoso; margine lævi; stipite concolori, cavo; lamellis latis, distantibus, crassis, adnatis, albis.

Street, Oct. 1872, J. A. Clark, no. 1788.

Gills in large specimens nearly $\frac{1}{2}$ inch wide.

1359. *H. metapodius*, Fr.

Street, J. A. Clark, Oct. 1871, J. Renny, Nov. 4, 1871.

1360. *H. Houghtoni*, B. & Br. Pileo convexo, læticolori, centro demum depresso, striato, cum stipite fulvo-flavo, transversim undulato, viscosissimo; lamellis decurrentibus, tenuibus, gilvis.

Amongst grass. Preston, Salop, Oct. 21, 1872.

Pileus $1\frac{1}{2}$–2 inches across; stem 2 inches and more high, $\frac{1}{4}$ thick, sometimes tinged above with blue. Odour foxy. The gelatinous coat is extremely thick, and at length separates and forms a cup in the centre.

**Lactarius glyciosmus*, Fr.

Herefordshire.

This appears to be a rare species, at least in England.

1361. *Marasmius terginus*, Fr.

Batheaston, Nov. 28, 1870. Amongst leaves in a wood.

Pileus $\frac{5}{12}$ inch across, faintly striate, of a pale reddish brown, darker in the centre; stem about 3 inches high, $\frac{1}{2}$ line thick, smooth, pale brown, satiny; gills reddish ochre, adnate by a tooth, but sinuated, moderately distant.

1361*. *Dædalea mollis*, Sommf.

C. B. Plowright, Sept. 1872. Exactly agreeing with specimens from Blytt.

1362. *Boletus inunctus*, Kromb. tab. 76. figs. 10, 11.

Ascot, Lyndhurst, Coed Coch.

1363. *B. rubinus*, Smith.

Chippenham.

Spores at first rosy, then warm brown, ·00025–·0003 inch long, ·0002 wide.

**B. cyanescens*, Bull.; Saund. & Sm. tab. 47.

East Budleigh, C. H. Spencer Perceval.

We were very glad to receive the true plant of Bulliard, as that figured by Mr. Cooke is a very different species, with very different spores. The floccose coating which encloses the whole plant when young is very curious. The degree in which the flesh becomes blue is variable, and was very slight in Mr. Perceval's specimens.

1364. *Polyporus frondosus*, Fr.

Berkshire, 1871. Exhibited at South Kensington, Oct. 1871.

1365. *P.* (Anodermei) *mollis*, Fr.

Near Slough, M. Terry, Esq.

1366. *P.* (Placodermei) *carneus*, Fr.

Welshpool, on an old stump, Nov. 1871, Rev. J. E. Vize.

This species occurs in various parts of the world, and has been found in British North America.

**Hydnum fragile*, Fr.
Forres, Rev. J. Keith.
1367. *H. compactum*, Fr.
Forres, Rev. J. Keith.
1368. *H. aurantiacum*, A. & S.
Forres, Rev. J. Keith.
1369. *H. ferrugineum*, Fr.
Reading, Mr. B. J. Austin.
1370. *H. cirrhatum*, P.
On a beech tree. Epping Forest, Mr. J. English.

On comparing the specific characters of *H. cirrhatum* and *H. corrugatum* there could be no doubt about Mr. English's plant being the former species; but this is not so clear on comparing the figures in Fries's 'Icones.'

At first snow-white, but gradually acquiring a pale ochraceous tint; imbricated, confluent behind; aculei long; pileus rough, with abortive prickles.

**Corticium sulphureum*, Fr. Var. *ochroideum*.
Batheaston, C. E. Broome.

1371. *C. lacunosum*, B. & Br. Molle, late effusum; hypothallo lanoso, fulvo, lacunoso; hymenio pulverulento.

Aboyne, Sept. 1870. Spreading for several inches, and looking like a thin sponge from the numerous lacunæ.

1372. *Cyphella pallida*, B. & Br. Cupulis primum orbicularibus, demum irregulariter lobatis, planis, tomentosis vel hispidulis, sessilibus; hymenio demum rugoso, pallide ochraceo. Rabenh. Fung. Eur. Exs. no. 1415.

On old stems of *Clematis vitalba*, spreading here and there to neighbouring rotten sticks.

Cups $\frac{1}{4}$–1 line across, sometimes proliferous.

Differs from *C. Curreyi* in the colour of the hymenium, which is rugose, like that of *Cantharellus muscigenus*, and its more irregular form. It appears also not to be erumpent as that species often is, but is seated on the bark or wood. Spores ·00025–·00035 inch long, elliptic.

1373. *C. dochmiospora*, B. & Br. Minuta, pezizæformis, nivea; sporis obliquis, ovatis, acutiusculis.

Batheaston, Oct. 28, 1864.

Resembles externally *Peziza villosa*; but the hairs are not granulated. Spores ·0005–·0006 inch long.

1374. *Dacrymyces macrosporus*, B. & Br. Gelatinosus, tuberculatus, roseus; floccis septatis, apice sporiferis; sporis primariis oblongis, 3–5-septatis, articulis constrictis; sporis secundariis ellipticis, utrinque apiculatis; conidiis concatenatis.

On dead branches, forming irregular gyrate and tuberculated masses of a rosy colour, about $\frac{1}{4}$ inch long, parasitic on old remains of *Sphæria stigma.* The mass of gelatine consists of delicate, branched, septate threads, mixed with shorter threads bearing oblong 3–5-septate primary spores ·0015–·002 inch long, ·00034–·0004 wide; these at length fall off and produce shortly stipitate secondary spores, one from each division. Secondary spores elliptic, ·0005 long, more prominent on one side, pointed at either end. The cells of the primary spores are empty after the production of the secondary spores. Other threads break up into much branched chains of conidia, ·0002 in diameter; the parts of the gelatinous mass where these are produced acquire a paler tint.

Batheaston, Dec. to March. It preserves its rosy tint when dry.

Plate VII. fig. 1. *a.* threads with primary spores and conidia; *b.* primary spores; *c.* ditto, producing secondary spores; *d.* secondary spores, more highly magnified.

* *Clavaria aurea*, Schæff.

This fine species occurred in 1871 in two or three places in the west of England, as at Stannage Park; and the Rev. H. Nicholls has lately sent from Hawkhurst a form closely approaching *C. rufescens*, which was found at the foot of a beech tree.

* *Geaster Michelianus*, B. & Br., Herb. Crit. It. no. 343.

This fine species has occurred at Castle Ashby, in a bed of rhododendrons, in two or three successive years.

The tough thick outer coat, large size, and other points sufficiently distinguish it from *G. tunicatus*, to which it bears some resemblance. The laciniæ of the outer peridium are sometimes as much elongated as in *G. saccatus.* It was considered as *G. tunicatus* under no. 1306.

1375. *Lycoperdon echinatum*, P.

Berkshire, Messrs. Hoyle and Austin.

Spores echinulate, ·0002–·00025 inch in diameter.

Scleroderma geaster, Fr.

Hereford, Oct. 6, 1870.

Spores ·0003–·0005 inch in diameter.

* *Batarrea phalloides*, P.

Noble specimens of this rare fungus were lately found at the Earl of Egmont's Nork, amongst the débris at the base of a hollow ash, by Mr. C. H. Spencer Perceval. The Dropmore specimens occurred in a similar situation.

* *Didymium squamulosum*, A. & S.

On fern, J. Renny.

Columella white.

1376. *Perichæna quercina*, Fr. Peridio externo crustaceo, dealbato; interiore tenuissimo, luteo-brunneo, e sporis flavis, areolato-impresso; floccis parcis; sporis globosis, asperulis.

On ash. Batheaston, March 1859; Shrewsbury, W. Phillips, Esq., Jan. 18, 1872.

Spores ·0005 inch in diameter.

1377. *P. picea*, B. & Br. Peridio atro-fusco, hemisphærico, demum circumscisso; sporis coffeatis, subglobosis floccisque fuscis lævibus.

On dead wood, W. Phillips, Esq.

Looks at first like a *Perisporium*. The colour of the spores approaches that of those in the section *Hyporhodii* of *Agaricus*.

1378. *Sphæronema æmulans*, B. & Br. Peritheciis subglobosis, e mycelio parco oriundis; collo apice ciliato; sporis minutissimis, motu Browniano præditis.

Epping Forest, Feb. 18, 1871.

Perithecia ·06 inch long; spores ·0001–·0003 in diameter.

Possibly a pycnidiiferous state of some *Melanospora*.

Plate VII. fig. 2. *a.* plant, more or less magnified, with emitted spores.

1379. *Monosporium saccharinum*, B. & Br. Hyphasmate gelatinoso, coffeicolori, e floccis brevibus erectis subclavatis; sporis obovatis, basi truncata affixis, pallide coffeatis.

Growing on decayed substances under glass. Batheaston, Feb. 1871.

Spores ·0004–·0005 inch long. Sometimes the tips of the threads have an articulation, and possibly form a second spore.

Plate VII. fig. 3. *a.* spores seated on their sporophores; *b.* a single immature spore; *c.* free spores.

1380. *Helminthosporium exasperatum*, B. & Br. Floccis flexuosis, sursum nodosis, fructiferis; sporis oblongis, utrinque obtusis, triseptatis.

On sweet william. Sibbertoft.

Flocci knotted above, each knot bearing an oblong spore, ·0012–·0018 inch long, ·0004–·0005 wide.

Plate VII. fig. 4. *a.* flocci; *b.* spores; *c.* spore germinating.

1381. *Dactylium implexum*, B. & Br. Floccis erectis, implexis; sporis subcylindricis, basi apiculatis, apicalibus.

On the inside of a willow. Hereford.

Spores ·001–·0012 inch long.

Plate VII. fig. 5. *a.* threads with spore; *b.* spores, more highly magnified.

1382. *D. melleum*, B. & Br. Strato tenui, melleo; floccis apice ramosis; ramis ramulis acutis sporas uniseptatas ferentibus terminatis.

On some decayed *Polyporus* or *Stereum*. Batheaston, Feb. 1871.

Spores ·0005 inch long.

Approaching, like the last, *Diplocladium minus*, Bonorden.

Plate VIII. fig. 6. *a.* creeping threads; *b.* fertile threads with spores; *c.* spores, more highly magnified.

1383. *D. Rennyi*, B. & Br. Floccis subtus parce ramosis, ramis apice ramulis clavatis coronatis; sporis ellipticis, uniseptatis.

J. Renny.

Very near *Diplocladium minus*, Bonorden; but the spore-bearing ramuli are obtuse above and slightly clavate, not attenuated.

1384. *Verticillium aspergillus*, B. & Br. Floccis deorsum simplicibus vel rarius divisis, sursum attenuatis, apice repetitim furcatis.

On decaying *Polyporus vaporarius*. Kelmarsh, Norths., Nov. 19, 1870.

Threads ·0055 inch high; spores ·0001 long. The threads are occasionally divided below, in which case each branchlet is forked at the tip. The habit is that of *Chlonostachys araucaria*, Cda. It is worth inquiry whether this may not be a state of *Hypocrea farinosa*.

Plate VIII. fig. 7. *a.* threads with spores; *b.* spores, more magnified.

1385. *Polyactis galanthina*, B. & Br. Floccis sursum breviter ramosis, fuscis; ramulis sursum incrassatis; sporis obovatis, sessilibus, e spiculis elongatis oriundis.

On bulbs of the common snowdrop, affecting the outer coats, and very destructive. G. F. Wilson, Esq.

Spores ·0006–·0007 inch long.

Plate VIII. fig. 8. *a.* threads with spores; *b.* ditto, more highly magnified; *c.* separate spores.

1386. *Helicomyces roseus*, Lk. Obs. i. 19.

1387. *Oïdium microspermum*, B. & Br. Pulvinulis regularibus, ochraceo-citrinis, e floccis radiantibus furcatis; sporis subglobosis, concatenatis.

On bark of Scotch fir. Batheaston, Nov. 25, 1871.

Spores ·0002 inch in diameter. Differs altogether from *O. aureum* and *O. fulvum* in the shape and size of the spores. Pulvinuli at length confluent.

1388. *Synchytrium taraxaci*, de By. & Wor., Schroet. in Cohn's Beiträge, p. 39.

On leaves of the common dandelion. Batheaston.

1389. *S. mercurialis*, Fuck. no. 1607; Schroet. *l. c.* p. 40.

On leaves of *Mercurialis perennis.* Batheaston, April 24, 1871.

Spores echinulate, ·0012–·0015 inch in diameter.

**S. anemones*, Wor.; Schroet. *l. c.*

On leaves and petals of *Anemone nemorosa.* Not uncommon.

1390. *Peziza* (Humaria) *Chateri*, Sm. Cupulis concavis, demum expansis, sessilibus, intus aurantio-rubris, extus pallide brunneis, granulatis, esetosis; paraphysibus clavatis; sporidiis ellipticis, echinulatis. Gard. Chron. Jan. 1872, p. 9, cum icone.

Cambridge, Mr. Chater.

Sporidia ·0008 inch long, ·0004 wide, echinulate when mature. Differs from *P. melaloma* in its rough sporidia and the absence of the dark hairs on the cups, which are granulated from the projecting coarse clavate brownish cells, and from *P. hirta* in the latter particular.

Plate VIII. fig. 9. Sporidia, magnified.

1391. *P.* (Dasyscyphæ) *lasia*, B. & Br. Cupulis globosis, erumpentibus, aurantiacis, demum ore laciniato-dentato apertis, extus lasiis; ascis elongatis; sporidiis fusiformibus; paraphysibus supra urnæformibus, quandoque uniseptatis, intermixtis floccis brevibus.

On elm. Langridge, March 16, 1870.

Cups smaller when on bark. Sporidia ·0005 inch long by ·0001.

Plate VIII. fig. 10. *a.* plant, magnified; *b.* paraphyses; *c.* asci; *d.* sporidia.

1392. *Rhyparobius dubius*, Boud. Ann. d. Sc. Nat. 1869, x. p. 240.

On rabbits' dung. Bathford, C. E. Broome.

1393. *R. Cookei*, Boud. *l. c.* p. 238.

On dogs' dung. Batheaston, C. E. Broome.

1394. *R. argenteus*, B. & Br. Minutissimus, argenteus, pilis mollibus ciliatus; ascis brevibus; cysto sporidiifero elliptico, apicem versus sito; sporidiis fusiformibus; paraphysibus furcatis.

On rabbits' dung, for the most part attached to filaments of *Mucor.* Mr. Renny, with figures.

Cups ·004 inch across; asci ·004 long; sporidia normally 64 in each cyst, ·0007 inch long, ·00025–·0003 wide. Scarcely visible to the naked eye; asci opening with a little lid, which splits vertically. Comes near to *R. felinus*, Boud., but has soft hairs and is of a pure white; tips of paraphyses slightly enlarged.

Plate IX. fig. 11. *a.* young plant; *b.* full-grown plant, magnified 100 diameters; *c.* hairs; *d.* asci with cyst; *e.* paraphyses; *f.* sporidia.

1395. *R. woolhopensis*, Renn. Minutus, primum candidus, dein albidus; cupulis basi substipitiformi incrassatis, tuberculatis, sursum pilis mollibus vestitis; paraphysibus simplicibus; ascis clavatis; cysto sporidiifero apicem versus sito; sporidiis fusiformibus.

On birds' dung, mixed with filaments of *Mucor* and mostly borne by them. Mr. Renny, with figures.

Cups ½ a line (·041) wide and high; sporidia normally 64, ·0007 inch long. Minute, scattered, at first pure white, then dingy, with a thick stem-like base, which is studded with large semi-globular warts, covered above with close-set hairs, which form a fringe to the margin; at length expanded, the hairs disappearing with age; substance of base vesicular; the cells often ·0015–·0018 inch in diameter, much smaller above.

Plate IX. fig. 12. *a*. plant, magnified 100 diameters; *b*. cells of stem, compressed under the microscope; *c*. edge of cup; *d*. asci with cyst and paraphysis; *e*. sporidia.

**Hypocrea lenta*, Fr.

On dead wood. St. Catharine's, Bath, Nov. 1866.

1396. *Sphæria* (Pertusæ) *pædida*, B. & Br. Peritheciis ovatis, rugosis, opacis, liberis, brunneo-nigris; ostiolo conico, demum deciduo; ascis linearibus; sporidiis uniserialibus, medio contractis.

On beech. Langridge, April 1859.

Quite superficial, confluent; sporidia ·0005–·0006 inch long, ·0002–·0003 wide.

Plate X. fig. 13. *a*. plant, more or less magnified; *b*. ascus; *c*. sporidia.

1397. *Chætomium rufulum*, B. & Br. Peritheciis subglobosis, eximie cellulosis, rufulis, e mycelio tenui oriundis; ascis brevibus, obtusis; sporidiis octonis, globosis, granulatis, biseriatis.

On a paper box under a bell-glass. Elmhurst, April 24, 1871.

Sporidia when young ·0004–·0005 inch in diameter, when full-grown ·0007. Perithecia globose, with a pointed apex, composed of about three rows of coarse cells, of a pallid ochre at first, attached to the paper by a few white threads about ·032 in diameter; ostiolum, if any, very inconspicuous; asci mostly curved, obtuse at either end, the narrow base soon losing all signs of attachment and floating freely in the perithecium; sporidia spherical when mature, strongly granulated, of a pale brown tint, and containing a small nucleus.

Plate X. fig. 14. *a*. plant on paper; *b*. perithecium; *c*. asci; *d*. sporidia.

* *C. glabrum*, B.

Asci linear; sporidia globose, uniseriate, smooth, ·0005 in diameter.

On the same matrix *Lycogala parietinum* occurs; and we have little doubt that it is a mere state of the *Chætomium*. The asci are mixed up with yellow threads; and it is probable that, as in other *Chætomia*, they are often absorbed, leaving the sporidia free, and thus appearing to be the spores of a Myxogaster.

PLATE X. fig. 15. *a.* plant, more or less magnified; *b.* ditto, ruptured; *c.* threads; *d.* asci; *e.* sporidia.

1398. *Sphinctrina coremioides*, B. & Br. Gard. Chron. 1872, p. 40, cum icone. Peritheciis stipitatis, globosis, extus setulosis; ascis linearibus, cito evanidis; sporidiis globosis, concatenatis.

On pear-roots. Painswick, Mr. J. Atkins.

Sporidia ·00025 in diameter, forming chains at the tips of the elongated pedicels of the asci, which are soon absorbed.

1399. *Peronospora ficariæ*, Tul. Comptes Rendus, Jan. 1854. On *Ranunculus ficaria*. Rev. J. E. Vize, Forden, May 1872.

1400. *P. lamii*, De By. Ann. d. Sc. Nat. 1863, xx. p. 120. On *Lamium rubrum*. Forden, Rev. J. E. Vize, May 1872.

1401. *P. hyoscyami*, De By. *l. c.* p. 123.

Market Deeping, in Mr. Holland's herb-garden, on the common henbane.

[To be continued.]

XXXVIII.—*Description of two new Species of Frogs from Australia.* By Dr. ALBERT GÜNTHER.

I AM indebted to Mr. Gerard Krefft for the opportunity of examining some frogs, of which the following appear to be new.

NOTADEN (g. n. Bufonid.).

Body thick, short, covered with large flat glandular warts. Head very short and high, with a very obtuse snout; eye of moderate size; mouth very short, reaching to below the middle of the eye. Limbs short. Teeth none; a pair of short and soft prominences between the narrow choanæ. Ear-opening covered by the skin, and visible only after the skin is removed; it is very narrow, as are the Eustachian tubes. Tongue without notch, broad. Not only the skin of the parotoid region, but that of the entire back is thickened by numerous glands. Fingers free; toes with a narrow web and fringe. A large shovel-like metatarsal prominence; no other tubercle. Clavicle present. Transverse process of sacral vertebra much dilated.

Notaden Bennettii.

Ground-colour greenish, with a very broad brownish band, marbled with black, along the middle of the back; it bifurcates anteriorly on the head, leaving the forehead greenish, and emits a transverse bar on each side of the back behind the shoulder. Limbs blackish, with a few small white specks. Throat with scattered black spots; abdomen whitish.

	lines.
Length of the body	21
,, fore limb	12
,, hind limb	22

Mr. Krefft writes to me that this frog "comes from the Castlereagh River; but it has been also observed near Fort Bourke." I have named this remarkable form after Dr. G. Bennett, to whom we are indebted for many specimens of the greatest interest.

Chiroleptes platycephalus.

Head large, broad, depressed, with its sides shelving; eyes small, shorter than the snout; canthus rostralis none; nostrils directed upwards; tympanum very indistinct, smaller than the orbit; choanæ and openings of the Eustachian tubes of equal and moderate width. Tongue rounded behind. Skin of the upper parts nearly smooth, with a few very small tubercles on the back. Inner finger distinctly opposite to the others, as long as the fourth, which is considerably shorter than the third. Second finger feeble and short. Toes depressed, broadly webbed; the third very little longer than the fifth; subarticular tubercles very little developed. Inner metatarsal tubercle shovel-like, with blunt edge; no outer tubercle on the metatarsus. Uniform greenish olive above, whitish below, with some small greenish spots on the throat.

	lines.
Length of the body	25
Width between the angles of the mouth	12
Length of fore limb	16
,, hind limb	35
,, tarsus	5
,, hind foot	$10\frac{1}{3}$

One specimen, from Fort Bourke.

XXXIX.—*Description of a new Saurian* (Hyalosaurus) *allied to* Pseudopus. By Dr. Albert Günther.

A few days ago, when looking with Professor Kölliker at some animals in Mr. Jamrach's establishment, two living reptiles (a *Zamenis hippocrepis* and what appeared to be a young *Pseudopus*) were offered for sale by a man who stated that he had just obtained them from a ship coming from North Africa.

On a closer inspection I found the lizard to be distinct from, though closely allied to, *Pseudopus*. The absence of an ear-opening being generally considered a generic character, I propose for this new type the name of

Hyalosaurus.

Differs from *Pseudopus* in having the region of the ear entirely covered with scales, without a trace of an external ear-opening.

Hyalosaurus Kœllikeri.

The shields on the head differ little from those of *Pseudopus*; but the vertical shield forms a broad suture with the posterior frontal, which occupies the entire width of the forehead, and a still broader one with the central occipital shield, which is of an unusually large size and subtriangular in shape. Dorsal scales in fourteen longitudinal series, of which the six middle ones are obtusely keeled, the keels being more prominent on the tail; ventral scales in ten series. Rudimentary hind limbs undivided, movable, very distinct. Brownish, with a row of black specks along the middle of the back of the anterior part of the trunk; sides of a darker colour; abdomen greenish white.

The length of the trunk of the single example is 5 inches; a considerable portion of the tail is lost, the remaining piece being about as long as the body.

XL.—*Points of Distinction between the Spongiadæ and the Foraminifera.* By H. J. Carter, F.R.S. &c.

Having preliminarily described and sketched most of the sponges in the British Museum, and having examined *all* microscopically, in the general as well as in the private collections of that institution, for the purpose (as desired by Dr. Gray) of finally placing them in some kind of order, and having previously examined many others (both living and dead), together with many Foraminifera under the like conditions as well as in a fossilized state, I have, as a matter of course, come to certain conclusions in my own mind respecting the general points of distinction between these two classes of organisms after they have become fully developed. The germ or "beginning" being apparently alike in all, that which chiefly concerns us is what the special vitality in each can make out of the germ.

Taking, then, the sarcode first, which can only be successfully studied in the living state, we find that the pseudopodial prolongations from *Spongilla* in the mass, are short, coarse, more or less conical, scantily branched, and seldom if ever reunited; while in the Foraminifera they are extremely long, delicate, and more or less reunited into an oblique reticulation.

Of the former I know of no figure that illustrates this better than that of *Spongilla* which was published in September 1849 ('Annals,' vol. iv. pl. 4. fig. 2), and none better of the latter than that by Dujardin of *Miliola vulgaris* ('Hist. Nat. des Zoophytes Infusoires,' pl. i. fig. 14, 1841).

I am not aware that in the sarcode itself of these pseudopodia there is any distinguishing peculiarity which is worth noticing here.

When, however, we come to the *composition* of the mass, then there are many points of difference; for while that of the Foraminifera as yet has shown nothing recognizable beyond granules, nuclei, ova, and probably contracting vesicles, that of *Spongilla*, which is apparently much more complicated, possesses two kinds of surface-openings, called respectively "pores" and "oscula"—the former minute and multitudinous, and the latter comparatively scanty and large—both respectively leading to more or less spherical groups of flagellated cells (spongozoa) in the interior. The pores go in more or less directly to the cavities where the groups of spongozoa are situated; and the oscula are the terminations of branched canals, whose ramifications lead from the same points. Currents of water &c. pass *in* through the pores and *out* through the oscula.

The spongozoon possesses a cilium, nucleus, and one or two contracting vesicles, together with apparently nothing more than a little granular mucus; they take in crude food brought to them through the pores, and eject the refuse through the ramifications connected with the branched systems of excretory canals that terminate respectively in the oscula. Ova are present in the sarcode of both Sponges and Foraminifera; but the organs for their production have not yet been discovered.

Although, however, the spongozoon is a flagellated infusorian possessing, so far as has yet been shown, no further organs than those mentioned, still, for all that we know, it may be as complicated as an elephant, whose trunk, liver, and bladder could alone be seen through the general transparency of the body.

In these matters minuteness goes for nothing. Size, light, darkness, motion, tenuity, &c. are only relative in degree; and the degree to which we can appreciate them depends upon the power of our brains respectively, *which is limited.*

That mind (taken in its general sense) alone can comprehend any thing beyond the power of the brain, which builds up the whole of the body and permits a portion of itself to be used by the brain it has developed, bearing a relation to the latter somewhat similar to that which steam bears to a steam-engine.

Thus, in the philosophy of the Buddhists, the mind does not perish with the brain; while Christianity promises a resurrection of the *flesh.*

But to return to our immediate subject, as this digression is merely to show that we should not deny or affirm that which is beyond the power of our *brains* to comprehend.

We come, now, to the skeleton of the Spongiadæ and the Foraminifera respectively; and here the differences are most manifest, inasmuch as the skeleton of the former is *inside*, while that of the latter is *outside.*

The sarcode of the sponges hangs upon their skeleton as the flesh of a human being hangs about his bones; while the sarcode of the Foraminifera lives inside its skeleton after the manner of a snail, only making its exit through holes all over its shell or test, in which generally, if not always, there is one principal opening, leading directly outwards from a single- or many-chambered interior, in accordance with the simple or complicated form of the species. Of course by the term "skeleton" I mean the organ of support.

The materials, too, of which the skeleton is composed are arranged differently. Thus, in the sponges the proper spicules (that is, the spicules formed by the sponge itself) have, in all instances with which I am acquainted, their points directed outwards, one object of which is no doubt for the better holding on of them by the sarcode, and another defence, as spines upon a hedgehog's back; while in the test of the Foraminifera, where spicules are present on the surface, both heads and points are directed outwards indiscriminately.

This is particularly well shown in *Squamulina scopula* and its branched variety ('Annals,' vol. v. p. 309, pls. iv. & v., May 1870, and vol. vi. p. 346, Oct. 1870), together with the concamerated form of the interior, rising evidently from the central or primary cell of a pseudoconcamerated discoidal base, closely resembling a discoidal foraminifer. The terminal opening is also shown, as well as the sarcodal contents of the concamerated cavity, consisting of granular sarcode charged with ova; and the peculiar form taken by the pseudopodia is described in the branched variety (*op. et loc. cit.*); so that, indeed, *Squamulina scopula* prominently puts forth all the points which distinguish a foraminifer from a sponge.

My astonishment, therefore, may be easily conceived when I saw the following *footnote* in Häckel's 'Monographie der Kalkschwämme,' vol. i. p. 456, translated in the 'Annals,' by W. S. Dallas, F.L.S., as "communicated by the author" (vol. xi. p. 244, April 1873.) Häckel there states:—

"Whether the simplest sponge-forms, corresponding with the picture of *Archispongia*, still exist is not known. Possibly a very near ally is the singular sponge which Bowerbank has described as *Haliphysema Tumanowiczii* (Brit. Spong. vol. ii. p. 76, fig. 359), and which Carter regards as a Polythalamian (*Squamulina*). I suspect, on the contrary, that it is a very simple Myxospongia, which, like *Dysidea*, forms for itself a skeleton of foreign bodies (spicules of other sponges, spines of Echinoderms, &c.), but in other respects has the simple structure of *Olynthus*."

But I am still more astonished at Häckel's likening *Squamulina scopula* to *Dysidea*, since in *Dysidea*, as well as in *all* the sponges which draw in foreign objects to strengthen their skeletons, these foreign bodies form the *axis*, not the walls, of horny fibre, or are cemented together by amorphous sarcode into a fibrous structure, according to the nature of the species, about which the soft portions of the sponge hang, as before stated, like flesh on the bones of a human being—that is, *outside* the fibre. This is the case in *Dysidea*. On the other hand, *Squamulina scopula* builds up a similar structure, but lives *inside* it—that is, inside the fibre as it were.

Perhaps *Polytrema rubra*, Dujardin (see Carpenter's 'Introduction to the Study of the Foraminifera,' p. 235, Ray Soc. Pub. 1862), most nearly approaches in structure to the sponges which strengthen their skeletons with foreign material. Here we have a cancellous structure whose cavities communicate with each other, but finally terminate on the surface in little circular areæ, each of which is pierced, like a pepper-box, with a number of distinct holes, while the intervals are filled up by the exterior termination of the clathrate skeleton, which, albeit for the most part it consists of a thin curvilinear lamina of calcareous matter, frequently presents in its structure foreign objects, such as the spicules of sponges, &c.

But even here the sarcode lives in the *cavities*, which may be easily seen to be but an extreme degree of what is already foreshadowed in the chambers of less complicated forms of Foraminifera, while its communication with the exterior is through the minute holes mentioned.

Thus, while the minute holes on the surface of the Foraminifera are fixed in form and size in a solid hard crust for the *egress* of the pseudopodia, the minute holes on the surface of the sponge (that is, the "pores") are situated in an unfixed, ever-changing, soft sarcode for the *ingress* of water bearing the particles of food on which the species may subsist. In short, one goes out to search for food with its bare pseudopodia, after the manner of an *Actinia*, while the other draws it into the interior of its habitation by the aid of currents of water produced by cilia, after the manner of an Ascidian. It is to the latter, I think, that we shall by-and-by find the sponges passing through Schmidt's *Gummineæ*.

The structure (not the form) of *Polytrema* appears to have been like that of *Parkeria* and *Loftusia*, Carpenter and Brady (Phil. Trans. vol. clix. part ii. 1869, pls. 72–80); but I have nothing to do with the *fossil* Foraminifera here.

It might be stated that the boring-sponges have a segmented form, like the Foraminifera, and that they often, in oyster-shells, leave a concamerated chain of cavities. This is true; but still they also have their spicular skeletons, and the parietes of their chambers consist of those parts of the oyster-shell which immediately surround the chambers. Thus the sponge does not form for itself a concamerated test. The polythalamous cavity is merely a "burrow."

Hence when Häckel states, regarding *Squamulina scopula*, that he suspects it to be a very simple *Myxospongia*, which, like *Dysidea*, forms for itself a skeleton of foreign bodies, but in other respects has the simple structure of his *Olynthus*, while his *Olynthus primordialis* (Monographie, Atlas, Taf. 1. fig. 1) is at the foot of his whole system, I am naturally inclined to say, "*Ex uno disce omnes*"?

Among the mounted specimens which Dr. Oscar Schmidt generously sent to the British Museum are two bearing respectively *Squamulina scopula* and the branched variety of this species, under which is written in his own hand "keine Spongien," as well here as in his estimable work on the Spongefauna of the Atlantic Ocean, p. 72, 1870. But Schmidt speaks with the modesty of a *bonâ fide* naturalist, Häckel with the infallibility of a Pope*.

* In the arrangement which I have proposed for the sponges in the British Museum, and which will of course apply to all others, I find that

XLI.—*On the Dentition of Rhinoceroses* (Rhinocerotes), *and on the Characters afforded by their Skulls.* By Dr. J. E. Gray, F.R.S. &c.

[Plate XI.]

In the 'Proceedings of the Zoological Society' for 1867, and in the 'Catalogue of Carnivorous and Pachydermatous Mammalia in the British Museum,' p. 295, I gave an account of the skulls of the Rhinoceroses in the British Museum, and described their dentition in the young and in the adult animals. Since that period the British Museum has received several additional specimens, which have enabled me to observe further details of the changes that take place in the skulls and teeth during their growth; and I have been induced to condense in this paper the results of their examination.

The Asiatic Rhinoceroses have the front of the nasal bone convex, produced, and more or less acute in front.

The intermaxillaries in the skull of the very young animal are spongy and united together in front, with two rudimentary teeth on the hinder part of each side. In the older animals these teeth are more elongate, produced, and separate from each other in front, and supported by a more or less long process of the intermaxillary bone, which encases the upper and outer side of their hinder part. The young animals have two teeth on each side, the hinder being the smallest; but in the older animals both these teeth drop out, and the front one is replaced by a large tooth, which eventually has a large flattened crown.

In the Asiatic one-horned Rhinoceroses (*Rhinoceros*) there is a small cylindrical cutting-tooth on the inner side of the

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they can be divided into five principal groups, in which *all* sponges, including the *Hexactinellidæ* and Calcispongiæ, may be included, thus:—

1st. Sponges with horny fibre and granular axis without foreign objects. *Aplysinidæ.*

2nd. Sponges with horny fibre, amorphous sarcode, and axis of foreign objects. *Herciniadæ.*

3rd. Sponges with horny fibre and axis of proper spicules only, *i. e.* spicules formed by the species. *Chalinidæ.*

4th. Sponges with horny fibre and axis of proper spicules, more or less echinated also with proper spicules. *Armatæ.*

5th. Sponges in which the fibre is formed of proper spicules cemented together by amorphous sarcode. *Renierinæ.*

It should always be remembered that the materials of the axis cannot get into the fibre after the latter is formed, and therefore that the sponge must arrange all this beforehand.

In a short time I hope to go further into this subject, as I have completed the 1st and 2nd divisions so far as subgrouping goes.

two large lateral ones. These teeth are close to the inner side of the lateral ones in the skull of the fœtal animal; but they become separated from them as the front of the jaw dilates for the secretion of the permanent cutting-teeth, and when the larger lateral cutting-teeth are developed they are more compressed together. They are generally present; but there is a skull of *Rhinoceros javanicus* in the Museum (723*a*) in which they are deficient, the inner sides of the large lateral cutting-teeth being very close together.

In the lower jaw of the skulls of very young animals there is a large conical cutting-tooth on each side in front. This tooth is very depressed, and has sharp edges on the sides, and a half-ovate end. It becomes worn down, and is replaced by a larger tooth, which becomes worn down on the upper surface so as to produce an elongated flat disk with an acute front.

In the skulls of the adult two-horned Asiatic Rhinoceroses (*Ceratorhinus*), these two middle cutting-teeth are wanting. I have never seen a very young skull of these animals.

Ceratorhinus sumatranus.

The figure of the skull, like the figure of the animal, attached to Mr. Bell's paper in the 'Philosophical Transactions' (vol. lxxxiii. 1793, p. 3, t. ii.–iv.) well represents this species, and has well-developed cutting-teeth in the lower jaw, and the space between the condyles of the skull narrow, which is the character of this species.

Home's figure of the skeleton of the Sumatran Rhinoceros (Phil. Trans. 1821, t. xxii.), from the skeleton now in the Royal College of Surgeons, better represents the height of the skull, but scarcely sufficiently shows the distinction between the two species.

The figure of *R. sumatrensis* ♀, Blainv. Ostéog. t. ii., is not so high behind as the skulls of either of the species, and in other respects is not characteristic.

Ceratorhinus niger. Plate XI. (skull).

The British Museum purchased from the Zoological Society the body of the Rhinoceros which was obtained by Mr. William Jamrach at Singapore, and which was captured at Malacca in 1871. It is peculiar for having a very rough skin, the body being covered with thick black hair; the tail is comparatively long and thin; and the ears are closer together than in *C. sumatranus.*

Mr. Edward Gerrard, Jun., has preserved and stuffed the skin, and prepared a very complete skeleton of the animal.

The skull is very different from those of the Sumatran Rhinoceros (*R. sumatranus*, Raffles), collected by Sir Stamford Raffles and now in the British Museum and in that of the Royal College of Surgeons, and from the skull which we purchased of Mr. Theobald, and proves most distinctly that I was right in stating the animal, when alive, to be very distinct from the Sumatran Rhinoceros described and figured by Bell in the 'Philosophical Transactions' for 1793, to which Sir Stamford Raffles gave the name of *R. sumatranus*, under which name the Malaccan Rhinoceros was exhibited at the Zoological Gardens and mentioned in the list of accessions in the 'Proceedings of the Zoological Society;' and I see by the report that a paper on the details of its visceral anatomy has been read to the Society by Mr. Garrod.

There has for many years existed in the British Museum a stuffed skin of a young specimen of this species, which was purchased of Mr. Franks of Amsterdam as the young Sumatran Rhinoceros; but there is reason to believe that this specimen was from Singapore, the port of Malacca.

The skull of the Malaccan Rhinoceros is very like that of the Sumatran one; but it is shorter and broader than that of *R. sumatranus*. The hole in the cheek for the passage of the large vessels is oblong, much larger, and nearer the margin of the nasal aperture; while in the two skulls of *R. sumatranus* it is smaller, circular, and some distance from the margin of the aperture. The front edge of the intermaxillary bones is broader, rounded, and not compressed or nearly so much produced as the front edge of the intermaxillary bone of the adult skull of *R. sumatranus*, nor so much as in the skull of the young animal of the same species, which is shorter and broader than in the adult. The grinders of the upper jaw are six in number, and appear broader than those of the adult *R. sumatranus*, but they occupy the same length.

The skull of the Malaccan Rhinoceros is not so high behind as that of the adult Sumatran Rhinoceros; and the space in the crown between the temporal muscles is flat, and much wider than that of the adult but not so aged Sumatran Rhinoceros in the British Museum. The back end of the upper part of the occiput is not nearly so broad as that of the Sumatran Rhinoceros.

The most striking difference is in the lower jaw. The condyles are further apart; indeed the whole jaw is wider; but the outer edge of the hinder angle is much more expanded. This latter peculiarity, as well as the form of the crown of the grinders in the upper jaw, may arise from the greater age of the specimen. The greatest peculiarity is that the front of the lower jaw is comparatively thin, expanded, and has neither teeth nor alveoli, nor, indeed, one may say, sufficient thickness to hold the large cutting-teeth usually found in the front of the lower jaw of this genus. The grinders are six on each side; that is to say, the front tooth on each side is retained, whereas it is shed from the skull of the adult but much less aged animal of *C. sumatranus* in the British Museum; and the grinders appear to differ in the form of their folds from those of the Sumatran species.

	C. niger.	*C. sumatranus.*
Length from tip of nose to occipital condyle of adult	in. 21½	in. 22
From front of intermaxillary to occipital condyle	20¼	21
From front edge to back edge of lower jaw	16½	17
Width at zygomatic arch	12	11
Width of hinder end of lower jaw	10⅜	9½
Width of upper part of lower jaw at end of tooth-line	7½	6¾
Height of back of skull	13	13½

It is very probable that the want of front teeth in the lower jaw may be an individual peculiarity produced by the age of the specimen; at least I do not think it safe to regard that peculiarity as specific without an examination of more specimens.

Ceratorhinus Crossii.

In the 'Annals and Magazine of Natural History,' 1872, x. p. 209, I referred to this species and thought it might be the same as *R. sumatranus* from Tavoy and Tenasserim, mentioned by Blyth, Journ. Asiat. Soc. Bengal, 1862, p. 156, who figures the skull and horns, and who identifies his animal with my *R. Crossii* (which was described from a pair of horns, P. Z. S. 1854), and has just informed me that he is certain that it is the head of the small black rhinoceros with two horns.

It is most likely that he is correct in thinking that the horn I figured as *R. Crossii* is of the same species as the skulls which he received from Tenasserim; but it is to be observed that I have never seen a skull of the Tenasserim Rhinoceros, and do not know whether it is the same as *C. sumatranus* from Sumatra or *C. niger* from Malacca, or whether it may be a distinct species. Therefore I think it best, until we receive skulls of the Tenasserim species, to give the Malaccan one a distinct name and call it *C. niger* (as the black colour at once distinguishes it from the greyish Sumatran species), more especially as some zoologists who admit the difference of the two species refer *R. Crossii*, of which we know nothing but the horn, to each of the species.

Ceratorhinus Blythii.

Mr. Blyth, in the 'Journal of the Asiatic Society of Bengal,' vol. xxxi. t. iii. f. 1, 2, 3, lithographs from photographs (which he has since given to me) three skulls of what he calls *R. sumatranus* from Tenasserim.

These skulls, according to the photographs, differ so much from each other that they do not afford materials for the determination of the question of the species to which the Tenasserim Rhinoceros should be referred.

The photographs represent the skulls of animals of very different ages; but I cannot believe the difference between them depends solely on age, as the skull of the oldest (fig. 1) and of the youngest (fig. 3) agree in the shape of the occiput and in the upper surface not being produced behind, while the skull of the half-grown one (fig. 2) has the upper surface of the occiput very much produced backwards, and the occipital condyles not so prominent.

The three photographs are nearly of the same breadth at the lateral condyles; but the length of the upper surface of the skull differs considerably as compared with its breadth. Thus in the photograph of the aged specimen (t. iii. f. 1) the length of the skull is once and three-fourths its breadth; in the youngest skull (t. iii. f. 3) it is very nearly of the same proportion; but in the nearly adult skull the photograph represents the upper surface as a little more than twice as long as the breadth at the condyles.

The most striking difference is in the height of the occipital end and the form of the lower jaw in the photographs of the adult and nearly adult skulls (f. 1 & 2).

In the adult skull the occipital end is high (that is, as high as two thirds the length of the skull from the occipital condyle to the end of the nose), and the hinder end of the lower jaw is nearly erect, with a broad rounded lower part, which is prominent, with diverging ridges on its outer margin. In the nearly adult specimen the hinder end is not nearly so high compared with the length, and the hinder end of the lower jaw shelves off towards its lower edge and has not the expanded rounded form of the lower jaw of the other specimen; but it is curious that the skull of the youngest one has the form of the occiput of the very aged one and the form of the lower jaw of the middle-aged one. All this shows the difficulty of distinguishing the species of these animals and the necessity of waiting until we get together more specimens and their skulls from different parts of Asia. It may turn out that more than one species of two-horned Rhinoceros inhabit Tenasserim. There is a one-horned one, *R. javanicus*, also found there. The photograph of the oldest skull (t. iii. f. 1) and the youngest (t. iii. f. 3) agree in many particulars with our skulls of *C. sumatranus* from Sumatra—that is to say, in the width of the skull at the lateral condyles and in the narrowness of the space that separates the temporal muscles of the adult; but the surface of the lower jaw of the adult specimen most resembles that of *C. niger*. The latter fact may depend solely upon the age of the specimen.

Mr. Blyth informs me that he believes the adult skull (t. iii. f. 1) is the skull of *R. Crossii*, which he thinks is *R. lasiotis*, and he believes that the two younger skulls (t. iii. f. 2 & 3) belong to the black Rhinoceros. The youngest skull (t. iii. f. 3) has the skin of the head and horns attached to it in the Museum at Calcutta. But the lower jaw in the two younger specimens does not agree in form with the lower jaw of *C. niger*; and therefore I should provisionally name them *C. Blythii*.

The African Rhinoceroses have the intermaxillary bones small, laminar, situated on the front end of a bony plate separated by a suture (which becomes obliterated in the older specimens) in the inner side of the front part of the maxillæ; and it has a tooth on the edge, which generally falls out in the adult animal; hence they are usually described as having no intermaxillary cutting-teeth. The lower jaw of the young *R. bicornis* (1365 *b*) has a small cylindrical cutting-tooth on each side of the broad end of the jaw, which disappears in the older animals; and the breadth of the front of the jaw does not increase, and therefore becomes smaller compared with the size of the skull. In the skull of the fœtal specimen of *R. bicornis*, 8¼ in. long (1365 *h*), with the three grinders but partially developed, the intermaxillaries are cartilaginous, and show rudiments or, rather, nuclei of two teeth.

The lamina on the inside of the maxillæ of these African Rhinoceroses, bearing the intermaxillaries, is represented in the Asiatic Rhinoceroses by a broad portion of the inside of the maxillæ, which is marked by an external groove; but in these animals the broad intermaxilla is attached to the end of the maxilla, as well as to the end of this defined part.

EXPLANATION OF PLATE XI.

The skull of the two-horned Rhinoceros (*Ceratorhinus niger*) from Malacca; and a view of its occipital extremity, showing the form and breadth of the hinder part of the head.

XLII.—*On some Works relating to a new Classification of Ammonites.* By Ernest Favre*.

The abundance with which Ammonites are distributed in the deposits of the secondary epoch, the variety and beauty of these fossils, and their importance in the classification of strata have long attracted the attention of naturalists. When the known species of this group increased in number, and a greater diversity of forms was discovered, the necessity of introducing some subdivisions among them came to be felt. Nevertheless, as no representative of this genus has yet been found living, and the organization of the animal was and still is in great part unknown, the various classifications proposed were only based on the most apparent characters of the shell—that is to say, on its general form, the nature of its ornaments, and that of the septa. Thus it was that the Ammonites were divided into various families, the *Heterophylli*, *Globosi*, *Ornati*, *Cristati*, &c.

The great works of M. Barrande on the Cephalopoda of the Silurian strata, the development of palæontological collections, and a very complete study of the anatomy of the *Nautilus* (the only tetrabranch now living) have thrown, within the last few years, a new light on the organization of the Ammonites. Important characters have been recognized, and have served as a basis for a classification into various groups which have been called genera. In this way a number of new names, such as *Arcestes*, *Phylloceras*, *Perisphinctes*, &c., of which the use has not yet spread beyond a certain number of palæontologists, have been introduced into certain works published in Germany. The new classification†, however, is not complete; and it relates especially to the Ammonites of the Jurassic formation, of which the museums of Munich and Vienna possess admirable collections. Moreover the naturalists who have created and adopted it still retain the old designation for the Ammonites from this formation which are not yet classed, as well as for the greater part of the Cretaceous Ammonites, until new materials enable the work to be completed.

Professor Suess has the merit of first drawing attention to the characters which may serve to establish a new classification of Ammonites, and directed in a quite different course from his predecessors' the researches on this group. M. Laube, M.

* Translated by W. S. Dallas, F.L.S., from the Bibliothèque Universelle, Archives des Sciences, January 15th, 1873, pp. 1-23.

† I shall not speak here of an attempt at classification which has been made in America by Prof. Agassiz and Mr. Hyatt, and which rests upon very different principles from those of the German classification.

Zittel, and M. Waagen afterwards, especially occupied themselves with this question*. The classification proposed by M. Suess rests in great part on the size of the last chamber and on the nature of the appendages to the mouth of the shell, which he believes to be in relation with the essential characters of the animal. That of M. Waagen, whilst taking into account these characters, is based on the nature of the *Aptychus*, which plays, as I shall show, an essential part in the organization of the Ammonite.

The *last chamber*, the size of which is constant in each group of Ammonites, differs much from one group to another. In some of them it occupies as much as one turn and a half, in others hardly half a turn. This difference is often connected, according to M. Suess, with differences in the form of the margin of the aperture, and in important anatomical characters. According to this learned palæontologist, in the Ammonites furnished with a large chamber the adductor muscles were probably placed on the sides near the margin of the shell, which generally presents the form of a crescent. In the much more numerous Ammonites which have a shorter chamber the latter encloses only a part of the animal; the margin of the aperture is then furnished with appendages of various forms, sometimes simple and discoidal (*myothèque*), sometimes more elongated and presenting a myotheca united to the shell by a longer or a shorter peduncle (*myolabe*). As these names indicate, these appendages served, in the opinion of M. Suess, as points of attachment for the muscles.

M. Waagen has opposed this opinion. The muscles have, according to him, a part too important in the organization of the Ammonite, and the life of the animal depends too much upon their preservation, for them to be thus placed on the edge

* The following are the titles of the various works in which this subject is treated:—

1865 and 1870. Ed. Suess, "Ueber Ammoniten," Sitzungsber. k. Akad. Wiss. Wien, lii., lxi.

1868. Zittel, Paläontologische Mittheilungen. Die Cephalopoden der Stramberger Schichten.

1869. Laube, "Ueber *Ammonites Aon* und seine Verwandten," Sitzungsber. k. Akad. Wiss. Wien, lix. 15.

1869. Waagen, "Die Formenreihe des *Ammonites subradiatus*," in Benecke's Geogn.-pal. Beitr. 1869, ii. 183.

1870. Zittel, Paläontologische Mittheilungen. Die Fauna der ältern Cephalopoden-führenden Tithonbildungen.

1870. Waagen, "Ueber die Ansatzstellen der Haftmuskeln beim Nautilus und den Ammonitiden," Palæontographica, herausg. v. Dunker und Zittel, xvii. 185.

1871. Waagen, "Abstract of results of examination of the Ammonite-fauna of Kutch, &c.," Records of the Geol. Surv. of India, 1871.

of the shell, and often beyond this edge on a pedunculated organ, exposed to all sorts of external dangers. The anatomy of the *Nautilus*, in conjunction with observations made directly on well-preserved Ammonites, lead him to a very different result from that obtained by M. Suess. This I shall explain hereafter.

It has long been a question how the animal of the Ammonite advanced in its shell, and how it formed its septa. The mode of progression was evidently the same as in the *Nautilus*. The researches of M. Keferstein, and those of M. Waagen, on the anatomy of the latter animal seem to have settled the question. The animal grows periodically; at certain moments, which are for it a time of repose, it remains fixed: the posterior part of its body, which is free, secretes calcareous matter and forms the septum; at other times this part secretes air, and the animal advances slowly. All its periphery is bound to the shell by a thin layer of conchioline*, of which the outer margin has the form of a ring (*annulus*), marked in the interior of the shell by a band from 1 to 2 millimetres in breadth. The adductor muscles are attached by a thicker coat of the same substance; the marks which they leave on the shell in the last chamber have a perfectly definite form. The whole animal, the posterior part excepted, is therefore united to the shell, and the chamber is hermetically closed.

This explains how the air can accumulate, how the animal can resist variations in the pressure of the air according as it is at a greater or less depth, and also how the soft parts thus sustained could, in the Ammonites, secrete the delicate lobes of the septa always in the same position and on the same spiral line. The mantle extends in front of this attaching ring (*Haftring*); it is composed of two parts—one, which is very short, corresponding to the antisiphonal region of the animal; the other, which is much longer, corresponds to the siphonal region, and secretes the shell with which it is connected by its outer margin. Contrary to the opinion of M. Suess, the form of the margins of the aperture has no direct relation with the position of the adductor muscles; it depends entirely on the form of the mantle.

Aptychus.—The most various opinions have been put forward as to the nature and functions of the *Aptychus* †. L. von

* A substance resembling epidermose and containing about C 50, H 6, and N 16·5 per cent.

† M. Coquand published, in 1841, 'Considérations sur les Aptychus,' in which he sums up all the opinions brought forward up to that date as to the nature of these singular organisms. He endeavours to demonstrate that these shells belonged to an extinct family of naked Cephalpooda.

Buch was the first to suppose that they belonged to the Ammonites, and that each species has a determinate form of aptychus. Oppel (Paläont. Mittheil.) demonstrated this fact, and ascertained that they have always a perfectly definite position in the neighbourhood of the siphonal side of the last chamber when the fossil is in a normal state of preservation *.

Three kinds of Aptychus have been distinguished:—*Aptychus* properly so called; *Anaptychus*, which is characteristic of the groups of the *Arietes* and *Amalthei*; and *Sidetes*, of which the Ammonite is not yet known, and which belongs to the Cretaceous formation.

The form of the Aptychus is generally known. The shell consists of three layers of different textures, of which the two external ones are often detached. The inner layer is thin, homogeneous, and often impregnated with organic substance; it is marked with fine lines of growth, and sometimes also with radiating lines. The middle layer, which is the thickest, is distinguished by its structure of juxtaposed canals.

The outer layer disappears easily; it has not always been observed. In the thick Aptychi of the *Perarmati* (*A. cellulosi*) it is very thin and pierced with very small holes; in the Aptychi of the *Flexuosi* and *Falciferi* (*A. imbricati*) it forms a thin homogeneous layer, destitute of pores, which often becomes detached; in the Aptychi of the *Planulati* it is covered with small points. It is particularly developed in the Aptychi of the Alpine strata; in many of them (*A. punctati*, Zitt.) the surface of the thick middle layer is, as in the *Imbricati*, garnished with imbricated folds. But while in these last the outer layer is very thin, it is thickened in the others so as to fill up the intervals of the projecting folds, so that well-preserved specimens seem nearly smooth; their surface is covered with round pores, which are sometimes pretty large, arranged in a radiating order, each row corresponding to a furrow of the middle layer. *A. profundus*, Pict., *alpinus*, Gümb., *striatopunctatus*, Voltz, *cuneiformis*, Oost., *radians*, Coq., and *Malbosi*, Pict., present this structure. We do not yet know to what group of Ammonites they correspond; for they are very abundant in certain beds of the Alps, in which Ammonites are scarcely ever found. This fact, which has repeatedly furnished an argument against the opinion that the Aptychus is an integral part of the Ammonite, may be explained in various ways. We may suppose that after the death of the animal

* M. Schluter has ascertained that the aptychus of the Scaphites occupied exactly the same position (Cephal. der ober. deutsch. Kreide, 1872, pl. 25. figs. 5 & 6).

the Aptychus detached itself from the shell and fell to the bottom of the water, whilst the shell of the Ammonite was thrown on the shore—or, as M. Zittel has supposed, that these organisms belong to a group of naked Tetrabranchs.

What is the part played by the Aptychus in the Ammonite? The *Nautilus* presenting nothing like it, it was difficult to determine its function. Voltz found its analogue in the operculum of the Gasteropoda. Von Buch and Quenstedt regard it as an internal shell. Keferstein has put forward the opinion that the Aptychus might be a protecting organ of the nidamentary glands of the female Ammonite. M. Zittel has corroborated this opinion by several proofs; and M. Waagen has made it a certainty.

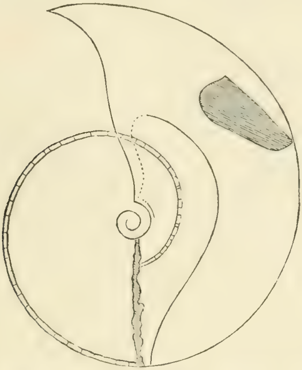
The normal position of the Aptychus in the Ammonite is so closely related to that of the nidamentary gland in the female *Nautilus*, that it seems difficult to assign to it a different function. Moreover the soft tissue of this gland has a great resemblance in its various parts to the structure of the different types of Aptychus, and the form of the Aptychus corresponds very well with that of the outer part of this gland. These various characters indicate therefore almost certainly the purpose which it serves, although in no living Cephalopod has there been found a similar thickening of the teguments of these glands. We may add, as an indirect proof, that no other organ exists in the *Nautilus* with the analogue of which the Aptychus could have been connected in the Ammonite.

It is evident that it could not have served to close the aperture of the shell. This opinion, which has been repeatedly maintained, and quite recently by M. Lehon *, has been refuted by M. Waagen. The museum at Munich contains a hundred specimens of Ammonites still provided with the Aptychus. Only five of them present the Aptychus placed perpendicularly to the aperture, as M. Lehon has shown it. In all the others it is deeply immersed in the shell in the position here figured (see opposite), a position which corresponds with that of the nidamentary glands of the *Nautilus* †. M. Waagen shows besides, by measurements of *Amm. steraspis*, that the dimensions of the Aptychus by no means agree with those of the aperture. Moreover its presence in Ammonites provided with appendages to the aperture proves evidently that it never plays the part of an operculum; for these appendages often approach each other towards the apex, and would have entirely paralyzed its movements. Keferstein, who had recognized the true

* Bull. de la Soc. Géol. de France, 1870, vol. xxvii. p. 10.

† See, for the position of these glands in the *Nautilus*, the excellent figure given as the frontispiece to Woodward's Manual.

function of the Aptychus, believed that the Anaptychus served as an operculum: it occurs, however, in the same position as



A. steraspis: figure taken from Waagen, Palæont. xvii. pl. 40. f. 4.

the former of these organs *; and it is therefore evident that it fulfilled the same purpose.

The function of the Aptychus being thus determined, furnishes an important point for the determination of the relative arrangement of the organs in the Ammonite, which may be deduced from that which they occupy in the *Nautilus*. In this animal the nidamentary gland is situated on the siphonal side above the adductor muscle, and outside of the ring of adherence. It is only natural to suppose that the relations of these various organs were the same in the Ammonite. Direct observation serves here to confirm the theory.

Oppel has remarked in a great number of Ammonites from the limestones of Solenhofen a mark of a peculiar form (Paläont. Mittheil. pl. 69). M. Waagen has ascertained that this impression has precisely the same shape as that of the ring of adherence in the *Nautilus* (see the foregoing sketch); it is the trace of the horny margin of this ring, which has been preserved in consequence of the tranquillity of the deposition of the sediments. This trace begins at the margin of the aperture, about in the middle of the sides, follows the spiral of the shell back towards the septum, and then bends forward towards the siphonal side. The Aptychus is above and outside of this

* See *A. planorbis*, Sow., in Waagen, Palæontogr. 1869, xvii. pl. 40. fig. 5.

mark (that is to say, nearer the siphonal side), the same as the nidamentary gland in the *Nautilus*. This important line once ascertained, M. Waagen deduces from it by analogy the position of the adductor muscle, of which the trace is ideally represented in the figure by a dotted line.

Apertural appendages.—We owe to M. Suess a detailed study of these appendages in various groups of Ammonites. In the group of the *Fimbriati* the ventral side shows nothing but a broad, short, and but slightly marked process, while the dorsal margin presents a long appendage which spreads far over the preceding turn. In the *Amalthei*, the *Falciferi*, and the *Cristati* * the keel extends far beyond the anterior margin of the chamber, in a long appendage which M. Suess regards as destined to support and protect the naked part of the body of the Ammonite, and in particular the excretory canal, in those groups which are distinguished by the smallness of their last chamber; this appendage curves outwards in *A. rostratus* †, and inwards in *A. Lamberti* ‡. In a great number of Ammonites (*Ornati*, *Coronati*, *Planulati*, *Flexuosi*, *Trimarginati*) the margins of the shell are produced into lateral appendages or auricles of various shapes, which M. Suess regards, as I have already stated, as the points of attachment for the muscles. In the typical *Planulati* the discoidal part and the stalk of these appendages are both well developed; in the *Coronati* the stalk is always short and the disk very large §; in *A. Jason* ||, these two organs are more or less confounded. The often hollow spiral line that we see in many Ammonites (*A. lunula*, *A. canaliculatus*, *A. bifrons*, &c.) is produced as far as this appendage; it is nothing but the trace left by the stalk, which gradually incorporates itself with the shell in proportion as the latter grows, while the discoidal part is very probably subjected to resorption.

If these lateral processes did not serve as points of attachment for the muscles, what could have been their use? The margin of the aperture of the *Nautilus* is also falciform; it is so in a more marked manner in some *Clymeniæ*, and still more in *Orthoceras undulatum*. This process serves in the *Nautilus* for the protection of the head, and in particular of the eye. We may therefore suppose, with much probability, that it fulfilled the

* See *A. Amaltheus* and *A. costatus*, Quenstedt, Jura, p. 162 and pl. 21. figs. 1–3; Cephalopoden, pl. 5. fig. 10 *a*; *A. serpentinus*, Pictet, Traité de Paléont. pl. 53. fig. 2; *A. cristatus* and *A. varians*, D'Orbigny, Céphal. crét. pls. 88 & 92.

† Buvignier, Statistique géolog. de la Meuse, pl. 31. fig. 8.

‡ Quenstedt, Jura, pl. 70. fig. 16.

§ D'Orbigny, Céphal. Jurass. pl. 149. fig. 1, pls. 135 & 139.

|| D'Orbigny, Céphal. Jurass. pl. 159. fig. 1.

same function in the Ammonite. It occurs constantly in certain genera of Ammonites; but this is not the case with the auricles; and the irregularity in the form and presence of these organs proves that they were not destined to the part M. Suess has attributed to them.

On examining these appendages with care, we see that their length is by no means in inverse proportion to that of the chamber. In the *Amalthei*, in which the chamber forms from half to two thirds of a turn, the margin scarcely presents a slight lateral process; in the *Planulati*, on the contrary, in which it is much longer, the auricles are often well developed. Their presence itself is very irregular, even in the same species; it presents great variations with age: M. Waagen has ascertained that they often disappear at a certain age. Moreover, sometimes, of two Ammonites of the same species and the same size, one presents auricles and the other a simple margin. As examples of this, Waagen cites and figures * two *A. opalinus* obtained at Zaskale, in Gallicia. It is probable that these appendages had some other physiological function. The species furnished with an Anaptychus do not present auricles at any period of their existence; those which have auricles, even if only during their youth, have, on the contrary, a true Aptychus.

The differences which I have just indicated are not sexual differences. In fact, there have been found, at Solenhofen, amongst the Ammonites which contain Aptychi, as many individuals provided with auricles as destitute of them. Now we have seen that the Aptychus is a distinctive sign of the female Ammonite. Certain shells from this same deposit, in which the line of the ring of attachment is still well marked and which have consequently been submitted since their death only to a slow decomposition in which the soft parts alone have disappeared, are not furnished with Aptychi; therefore they never had any, and they evidently belonged to males. Now they do not present any difference from the female individuals, except perhaps a little more strongly marked ornamentation.

The figures of *A. steraspis* given by Oppel (Paläont. Mitth. pl. 69) are very instructive on this point.

The Structure of the Shell.—The shell of the *Nautilus* is composed of two layers—an external layer formed of an aggregate of cells of different sizes, and the largest of which are those nearest the outside (it forms the most important part of the shell properly so called, and M. Suess has named

* Palæontographica, 1869, xvii. pl. 40. figs. 6 & 7.

it *ostracum*), and an internal nacreous layer formed of very small cells, which constitutes the septa and lines the inner surface of the ostracum. The former is secreted by the mantle; the latter by the body of the animal. This same structure has been recognized in many Ammonites, notwithstanding the difficulties which observation presents; it is observed, in particular, in many Ammonites of the *Fimbriati* group.

M. Barrande has established the fact that in many of the palæozoic Cephalopoda the organization was such that not only the animal was entirely lodged in the shell, but it could not put out more than a comparatively restricted number of its organs. This character coexists generally with a great thickness of the shell, due very probably to the nacreous layer, and with certain swellings of this layer which M. Barrande has named organic deposit. The structure of certain Ammonites presents some analogy with this latter fact. In *A. cymbiformis*, of the Trias of Hallstatt, the surface of the ostracum, garnished with the striæ of growth of the shell, is seen continuing regularly without interruption to the anterior margin; and it is only where the shell is broken that we observe on the cast deep periodical furrows, corresponding to so many folds or *varices* which were formed regularly on the inner surface of the shell, and which occur in the youngest individuals. Generally these varices do not represent former apertures; for they are not parallel to the lines of growth of the ostracum, as is seen in *A. Jarbas*. The periodical arrests of growth which are indicated by these varices have nothing in common with those which are necessary for the formation of the septa. The constrictions which are observed in the *Planulati*, for example in *A. polygyratus*, are of a totally different nature; they do not accord with a varix of the interior of the shell, but they are produced by folds in the ostracum, without any change in the thickness of the shell: M. Suess calls them *contractions*. The varices and the contractions have this in common, that in each group they are only observed in those individuals which have the aperture but little elevated; in *Arcestes* they exist in *A. cymbiformis*, but they are wanting in those which have an elevated aperture, such as *A. Layeri*, *Metternichi* (*Pinacoceras*, Mojs.). The varices are only seen in *Goniatites*, *Arcestes*, *Phylloceras*, and *Clymenia*. The contractions are seen in *Lytoceras*, *Perisphinctes*, and many other Ammonites. The distinction of the contractions and the varices seems to agree with that of the great groups of Ammonites.

The wrinkled layer (*Runzelschicht*) is formed by a deposit of calcareous folds in the neighbourhood of the mouth a little in front, on the convexity of the preceding turn. It has been observed in the Goniatites by Keyserling, in many Silurian Cephalopoda by M. Barrande, and in the *Clymeniæ* by M. Gümbel; M. Quenstedt and M. von Hauer have recognized it in the Ammonites of the group *Arcestes*; M. Laube in *A. (Phylloceras) Jarbas*; M. Suess in *Clydonites delphinocephalus*.

This layer extends to a larger or smaller part of the interior of the shell; it becomes gradually effaced and disappears with growth. It appears to be wanting in the genera which present contractions. The Ammonites in which it is found (*Arcestes* and *Phylloceras*) are also those which have varices; by these characters they approach certain palæozoic Cephalopoda; they are also those which appeared first*.

The great differences in the structure of the Aptychi indicate considerable differences in the structure of the nidamentary glands, and consequently in the entire organization of the Ammonites. The various characters which we have enumerated seem fully to justify a division into genera of the fossils of this great group. This new classification is based, then, first of all on the structure of the nidamentary gland; next, on the length of the chamber of habitation; in the third place, on the form of the latter and of the aperture, the septa, and the ornaments. The general form of the shell, to which the older classification attached great importance, seems to be a very variable character, and, in consequence, a secondary one. It is upon these principles that M. Waagen has based the following table:—

A. Nidamentary Gland without solid integument.

Chamber short; appendage ventral	Phylloceras, Suess.
Chamber short; appendage dorsal	Lytoceras, Suess.
Chamber very long (1½ to 2 turns)	Arcestes, Suess.
? Chamber short; apertural margin falciform, with the appendage ventral; ornaments of the same kind as those of the Argonaut	Trachyceras, Laube.

B. Nidamentary Gland with a solid integument (*Aptychus*).

I. *Gland simple, not divided, with*:—

1. Integument horny (*Anaptychus*).

Chamber very long (1 to 1½ turn); apertural margin with a pointed ventral appendage ..	Arietites, Waag.
Chamber from ⅔ to 1 turn; apertural margin with a rounded ventral appendage	Ægoceras, Waag.
Chamber short (½ to ⅔ turn); apertural margin with a long ventral appendage	Amaltheus, Montf.

* These Ammonites are abundant in the Trias. M. Waagen has lately discovered some in the Carboniferous formation in India.

2. Integument calcareous.

Aptychus Numida, Coq. Shell unknown. (Sidetes?)	—— ?

II. *Gland double, with the Aptychus calcareous.*

1. Aptychus possessing furrows on the external side.

Aptychus thin, presenting externally a layer of conchioline, which is easily detached. Chamber short; apertural margin falciform, with an acute ventral appendage	HARPOCERAS, Waag.
Aptychus thick, having internally a solid layer of conchioline. Chamber short; apertural margin falciform, with a rounded ventral appendage	OPPELIA, Waag.
Chamber short, having near the aperture a groove or a swelling; apertural margin provided with lateral auricles and a rounded ventral appendage	HAPLOCERAS, Zitt.
Chamber pretty long; last turn detached from the others	? SCAPHITES, Park.

2. Aptychus thin, granulated externally.

Chamber long; apertural margin simple or furnished with auricles	STEPHANOCERAS, Waag.
Chamber long; aperture narrowed by a furrow, simple or furnished with auricles	PERISPHINCTES, Waag.
Chamber short; aperture simple or furnished with auricles	COSMOCERAS, Waag.

3. Aptychus thick, smooth, and punctated externally.

? Chamber long. Umbilicus large. Shell with furrows; apertural margin with a nasiform ventral appendage	SIMOCERAS, Zitt.
Chamber short; apertural margin generally simple	ASPIDOCERAS, Zitt.

In this table I have employed the words *ventral* and *dorsal* in place of *siphonal* and *antisiphonal*, because the appendages to which they apply, and which are placed at the extremity of the last chamber, are not in any way related to the siphon. Two newly established genera must be added, viz. *Pinacoceras*, Mojsis., allied to *Arcestes*, and *Peltoceras*, Waag., intermediate between *Perisphinctes* and *Aspidoceras*.

This table is far from embracing the whole of the family of Ammonitidæ. There are wanting *Ceratites* and *Goniatites*, long since separated from the true Ammonites, all the unrolled Ammonitidæ, already classified in accordance with other characters, and to which the genus *Scaphites* forms the transition; and, lastly, many true Ammonites for which no genus has yet been created, and to which, in the meanwhile, it is necessary still to leave the old name, are necessarily omitted from it.

As the nature of this memoir does not permit me to give here the descriptions of the newly established genera, I confine myself to citing the works in which they have been described, and giving a few examples of them. In the works indicated, there will be found especially the descriptions of the septa characteristic of each genus. The names of the authors followed by the dates of their publications refer to the bibliographic note at the commencement of this article.

PHYLLOCERAS, Suess, 1865, 6. Zittel, 1868, 56; 1870, 153. Neumayr, Jahrb. geol. Reichsanst. 1871, xxi. 297. Heterophylli, von Buch, Ueber Ammoniten, 1832. Triassic, Jurassic, and Cretaceous. Examples: *Ph. Jarbas, heterophyllum, tatricum, Zignodianum, ptychoicum, Thetys.*

LYTOCERAS, Suess, 1865, 8. Zittel, 1869, 70; 1870, 162. Fimbriati, lineati. Triassic, Jurassic, and Cretaceous. Examples: *L. Simonyi, sphærophyllum, fimbriatum, Eudesianum, Adelæ, Liebigi, subfimbriatum.*

ARCESTES, Suess, 1865, 6. Globosi. Triassic. Examples: *A. galeiformis, subumbilicatus, cymbiformis.*

PINACOCERAS, Mojsisovics, Verhandl. geol. Reichsanst. 1872, 315. Triassic. Example: *P. Metternichi.*

TRACHYCERAS, Laube, 1869, 15. Triassic. Example: *T. Aon.*

ARIETITES, Waagen, 1869, 69; 1870, 98. Arietes, Von Buch; partim capricorni. Triassic and Liassic. Examples: *A. Bucklandi, obtusus.*

ÆGOCERAS, Waagen, 1869, 69; 1870, 199. Partim capricorni, coronarii, ornati, macrocephali, &c. Triassic and Liassic. Examples: *Æ. incultum, planorbis, angulatum, Henleyi.*

AMALTHEUS, Montfort. Waagen, 1869, 69; 1870, 207. Amalthei, Von Buch; partim ornati, falciferi, pulchelli, clypeiformi. Triassic, Jurassic, and Cretaceous. Examples: *A. oxynotus, margaritatus, pustulatus, cordatus, Lamberti.*

HARPOCERAS, Waagen, 1869, 245, 250; 1870, 202. Falciferi, Von Buch; partim disci, insignes, clypeiformi. Jurassic. Examples: *H. radians, opalinum, hecticum, discus.*

OPPELIA, Waagen, 1869, 72; 1870, 203. Œkotraustes, Waagen, 1869, 25. Oppelia, Zittel, 1870, 175; partim denticulati, disci, clypeiformi, ligati. Jurassic and Cretaceous. Zittel has united under this name the two subgenera *Oppelia*, Waag., and *Œkotraustes*, Waag.; he has separated from it the genus *Haploceras.* Examples: *O. subradiata, tenuilobata, flexuosa.*

HAPLOCERAS, Zittel, 1870, 166. Jurassic and Cretaceous. Examples: *H. Erato, ooliticum, Grasianum.*

STEPHANOCERAS, Waagen, 1869, 248; 1870, 205. Coronarii, Von Buch; partim macrocephali, coronati, dentati, bullati, &c. Jurassic and Cretaceous. M. Waagen at first made of *Stephano-*

ceras a genus which comprised three subgenera, *Stephanoceras, Perisphinctes,* and *Cosmoceras*; subsequently he raised each of these subgenera to the rank of distinct genera. Examples: *S. Humphriesianum, macrocephalum, coronatum, Parkinsoni.*

Perisphinctes, Waagen, 1869, 248. Zittel, 1870, 218. Waagen, 1870, 206. Planulati, Von Buch; partim macrocephali, coronati, coronarii, dentati. Jurassic and Cretaceous. Examples: *P. Martinsi, plicatilis, biplex, Calisto.*

Peltoceras, Waagen, 1871, 91. Includes the species detached from the genera *Perisphinctes* and *Aspidoceras*. Jurassic. Examples: *P. arduennense, transversarium, athleta.*

Cosmoceras, Waagen, 1869, 248. Zittel, 1870, 215. Waagen, 1870, 208. Dentati, ornati. Jurassic and Cretaceous. Examples: *C. calloviense, ornatum, mamillare, verrucosum.*

Simoceras, Zittel, 1870, 207. Tithonic. Examples: *S. volanense, biruncinatum, strictum, catrianum.*

Aspidoceras, Zittel, 1868, 116. Waagen, 1869, 248. Zittel, 1870, 192. Middle and Upper Jurassic and Lower Cretaceous. Examples: *A. bispinosum, cyclotum, orthoceras, Lallierianum, iphicerus, rogoznicense.*

XLIII.—*Description of a new Snake from Madagascar.* By Dr. A. Günther.

The Trustees of the British Museum have purchased some specimens of reptiles from Madagascar, and among them a snake which appears to be the type of a new genus of the family *Dendrophidæ.*

Ithycyphus.

Body compressed, with the abdominal scutes distinctly keeled. Scales smooth, imbricate, without apical groove, in twenty-one series. Ventral scutes less than 200; anal and subcaudals divided. Upper shields of the head normal. One undivided nasal; loreal distinct; one præ-, three postoculars. Pupil round. None of the anterior or middle maxillary teeth enlarged; posterior maxillary tooth grooved.

Ithycyphus caudolineatus.

Body slender, compressed; head narrow, flat, with the snout depressed, obliquely truncated in front. Eye rather small. Vertical bell-shaped. Nostril round, in the middle of the narrow, elongate, single nasal shield. Loreal elongate, as long as the nasal. The single præocular reaches to the upper surface of the head, and is in contact with the vertical. Three postoculars. Eight upper labials, the fourth and fifth entering the orbit. Temporals 1 + 2 + 3, but rather irregularly arranged. A groove (of black colour) between the temporals and labials. Ventrals 187; subcaudals 135. Brownish, some of the dorsal scales with a blackish edge; tail with a black line on each side, along the outer margin of the subcaudals; sometimes another pair of less distinct blackish lines along the back of the tail. Brownish yellow below, with or without irregular powdered spots.

Total length 33 inches, of which the tail takes 13 inches.

Southern parts of Madagascar.

XLIV.—*Reply to Professor Verrill's "Remarks on certain Errors in Mr. Jeffreys's Article on the Mollusca of Europe compared with those of Eastern North America."* By J. Gwyn Jeffreys, F.R.S.

I have been hitherto prevented by various engagements from noticing Prof. Verrill's remarks on the above article, which was published in the 'Annals' of last October.

Although I would rather invite than deprecate a fair criticism of this or any other publication of mine, I cannot help regretting that the present critic has not adopted the same style of courtesy which so agreeably characterizes his scientific countrymen.

I do not admit the wholesale charge of "errors" and "mistakes" which is so freely made in his "Remarks," nor that it was incumbent on him personally to disclaim my views. Let them be examined by some competent authority.

The errors attributed to me are those which relate to geographical and local distribution, to the difference of certain species, and to the nomenclature of two other species.

The question of geographical distribution, involving that of migration, is a subject which cannot be hastily disposed of; but Prof. Verrill's idea that the land and freshwater shells which are common to the Old and New Continents may have originated in America and thence crossed to Europe "in the direction of the prevailing currents and winds" is more ingenious than probable. Currents and winds are not the kind of agency we should expect for the migration of such animals. However, I will not offend his national susceptibilities any further.

With regard to local distribution I can only repeat that I consulted the recent edition of Gould's 'Invertebrata of Massachusetts,' and found it a most useful guide. If Prof. Verrill is dissatisfied with that work, he may directly criticise it to his heart's content; but he ought not to indirectly criticise it through me.

As to the difference of certain species (9 only out of 401 species) I would observe as follows :—

1. *Gemma gemma.* I am by no means sure that this is not the fry of *Venus mercenaria*, although Prof. Verrill has far greater opportunities than I have for deciding the matter.

2. *Arca transversa.* This may be distinct from *A. pexata*, and not merely a variety of it; but Prof. Verrill is evidently fond of adopting genera founded on unimportant characters, and his proneness to multiply species also may therefore be assumed as probable.

3. *Mactra ovalis.* I cede the point to Prof. Verrill as to this being distinct from *M. solidissima.* I had not seen specimens of *M. ovalis* and the preceding two controverted species, and only formed my opinion from Gould's work.

4. *Astarte castanea.* *A. borealis* and other species of the same genus are so polymorphous that I was justified in saying *A. castanea* is "perhaps a variety of *A. borealis.*" I fully expect to see a connecting link between them. The same observation will apply to *A. quadrans.*

5. *Pecten fuscus.* Prof. Verrill may be right in stating that this is the young of *P. tenuicostatus* and not of *P. irradians.* I judged otherwise from the description of the first-named species in Gould's work.

6. *Dentalium dentale*, Gould. I admit that this may be specifically, but not generically, distinct from *D. striolatum.*

7. *Dentalium striolatum.* Having examined and carefully compared numerous specimens of this shell and *D. abyssorum*, I have no hesitation in considering them the same species. All have a terminal pipe (as in *D. dentalis*), which is partly slit (as in *D. entalis*), so as to connect *Dentalium* with the so-called genus *Entalis.*

8. *Crepidula plana.* If Prof. Verrill has found this species on the *outside* of other univalve shells or other substances in company with typical specimens of *C. fornicata*, and there is no intermediate form, I agree that they may be different species.

9. *Margarita acuminata.* Probably distinct from *M. varicosa.*

As to the alleged errors of nomenclature, my answer is this :—

Æolis salmonacea and *Æ. gymnota.* Couthouy certainly described both before Dekay; and the names of the former must therefore stand for these species.

Lacuna divaricata. The mistake made by Fabricius in supposing this was Linné's species does not invalidate his claim to the authorship of the specific name, inasmuch as it belongs to a different genus. The specific name has been adopted by Möller, Lovén, Sars, the Messrs. Adams, Petit, and nearly every other writer on North-European shells.

Natica affinis of Gmelin is unquestionably the *N. clausa* of Sowerby. It was originally figured and noticed by Olafsen and Povelsen in their 'Reise igiennem Island' (1772), vol. i. t. x. and vol. ii. pp. 665 and 1016. It was afterwards (1776) described by O. F. Müller in his Prodromus to the 'Zoologia Danica,' p. 245. no. 2956, citing Olafsen and Povelsen's work, but without a specific name. That name (*affinis*) was given by Gmelin in his edition of the 'Systema Naturæ' (1788), p. 3675, with a reference to Müller as above and the following habitat, "in Oceano septentrionali." Prof. Verrill has mistaken for this species the *Nerita australis* of Gmelin, which is described as having a silverish mouth or aperture and inhabiting New Zealand. He might have spared his note of admiration.

In conclusion I acknowledge my obligation to Prof. Verrill for pointing out the mistakes, although so very few, which I made. I conscientiously did my best with the materials at my command, and I am satisfied if I have done something towards correlating the European with the North-American Mollusca.

BIBLIOGRAPHICAL NOTICES.

Birds of the Humber District. By John Cordeaux. London: Van Voorst, 1872.

The pursuit of Natural History has, we rejoice to say, become exceedingly popular of late years; and perhaps nothing has tended to diffuse this taste more generally than the publication of local Faunas. Not very long ago the immortal chronicler of Selborne, whom every field-naturalist still regards as his patron saint, stood nearly alone in this department; and his faithful though simple records, limited almost to a single parish, have possessed a charm for succeeding generations, and roused a kindred feeling among out-of-door observers, who naturally take a deeper interest in things they see around them than in those they merely read of. If "the schoolmaster has been abroad," so has the botanist, the geologist, the entomologist, and last, though not least, the ornithologist. So preeminent, indeed, are the attractions of this charming study, that its votaries are probably more numerous than those of any other branch of zoology. We do not here allude to what may be termed the science of ornithology or to the labours of the closet-naturalist, to the manufacture of genera or the nomenclature of species, but to the knowledge acquired and to the delight experienced by the true lover of nature, who studies the habits of his feathered favourites in the woods, in the fields, on the sea-shore, or in the swamps and fens of the county to which, either from choice or chance, his attention has been especially directed.

Such a one is Mr. Cordeaux, the author of the volume before us, which is evidently the result of assiduous observation at all seasons and in all weathers, during a period of ten years, in the maritime tract which he characterizes as "The Humber District," including within its limits not only the wide estuary itself, with its muddy flats from the Spurn Head to its junction with the Trent and Ouse, but "the lands adjoining, namely part of North and Mid Lincolnshire and Holderness, a district enclosed to the north, west, and south by the curved sweep of the wold hills. To the east its sea-board extends from Flamborough Head in the north to Skegness on the Lincolnshire coast in the south. This is a well-defined and clearly marked province, both geologically and zoologically. It may be compared to a half circle or bent bow, the Lincolnshire and Yorkshire wolds forming the bow, the coast-line the string; whilst the great river itself is like an arrow placed in the string and across the bow, dividing the district into two nearly equal divisions." (Introduction, page v.)

But in spite of the attractions it still possesses for the practical observer, our author tells us that even in the beginning of the present century, "when Colonel Montagu made his celebrated ornithological tour through Lincolnshire," it had been shorn of much of its ancient wildness, "immense changes having taken place in the physical features of the country by the drainage and partial cultivation of the fen lands. Some species of birds had disappeared, and others were rapidly verging on extinction." Truly it must have been a perfect paradise for wild fowl before it became what it now is, "probably the best-farmed county in the kingdom."

Mr. Cordeaux says that the migratory birds visiting this district in the autumn and winter, almost without an exception, come from the direction of the sea, arriving on the coast in lines of flight varying from full north to east.

"The only exception to this rule is that of the Grey or Winter Wagtail (*Motacilla boarula*), which reaches us from the west or north-west. In the spring also, I am strongly inclined to think, the greater portion of our little summer visitors, including the delicate Warblers and Willow-wrens, arrive from the sea, coming from the south-east to east, appearing first in the warmer and low-lying country between the coast and the foot of the wold range, and gradually extending inland across the high wolds, a cold backward district, to the interior of the county." (Introduction, page vi.)

The latter portion of the above paragraph is exceedingly interesting. We can testify, from our own observation, that most of our insectivorous vernal visitors, in the southern and south-western maritime counties, also "arrive directly from the sea," apparently from the opposite coast of France; but to reach the Humber district these delicate migrants from the south (and even from the south-east) apparently make a *detour* of many miles to avoid the projecting coast of Norfolk, showing that "the overland route" has less attraction for them than the open sea-voyage at this season of the year.

Our author fully appreciates the value of that indispensable companion of the field-naturalist, a good spy-glass. We envy his experience as recorded in the following passage:—

"The Godwits which visit our foreshore in the spring and autumn feed largely on an annelid, *Arenicola piscatorum*, or some allied species, which they obtain by boring. With the aid of my telescope I have frequently observed their manner of feeding. They advance rather quickly over the flats, and at the same time keep rapidly thrusting their long bills into the ooze, as if feeling for some concealed creature. It is easy to see when any are successful, as instantly every motion displays extreme energy, the bird's head itself being half buried in its eagerness to grasp and hold its wriggling prey. Often when the bill is withdrawn I have seen a huge lob-worm, held crossways, dangling from it. This requires some little manipulation before it can be swallowed; the Godwit's head is thrown backwards, and the mandibles are rapidly worked till the worm becomes properly adjusted, when down it goes, the neck perceptibly swelling and thickening in the descent; then there is a satisfied smack of the mandibles, and the search recommences." (Page 119.)

The Ruff (*Machetes pugnax*) and Reeve (female) are still associated in the popular mind with the fens of Lincolnshire; and, judging from the numbers occasionally exposed in the London markets, the species is yet numerous; but most, if not all, of these birds are supplied from Holland. Mr. Cordeaux says:—

"The Ruff and Reeve, formerly so abundant in Lincolnshire, where its capture and feeding for the London market was a regular trade, is now only known as a bird of passage, lingering for a few weeks or days in small numbers in the neighbourhood of its old haunts during the period of the spring and autumn migrations. It is almost a regular autumn, but only an occasional spring, visitant to this district." (Page 120.)

That apparently fragile little creature, the Golden-crested Wren (*Regulus cristatus*), unlike so many comparatively robust insectivorous birds, remains with us the whole year; but, avoiding equally the extremes of heat and cold, vast numbers arrive on the east coast of Lincolnshire and Yorkshire at the period of the autumnal migration, when they "cross the wild North Sea, arriving on our eastern shores in October. The migration of the Goldcrests is now a fact as well established as is that of the Woodcocks. They appear about the second or third week in October, preceding the Woodcocks by a few days; and so well is this known to those living on the east coast of Yorkshire and Lincolnshire that they have earned for themselves the sobriquet of the 'Woodcock-pilots.' Almost every year I find some about the second week of October, either on the Humber embankments or in the marsh hedgerows. On the 12th of that month in 1863 an extraordinary flight appeared in the Great-Cotes marshes. On that morning I observed large numbers of these fairy birds on the hedgerows and bushes in the open marsh district near the Humber, many also creeping up and down on the reeds in the drains, and at my lonely marsh farmstead quantities of these active little fellows, everywhere busily searching every nook and corner on the fold-yard fences, the cattle-sheds, and stacks. The Goldcrest appears in flocks every year, both at Spurn and Flamborough, about the middle of October; they have on several occasions been found dead beneath these lighthouses, having dashed bewildered against the glass lanterns in their night migration." (Page 37.)

Equally valuable are our author's notes on the arrival and departure of our shore and sea birds; but some of his personal experiences and observations are even more especially interesting; and we only regret that we have not space for copious extracts in verification of our opinion. Here is a delightful little episode, the hero of which is one of our rarest feathered visitors from the far north, and the only example of the species that Mr. Cordeaux had ever met with in the county:—

"December 12th, 1870. I came quite suddenly this morning on a beautiful little Phalarope (*Phalaropus hyperboreus*) swimming in a drain near the Humber. I saw at once, by its small size (about as large as a Dunlin) and plumage, that it was not the grey species. The little bird rode as buoyantly as a gull upon the water, with head thrown backward like a duck. It was the first occasion that I have seen a Phalarope in these marshes; I observed all its movements intently. It was shy, but not wild, diving on my approach for twenty yards up the drain, and then, leaving the water, ran along the narrow strip of 'warp' like a Sandpiper. On my moving forward it again entered the water, diving further up the drain, issuing as before on to the 'warp,' but this time under the opposite bank; the dive was again repeated, when I lost sight of it round a sharp bend in the stream. For the next ten minutes I stood at this corner, vainly looking both up and down the drain for its reappearance, and had nearly given it up when I caught sight of the little creature directly opposite, and within a few feet—so near, that had I reached forward I might have touched it with the gun-muzzle. No wonder that I had overlooked it; for it had now exactly the appearance of a small lump of earth fallen from the bank; the whole of its body was sunk below the water, excepting the upper part of the back and head from just below the eyes, which were level with the surface—the bill and fore part of the forehead also immersed, the water covering the hind part of the neck between the back and head. The deception was perfect; and had I not been specially looking, I might have passed the place scores of times without noting any thing unusual. As it was, I had stood within a few feet for several minutes, and had passed my eyes over and over again across the place without finding it. Once, and once only, it raised its head, and immediately afterwards dived, going under very quietly and leaving hardly a ripple; this time I saw it emerge on the drain side about the same distance, namely twenty yards. Just then a flight of Plover passed, at which I fired; and I think the report must have caused it to rise, as, although I spent an hour in looking up and down the drain, and returned again at a later period in the day, I saw it no more." (Page 140.)

Vast numbers of Guillemots (*Uria troile*) and Razor-bills (*Alca torda*) breed on the precipitous cliff of Flamborough Head, as well as in various similar localities on the coasts of the British Islands. We ourselves have never had the good fortune to observe the mode in which the mother birds safely convey their young to the water from their aërial nurseries on the upper ledges, although we have often watched patiently for hours, in the vain hope of witnessing the performance. Indeed until now we never met with a satisfactory solution of the mystery; but here it is:—

"When the young are partly fledged, and even when they are quite little things, the old birds carry them down to the sea on their backs. This is done late in the evening, after sunset. The Flamborough boatmen say that when they are fishing under the Specton Cliffs, on summer evenings, they have often observed this process of carrying the young down, the little fellow clinging to its parent's back, and not unfrequently tumbling from the somewhat precarious perch into the sea sooner than was intended." (Page 184.)

We must now take leave of this, the latest contribution to the avifauna of the British Islands, which, as a careful and painstaking record of the arrival of our migratory birds on the shores and flats of the wild and interesting region to which the author's remarks have been limited, may be regarded as almost exhaustive; and we heartily recommend, as a model for future monographers with similar tastes and equal opportunities, this charming little volume on the "birds of the Humber District."

Lecture on the Feræ Naturæ of the British Islands.
By John Colquhoun, Author of 'The Moor and the Loch,' &c.

If quality, not quantity, is the test of merit, then is the little *brochure* before us (for its modest dimensions forbid a claim to a more ambitious title) deserving of our warmest commendation. Though purporting to be simply "a lecture delivered to the St. Steven's Young Men's Literary Society," yet it contains matter that might easily be expanded into a goodly volume. Indeed the pleasure we have experienced in perusing its few though charming pages induces us to regard with envy the favoured audience who enjoyed the still greater treat of listening to the instructive words of such an observant naturalist and dexterous sportsman as the author of 'The Moor and the Loch.'

Unlike many who undertake to deliver public lectures in the present day to their less enlightened brethren, nothing has been "got up" by Mr. Colquhoun for the occasion. There has been no "cramming" or petty larceny from the labours of others; all is fresh and original, the result of long personal experience. Few indeed of the present, and still fewer of the rising generation, can venture to hope for such opportunities as have fallen to the lot of this veteran observer. Even in Scotland the nobler predatory quadrupeds are rapidly diminishing in number, while in England they have, with the exception of the fox, all but disappeared, the exclusive preservation of Reynard as an object of sport having perpetuated the species; but even in the Scottish Highlands, where no such immunity from persecution exists, Mr. Colquhoun considers that he will be "the last to disappear," as "from his swiftness and strength he can gather subsistence scattered over an immense tract of country, and when food fails on the higher grounds can make a raid on the lowlands during the long wintry nights, returning again to shelter with his booty ere the day dawns. Next, the great increase of alpine hares on the mountains and gradual but steady introduction of rabbits into many remote ranges, afford the hill-fox a favourite meal with but little trouble in securing it. Lastly, of all beasts of prey sly Reynard is the most difficult to trap."

On the other hand the marten (*Martes foina*) and the wild cat (*Felis catus*) are easily deceived with a bait. "Indeed both are so greedy and fearless as to rush into the snare for a piece of raw meat. Neither have speed to hold out before a swift plucky terrier, but are quickly 'treed' or run to ground. Should they take refuge in a hole or cleft of the rock, they are not difficult to bolt by smoke; but if they prove stubborn a neatly set trap will most likely secure them after nightfall. No wonder, then, that these interesting *carnivora* have vanished from the greater part of even the Scottish hill-districts, and that a tourist may now explore two thirds of the Highlands, and far from seeing either of them will find from the natives that there are none to be seen!"

Our author shares the popular belief that the dark ferrets, so common in every ratcatcher's hutch, owe their dusky hue to polecat parentage. He says, "dark ferrets exactly resemble foumarts, only they are smaller and of lighter shade. Many of these brown ferrets are half polecats; in fact the polecat is just a wild ferret."

Most of our high zoological authorities are of a different opinion. Bell considers the ferret (*Mustela furo*) specifically distinct from the polecat (*Mustela putorius*), and says that "of the assertion that the breeders of ferrets have recourse to the polecat to improve the breed he could obtain no authentic verification"*. Surely this *quæstio vexata* might easily be decided by experiment.

In reference to the food of the foumart, Mr. Colquhoun records that he found on one occasion, under the last massive boulder of a huge heap of stones, a female polecat with three young ones and

* 'British Quadrupeds.'

the remains of several large yellow frogs—and adds, "Still more difficult to credit, eels are often found among the food-store. How he catches *them* I have some curiosity to know. Yarrell says eels slide like serpents over the dewy grass from one drain to another. If so, the difficulty ends; for the foumart's instinct would soon teach it to watch for the land progress of its slimy prey."

In dear old Bewick, the delight of our youth, the woodcut of the foumart represents the animal with an eel in its mouth, the accuracy of the illustration being founded on the fact that several fine eels were discovered in its retreat, and that it had been tracked in the snow to the banks of a rivulet. Now we have never met with any one who could assert that they had ever seen a foumart in the water, and the matter has always been a puzzle to us; but we have to thank Mr. Colquhoun for dispelling the mystery.

We regret that the limited space at our disposal forbids us to indulge in further quotations. Suffice it to say that the badger (*Meles taxus*), the otter (*Lutra vulgaris*), and even the rat, all come in for their share of notice, their habits being graphically described and illustrated by characteristic anecdotes. We cordially recommend this interesting essay to the general reader as well as to the naturalist and sportsman.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Jan. 30, 1873.—George Busk, Esq., Vice-President, in the Chair.

"Note on the Origin of *Bacteria*, and on their Relation to the Process of Putrefaction." By H. Charlton Bastian, M.D., F.R.S.

In his now celebrated memoir of 1862, M. Pasteur asserted and claimed to have proved (1) that the putrefaction occurring in certain previously boiled fluids after exposure to the air was due to the contamination of the fluids by *Bacteria*, or their germs, which had before existed in the atmosphere, and (2) that all the organisms found in such fluids have been derived more or less immediately from the reproduction of germs which formerly existed in the atmosphere.

The results of a long series of experiments have convinced me that both these views are untenable.

In the first place, it can be easily shown that living *Bacteria*, or their germs, exist very sparingly in the atmosphere, and that solutions capable of putrefying are not commonly infected from this source.

It has now been very definitely ascertained that certain fluids exist which, after they have been boiled, are incapable of giving birth to *Bacteria*, although they continue to be quite suitable for the support and active multiplication of any such organisms as may have been purposely added to them. Amongst such fluids I may name that now commonly known as "Pasteur's solution," and also one which I have myself more commonly used, consisting of a simple aqueous solution of neutral ammonic tartrate and neutral sodic sulphate*. When portions of either of these fluids are boiled and poured into superheated flasks, they will continue quite clear for many days, or even for weeks; that is to say, although the short and rather narrow neck of the flask remains open the fluids will not become turbid, and no *Bacteria* are to be discovered when they are submitted to microscopical examination.

But in order to show that such fluids are still thoroughly favourable media for the multiplication of *Bacteria*, all that is necessary is to bring either of them into contact with a glass rod previously dipped into a fluid containing such organisms. In about thirty-six hours after this has been done (the temperature being about 80° F.), the fluid, which had hitherto remained clear, becomes quite turbid, and is found, on examination with the microscope, to be swarming with *Bacteria* †.

Facts of the same kind have also been shown by Dr. Burdon Sanderson ‡ to hold good for portions of boiled "Pasteur's solution." Air was even drawn through such a fluid daily for a time, and yet it continued free from *Bacteria*.

Evidence of this kind has already been widely accepted as justifying the conclusion that living *Bacteria* or their germs are either wholly absent from or, at most, only very sparingly distributed through the atmosphere. The danger of infection from the atmosphere having thus been got rid of and shown to be delusive, I am now able to bring forward other evidence tending to show that the first *Bacteria* which appear in many boiled infusions (when they subsequently undergo putrefactive changes) are evolved *de novo* in the fluids themselves. These experiments are moreover so simple, and may be so easily repeated, that the evidence which they are capable of supplying lies within the reach of all.

That boiling the experimental fluid destroys the life of any *Bacteria* or *Bacteria*-germs preexisting therein is now almost universally admitted; it may, moreover, be easily demonstrated. If a portion of "Pasteur's solution" be purposely infected with living *Bacteria* and subsequently boiled for two or three minutes, it will continue (if left in the same flask) clear for an indefinite period; whilst a similarly infected portion of the same fluid, not subsequently boiled, will rapidly become turbid. Precisely similar phenomena occur when we operate with the neutral fluid which I have previously mentioned; and yet M. Pasteur has ventured to assert that the germs of *Bacteria* are not destroyed in neutral or

* In the proportion of 10 grains of the former and 3 of the latter to 1 ounce of distilled water.

† The Modes of Origin of the Lowest Organisms, 1871, pp. 30, 51.

‡ Thirteenth Report of the Medical Officer of the Privy Council (1871), p. 59.

slightly alkaline fluids which have been merely raised to the boiling-point*.

Even M. Pasteur, however, admits that the germs of *Bacteria* and other allied organisms are killed in slightly acid fluids which have been boiled for a few minutes; so that there is a perfect unanimity of opinion (amongst those best qualified to judge) as to the destructive effects of a heat of 212° F. upon any *Bacteria* or *Bacteria*-germs which such fluids may contain.

Taking such a fluid, therefore, in the form of a strong filtered infusion of turnip, we may place it after ebullition in a superheated flask with the assurance that it contains no living organisms. Having ascertained also by our previous experiments with the boiled saline fluids that there is no danger of infection by *Bacteria* from the atmosphere, we may leave the rather narrow mouth of the flask open, as we did in these experiments. But when this is done, the previously clear turnip-infusion invariably becomes turbid in one or two days (the temperature being about 70° F.), owing to the presence of myriads of *Bacteria*.

Thus, if we take two similar flasks, one of which contains a boiled "Pasteur's solution" and the other a boiled turnip-infusion, and if we place them beneath the same bell-jar, it will be found that the first fluid remains clear and free from *Bacteria* for an indefinite period, whilst the second invariably becomes turbid in one or two days.

What is the explanation of these discordant results? We have a right to infer that all preexisting life has been destroyed in each of the fluids†; we have proved also that such fluids are not usually infected by *Bacteria* derived from the air; in this very case, in fact, the putrescible saline fluid remains pure, although the organic infusion standing by its side rapidly putrefies. We can only infer, therefore, that whilst the boiled saline solution is quite incapable of engendering *Bacteria*‡, such organisms are able to arise *de novo* in the boiled organic infusion.

Although this inference may be legitimately drawn from such experiments as I have here referred to, fortunately it is confirmed and strengthened by the labours of many investigators who have worked under the influence of much more stringent conditions, and in which closed vessels of various kinds have been employed §.

Whilst we may therefore infer (1) that the putrefaction which

* How unwarrantable such a conclusion appears to be, I have elsewhere endeavoured to show. See 'Beginnings of Life,' 1872, vol. i. pp. 326–333, 372–399.

† [*Note*. Jan. 31, 1873.]—In 'The Beginnings of Life,' vol. i. p. 332, note 1, I have cited facts strongly tending to show that *Bacteria* are killed in infusions of turnip or of hay when these have been heated to a temperature of 140° F. They also seem to die at the same temperature in solutions of ammonic tartrate with sodic phosphate.

‡ See 'Beginnings of Life,' vol. ii. p. 35, and vol. i. p. 463.

§ See a recent communication by Prof. Burdon Sanderson, in 'Nature,' January 9th.

occurs in many previously boiled fluids when exposed to the air is not due to a contamination by germs derived from the atmosphere, we have also the same right to conclude (2) that in many cases the first organisms which appear in such fluids have arisen *de novo*, rather than by any process of reproduction from preexisting forms of life.

Admitting, therefore, that *Bacteria* are ferments capable of initiating putrefactive changes, I am a firm believer also in the existence of not-living ferments under the influence of which putrefactive changes may be initiated in certain fluids—changes which are almost invariably accompanied by a new birth of living particles capable of rapidly developing into *Bacteria*.

Feb. 27, 1873.—William Spottiswoode, M.A., Treasurer and Vice-President, in the Chair.

"On Leaf-Arrangement." By Hubert Airy, M.A., M.D.

Assuming as generally known the main facts of leaf-arrangement, the division into the whorled and spiral types, and in the latter more especially the establishment of the convergent series of fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, $\frac{21}{55}$, $\frac{34}{89}$, $\frac{55}{144}$, &c. as representatives of a corresponding series of spiral leaf-orders among plants, we have to ask, what is the meaning that lies hidden in this law?

Mr. Darwin has taught us to regard the different species of plants as descended from some common ancestor; and therefore we must suppose that the different leaf-orders now existing have been derived by different degrees of modification from some common ancestral leaf-order.

One spiral order may be made to pass into another by a twist of the axis that carries the leaves. This fact indicates the way in which all the spiral orders may have been derived from one original order, namely by means of different degrees of twist in the axis.

We naturally look to the simplest of existing leaf-orders, the two-ranked alternate order $\frac{1}{2}$, as standing nearest to the original; for it is manifest that the orders at the other extreme of the series (the condensed arrangement of scales on fir-cones, of florets in heads of *Compositæ*, of leaves in close-lying plantains, &c.) are special and highly developed instances, to meet special needs of protection and congregation: they are, without doubt, the latest feat of phyllotactic development; and we may be sure that the course of change has been from the simple to the complex, not the reverse. This point will be illustrated by experiment below.

But first, what are the uses of these orders? and at what period of the leaf's life does the advantage of leaf-order operate? The period must be that at which the leaf-order is most perfect—not, therefore, when the twig is mature, with long internodes between the leaves, but while the twig and its leaves are yet *in the bud*; for it is in the bud (and similar crowded forms) that the leaf-order is in perfection, undisturbed by contortions or inequalities of growth; but as the bud develops into the twig the leaves become separated, the stem often gets a twist, the leaf-stalks are curved and wrung to present the blades favourably to the light, and thus the leaf-order that was perfect in the bud is disguised in the grown twig.

In lateral shoots of *yew* and *box* and *silver fir* we see how leaves will get their stalks twisted to obtain more favourable exposure to light; and if general distribution round the stem were useful to the adult leaves, we should expect the leaves of a vertical *elm*-shoot (for example) to secure such distribution by various twists of stalk and stem; but the leaf-blades of the elm keep their two ranks with very great regularity. This goes to show that it is not in the mature twig that the leaf-order is specially advantageous.

In the *bud* we see at once what must be the use of leaf-order. It is for *economy of space*, whereby the bud is enabled to retire into itself and present the least surface to outward danger and vicissitudes of temperature. The fact that the order $\frac{1}{2}$ does not exhibit this advantage in any marked degree, supports the idea that this order is the original from which all the more complex spiral orders have been derived.

The long duration of the bud-life as compared with the open-air life of the leaf gives importance to the conditions of the former. The open-air life of the bud is twelve months, and adding the embryo life of the bud, we have about a year and a half for the whole life of the bud; and for the twelve months of its open-air life it is in a state of siege, against which a compact arrangement of its embryo-leaves within must be of great value. But the open-air life of the unfolded leaves is (except in evergreens) not more than six months.

That the order $\frac{1}{2}$ would under different degrees of contraction (with twist) assume successively the various spiral orders that exist in nature, in the order of their complexity, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, &c., may be shown by the following experiment:—

Take a number of spheres (say oak-galls) to represent embryo leaves, and attach them in two rows in alternate order ($\frac{1}{2}$) along opposite sides of a stretched india-rubber band. Give the band a slight twist, to determine the direction of twist in the subsequent contraction, and then relax tension. The two rows of spheres will roll up with a strong twist into a tight complex order, which, if the spheres are attached in close contact with the axis, will be nearly the order $\frac{1}{3}$, with three steep spirals. If the spheres are set a little away from the axis, the order becomes condensed into (nearly) $\frac{2}{5}$, with great precision and stability. And it appears that further contraction, with increased distance of the spheres from the axis, will necessarily produce the orders (nearly) $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, &c. in succession, and that these successive orders represent successive *maxima* of stability in the process of change from the simple to the complex.

It also appears that the necessary sequence of these successive steps of condensation, thus determined by the geometry of the case, does necessarily exclude the non-existent orders, $\frac{1}{4}$, $\frac{2}{7}$, $\frac{3}{7}$, $\frac{4}{9}$, $\frac{4}{11}$, &c.

Numbering the spheres from 0 upwards, it appears that, under contraction, the following numbers are brought successively into contact with 0, alternately to right and left:—1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, &c. None of them stands vertically above 0 while in contact with it, but a little to the right or a little to the left; and so far the results of this experiment fall short of the perfect fractions $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$ &c.: but in this very failure the results of the experiment are more closely in agreement with nature than are those perfect fractions themselves; for those fractions give the angular divergence only in round numbers (so to speak), and lose account of the little more, or the little less, which makes all the difference between a vertical rank and a spiral. In the large majority of spiral-leaved plants, one has to be content with "$\frac{2}{5}$ nearly" or "$\frac{3}{8}$ nearly;" and it is difficult to find a specimen in which the fraction represents the order exactly.

The geometrical relations of the members of the above series 1, 2, 3, 5, 8, 13, &c. are as simple as their numerical relations.

Analysis of the order seen in the head of the sunflower and other examples, by consideration of their several sets of spirals, presents a striking agreement with the above synthetical process. In the sunflower, a marginal seed taken as 0 is found to be in contact with the 34th, the 55th, and the 89th (counted in order of growth), and even with the 144th, if there is not contact with the 34th. The dandelion, with a lower degree of condensation, has 0 in contact with the 13th, the 21st, and the 34th in large specimens; the house-leek in its leaf-order has 0 in contact with the 5th, 8th, and 13th; the apple-bud has 0 in contact with the 2nd, 3rd, and 5th; and thus we see that in nature the very same series of numbers is found to have contact-relation with 0 which we have already seen possessing that relation in the experimental condensation of the order $\frac{1}{2}$.

Difference of leaf-order in closely allied species (e.g. *Plantago major* and *P. coronopus*) is found in close relation to their different habits and needs.

The prevalence of the order $\frac{1}{2}$ in marine *Algæ*, and in *Gramineæ*, a low-developed gregarious group, and its singular freedom from individual variation in that group and in elm, beech, &c., support the view that this order is the original of the spiral orders.

In many plants we find actual transition from the order $\frac{1}{2}$ to an order more complex, as, for instance, in *Spanish chestnut, laurels, nut, ivy*; and these instances agree in presenting the complex order in the buds that occupy the most exposed situations, while they retain the simple $\frac{1}{2}$ in the less-exposed lateral buds. Several kinds of *aloe* have the order $\frac{1}{2}$ in their basal leaves, and a higher order in the remainder. A species of *cactus* often contains a complete epitome of phyllotaxy in a single plant, or even in a single shoot.

Shoots of *acacia* often present a zigzag disposition of their leaves, on either side of the branch, which seems unintelligible except as a distortion of an original two-ranked order.

The prevalent two-ranked arrangement of rootlets or roots seems to be a survival underground of an order which originally prevailed through the whole plant, root, stem, and branch.

In the whole Monocotyledonous class the first leaves in the seed have the order $\frac{1}{2}$.

In the Dicotyledonous class the first leaves in the seed have the simplest order of the whorled type.

As the spiral orders have probably been derived from a two-ranked alternate arrangement, so the whorled orders have probably been derived from a two-ranked *collateral* (two abreast) arrangement. This is illustrated by an experiment similar to the former; and it is seen that successive parallel horizontal pairs of spheres are compelled under contraction to take position at right angles to one another, exactly in the well-known crucial or decussate order. These whorls of two contain potentially whorls of three and four, as is seen in variations of the same plant; but the experiment does not show the change.

The reason of the non-survival of the (supposed) two-ranked *collateral* order lies in its manifest instability; for under lateral pressure it would assume the alternate, and under vertical the crucial order.

The bud presents in its shape a state of equilibrium between a force of contraction, a force of constriction, and a force of growth.

To sum up, we are led to suppose that the original of all existing leaf-orders was a two-ranked arrangement, somewhat irregular, admitting of two regular modifications, the alternate and the collateral—and that the alternate has given rise to all the spiral orders, and the collateral to all the whorled orders, by means of advantageous condensation in the course of ages.

March 6, 1873.—Sir George Biddell Airy, K.C.B., President, in the Chair.

"On a new Genus of Amphipod Crustaceans." By Rudolph von Willemöes-Suhm, Ph.D., Naturalist to the 'Challenger' Exploring-Expedition.

In lat. 35° 47′, long. 8° 23′, off Cape St. Vincent, the trawl was sent down to a depth of 1090 fathoms on the 28th of January, and brought up, among other very interesting things, a large transparent Amphipod with enormous faceted eyes. The animal, evidently hitherto unknown, will be the type of a new genus, having the following characters:—

THAUMOPS, nov. gen.

Caput oblongum, inflatum, oculis maximis superiorem capitis partem tegentibus. Segmenta thoracica 6, abdominalia 5. Antennarum in feminis par unum, maxillarum par unum, pedum paria duo minima maxillarum locum tenentia. Mandibulæ nullæ. Pedes thoracici 5, abdominales 3 in utroque latere. Appendices caudales 4. Gangliorum pectoralium paria 5, abdominalium 3.

Thaumops pellucida, n. sp.

Corpus longitudine 14 mm., latitudine 21 mm., pellucidum.

An anatomical description of this interesting animal is given, illustrated by two plates; and it is shown that, among the Amphipods known to us, *Phronima* is its nearest relative. But there are so many points in which this genus differs from *Phronima*, that it cannot form a member of the family Phronimidæ; and I therefore propose to establish for it a new family, Thaumopidæ, belonging to the tribe of *Hyperina*.

The form of the *head* is totally different from that of *Phronima*; the antennæ are not situated near the mouth, but at its front; and the enormous faceted eyes occupy its upper surface. The first two pairs of thoracic appendages are not, as in *Phronima*, ambulatory legs, but maxillipeds, so that only five pairs of legs are ambulatory in *Thaumops*. The *thorax* is composed of six segments—the first of which has, on its underside, the vulva and one pair of maxillipeds; and the second, representing two segments, bears two pairs of appendages, the larger maxillipeds and the first pair of ambulatory legs. The *abdomen* consists of five segments, with three pairs of pedes spurii, the caudal appendages being attached to the fourth and fifth segments.

The animal being beautifully transparent, the *nervous system* could be carefully worked out without dissecting it; the position of the nerves going out from the cephalic ganglion, as well as that of the five pairs of thoracic and the three pairs of abdominal ganglia, could be ascertained. The *eyes*, having at their borders very peculiar appendages, were examined; and a description is given of the structure of the large crystalline bodies which are to be seen in them. Organs of hearing and touch have not been discovered.

The *mouth* is covered by a pair of maxillæ and a small labium. There is a recurved œsophageal passage leading into a large cæcal stomach, and an intestinal tube departing from near the end of the œsophagus and running straight to the anus.

The *heart* is an elongated tube extending from the second to the fifth segment, with probably three openings. Three pairs of transparent sac-like gills are attached at the base of the second, third, and fourth pairs of feet.

Genital organs.—The single specimen taken is a female. The ovary, probably composed of two ovaries, has a rose-colour; and the genital papilla is situated at the under part of the first segment; it is covered by two small lamellæ, which in this case did not sustain the eggs, which were found to be attached to the first pair of ambulatory legs. The animal seems to carry them in a similar manner as the pycnogonid *Nymphon*.

Development.—The eggs contained embryos having already the antennæ, the five pairs of legs, and the abdominal feet; they show that *Thaumops* has to undergo no metamorphosis, and that the young ones leave the eggs with all their appendages well developed.

Mode of life.—It could not be made out whether *T. pellucida* inhabits the deep sea, or whether it is, like *Phronima*, a pelagic animal, having been caught by the trawl only as the latter came up from the depths.

H.M.S. 'Challenger,' Teneriffe,
February 13, 1873.

March 20, 1873.—Mr. George Busk, Vice-President, in the Chair.

"On the Distribution of the Invertebrata in relation to the Theory of Evolution." By JOHN D. MACDONALD, M.D., F.R.S., Staff Surgeon R.N., Assistant Professor of Naval Hygiene, Netley Medical School.

All organized beings exhibit both structural and functional conditions, forming the grounds of comparison by which natural affinities in smaller groups, and points of difference in larger ones, are detected and established in systematic classification.

General anatomical or physiological considerations in agreement are usually of more importance than the harmony of single or special conditions of either description; and though structural characters, as a rule, are superior to those of a functional nature, much may be learnt from an arrangement founded on physiological principles alone. I have elsewhere pointed out the deceptiveness of taking the habit of life as a guide in classification, though this is adopted by many zoologists; for essentially different types may live under precisely similar circumstances, or the habit of life may be very different in the members of the same type. Thus, if we look upon a pectinate gill for aquatic respiration, fluviatile or marine, and the amphibious coincidence of this with a pulmonary chamber, or the presence of the latter cavity alone in purely terrestrial Gasteropods, as grouping characters, nothing can be more erroneous; for all these conditions of the respiratory system are to be met with in unequivocal examples of the same group, anatomically defined, as in the Nerite alliance, or that of *Rissoa* for example. Nevertheless animals so simple in their nature as the Protozoa may be distributed physiologically, with some show of truthfulness in the resulting scheme.

Passing the leading types of the Protozoa in review, we notice that the Gregarinidæ alone are essentially parasitic in their habit of life, obtaining nutriment from materials elaborated by other animals. All the rest are therefore non-parasitic, deriving their sustenance from the outer world. If we now consider the manner in which nutritious matters are taken up and assimilated by these animals, we find that some of them must subsist on organic substances in solution, which are absorbed by the general surface of the body. Moreover we observe that this takes place either indirectly through a more or less consistent investing substance, or directly through the pores, foramina, or fenestrations of the calcareous or siliceous capsules protecting the contained sarcode bodies. In other instances, on the contrary, solid food is actually consumed by mouthless beings, which simply open their bodies to receive it; and this opening of the body may take place at any part of the surface most convenient, or it may be restricted to a definite locality, shadowing forth the permanent mouth of the Stomatoda, or even that of the most primitive form of Hydrozoa.

The annexed Table of arrangement is drawn up in accordance with the foregoing remarks.

Physiological Classification of the Protozoa.

Habit of life and mode of nutrition:—	
I. Parasitic	*Gregarinidæ.*
II. Non-parasitic.	
A. Assuming food in a state of solution by absorption of the general surface.	
1. Indirectly through a medium	
a. Forming a cell-like envelope	*Thalassicollidæ.*
b. Lining porous canals in the common mass	*Porifera.*
2. Directly through	
a. The pores or foramina of a calcareous shell	*Foraminifera.*
b. Fenestrations of a siliceous shell	*Polycystina.*
c. A more largely exposed surface	*Acanthometridæ.*
B. Assuming solid food by an adventitious mouth.	
1. At any part of the surface where the contact is made	*Monera, Amœba, &c.*
2. At a definite part, determined by the opening of the shell	*Gromia, Difflugia, &c.*
C. Assuming solid food by a permanent mouth,	
1. The same orifice being also excretory	*Infusoria.*
2. Discharging excreta by a rudimentary anus	*Noctilucidæ.*

This Table may be said to afford us good general grounds for forming an estimate of the relative superiority of the several types thus physiologically defined, and it is mainly in keeping with their more commonly received distribution founded on structural particulars.

A show of progressive improvement is seen in the respective sections A, B, and C—though to all appearance the simplest group of animals in existence, namely the *Monera* of Häckel, is included in the section B. These rudimentary creatures are destitute of both nucleus and contractile vesicle, though exhibiting activities in movement, taking food, and reproducing their kind, not even second to those of *Amœba* and its allies. The smallest ciliated molecule endowed with animal life could not present a more simple structure than that of the perfectly homogeneous and jelly-like *Monera*. Indeed the evolution of any of the other primitive forms from a plastic source like this is quite conceivable, though of course we have no actual means of observing such a transmutation.

Moreover the development of amœboids in some part of the life-history of most Protozoa would appear to stamp that form as the earliest genetic type of beings. With the exception of a nucleus and a contractile vesicle, *Amœba* itself may have sprung from *Protamœba*; and the finally encysted jelly-globules of *Protomyxa* and *Myxastrum* breaking up into naked amœboids, or pseudonavicellæ liberating them, very strikingly suggest the source from which the *Gregarinæ* may have been evolved.

The valuable researches of Mr. Archer, of Dublin, have brought to light many very interesting freshwater Protozoa, thus much augmenting our materials for comparison, and adding new zest to inquiry as to their natural affinities or their probable origin and derivatives.

If evolutionary forces are admitted to be in constant operation, it would be hard to say that any two existing forms should stand to each other in the relation of source and product. It would perhaps be safer to say that existing forms have taken their origin from *such* forms as are still in existence; for as it is but reasonable to suppose that in the lapse of time all the members of the primary type must have undergone some change, the persistence of that type through all in its primitive state is difficult to conceive, though, for any thing we yet know, this may be the case.

Without indulging in this theme further, if we now seek for the most probable derivatives of definite types of Protozoa, some remarkable facts strike us, first, in relation to the Cestoid worms, as bearing upon their possible derivation from the Gregarinidæ. I have already noticed the affinity of the Gregarinidans themselves to *Protomyxa* and *Myxastrum* amongst the *Monera*; but when we find the hooklets of *Tænia* and the sucker-pits of *Tænia* and *Bothriocephalus* shadowed forth in *Hoplorhynchus* and *Actinocephalus* respectively, we can scarcely help acknowledging the alliance here indicated. In the Gregarinidæ, moreover, there is not only a distinct external integument, but Van Beneden has lately demonstrated the existence of circular muscular fibres on its inner surface; a similar habit of life in both cases is also very significant. Nor would it be inconsistent to regard the Trematoda and Nematoidea as further developments of the same series of essentially internal parasites.

Now, although the Thalassicollidæ are not parasites, the genus *Thalassicolla* and the *Gregarinæ* alone of all the simple Protozoa take up their nutriment in solution, after the manner of the compound forms, namely the Porifera, restricted Polycystina, and Foraminifera. This fact, I think, is significant, as suggesting the derivation of *Gregarina* from some such original as *Thalassicolla*, as it does not seem natural to suppose that the former, which is so essentially an Entozoon, could have been descended from a stock capable of assuming solid food in the outer world.

Dr. Carpenter unconsciously gives us the weight of his opinion in the following quotations from his valuable work on the microscope. On page 449 he says, speaking of *Sphærozoum*, "Towards the inner surface of this (the outer) coat are scattered a great number of oval bodies resembling cells, having a tolerably distinct membraniform wall and a conspicuous round central nucleus, thus corresponding closely with the *Gregarina* type." I might mention in passing that, having frequently taken in the towing-net the unequivocal allies of *Dictyocha* with sarcode bodies identical with those of *Sphærozoum*, I have no hesitation in assuming *Dictyocha* itself to belong rather to the Thalassicollidæ than to the group with which it is more usually associated. This family is commonly included under the head of Rhizopoda; and there can be no doubt that the generalization, irrespective of that term, is a correct one; but it is a stretch of transcendental anatomy to speak of the existence of pseudopodia in any member of it. The radiating branched filaments within the dense external investment of *Thalassicolla nucleata* are not extensions of the sarcode body, like those of *Gromia* for example, but apparently act as retinacula, and as conduits for dialytic currents, which may account for the phenomenon of cyclosis observed in some instances.

Professor James-Clark, of Pennsylvania, appears to have satisfied himself, at least, that there is a remarkable agreement of characters exhibited between the Porifera and the Infusoria, which are connected, as he endeavours to show, by a regular gradation of animals. The derivation of the latter group of Protozoa from the former, which I had myself assumed quite independently, is therefore supported by that gentleman's researches.

Even with our present advanced knowledge of the Infusoria it is doubtful if we do not still include amongst them the larvæ of *Turbellaria*; and, indeed, the passage from the one type to the other would appear to be natural and easy. On the other hand, tracing through such forms as *Nemertes*, *Bonellia*, and *Priapulus*, *Sipunculus* will lead directly to the less-equivocal Echinodermata; and here the series must wind up; for further evolution, though perhaps possible, does not appear to have taken place.

The existence of such low or simple forms of Rotifera as the genus *Asplanchna*, for example, would be favourable to the idea that the Noctilucidæ might have been the progenitors of that order of beings. It is of course quite gratuitous, but convenient, at present to assume that the Noctilucidæ would thus hold the same relationship to the Polycystina that the Infusoria appear to do to the Porifera. However this may be, it is more certain that the Rotifera are at the root of the annulose and articulate series.

From the Rotifera, through the Annelida, we may thus trace the development of the crustaceous and chitinous types of Articulata like a dichotomous branch.

The Annelida may be linked with the Crustacea by means of the Sagittidæ, whose exquisitely striped muscular fibres accord to them a higher position than the other parts of their organization would perhaps warrant them to take.

There is obviously a representative relationship between the crustaceous Macrura, Anomura, and Brachyura and the chitinous Myriopoda, Insecta, and Arachnida.

The earthworms and the leeches may help to fill up the gap between the Chætopod Annelida and the Myriopoda (as, for example, between the genera *Geophilus* and *Nereis*), though it must be confessed that the existing links are inadequate, or they have never been sufficiently made out.

The first rudiments of a tracheal system are probably to be sought for in the Terricolous Annelida, though true articulated limbs and a dorsal heart seem to make their first appearance in the Iulidæ.

Should the simplest hydroid polyps have sprung from such Protozoa as *Difflugia*, *Arcella*, or *Astrorhiza*, with their pseudopodial tentacula encircling a fixed oral point, the existence of a living series from the lowest type of animals to that which is obviously on the confines of the Vertebrata would be clearly demonstrable*. Furthermore, as the interpolation of any other invertebrate types would disturb the harmony here, the inference is natural that they also might be distributed in a similar way into as many groups or series as their affinities or antipathies would suggest or necessitate.

Having studied this subject very carefully, it appears to me that the whole of the Invertebrata admit of distribution into four distinct series, corresponding with the number of sections of the Protozoa, from which all the other types may have taken their origin. Thus, on dividing the Astomatous Protozoa into compound types and their allied simple forms, we obtain the following highly suggestive arrangement, in which the groups represent each other so remarkably that they would seem to be quite natural.

* The annexed Table exhibits the progressive modification of the alimentary system in ascending from the Hydrozoa to the Tunicata :—

Evolution of the Alimentary Canal in particular.

Molluscoida (including Ctenophora)	Intestine insulated from the somatic cavity ...	With primary hæmal and final neural flexure	*Ascidiozoa.*
		With simple neural flexure	*Brachiopoda* and *Polyzoa.*
	Intestine straight, and communicating with the somatic cavity		*Ctenophora.*
Cœlenterata	Intestine not yet developed; stomach communicating with the somatic cavity		*Actinozoa.*
	True stomach not yet developed, its office being answered by the somatic cavity		*Hydrozoa.*

Additional matter in the above connexion will be found in a paper by the author "On the Morphological Relationships of the Molluscoida and Cœlenterata," published in the Transactions of the Royal Society of Edinburgh, vol. xxiii. part 3, 1864.

I have appended the Stomatoda and the twelve remaining sections of the Invertebrata in the order indicated by their affinities.

Scheme of Classification of Invertebrata.

Leading Types of Protozoa, aggregate or compound.

1.	2.	3.	4.
Collosphæra.	Porifera.	Polycystina.	Foraminifera.
	Corresponding simple forms.		
Thalassicolla.	Actinophrys.	Acanthometra.	Amœba.
Gregarina.	Gromia.	Podocyrtis.	Difflugia.
	Derivative types.		
Cestoidea.	Infusoria.	Noctilucidæ.	Cœlenterata.
Trematoda.	Turbellaria.	Rotifera.	Molluscoida.
Nematoidea.	Sipunculidæ.	Annelida.	Mollusca.
	Echinodermata.	Articulata.	

So as not to complicate the Table, I thought it better to supplement it with the definition of the four leading types of compound Protozoa.

1. In the Collosphæra type, the sarcode bodies lie at some distance apart and are always distinct.

2. In the Porifera type the sarcode bodies are closely approximated or confluent.

3. In the Polycystina type the sarcode bodies are concentric and connected by radiating stolons.

4. In the Foraminifera type the sarcode bodies are connected by stolons in linear series or some order of juxtaposition.

If it is incumbent upon the developmental hypothesis to derive the Vertebrata from the preexisting Invertebrata, the only line through which it would be possible to trace their descent is that leading from the Protozoa to the Mollusca proper, or the fourth series of the Table. It would also appear that the Entozoa, Echinodermata, and Articulata appertain severally to separate series of their own; and whatever may happen by-and-by, it would be difficult to find, in the present fauna of the globe, a single form clearly deducible from any of them.

The habit of life of the Entozoon, the peculiarity of structure of the Echinoderm, and the very perfection of organization of the Articulata, as it were, preclude their evolution into any other existing type. To use a common phrase, they may be said to lead nowhere, though they may be easily and, I think, consistently traced back to their possible origin in the Protozoa.

It would be great presumption to say that even an approach to perfection had been attained in this attempted classification of a whole subkingdom of animals. Nevertheless, in the preceding Table, the relationships existing amongst the members of that subkingdom are presented to the eye at a single glance, and in a manner that would be quite unattainable by systems maintaining the original creation of every so-called species, and that in an order perhaps more easily described than understood.

MISCELLANEOUS.

Preliminary Notice of some Extinct Tortoises from the Islands of Rodriguez and Mauritius. By Dr. ALBERT GÜNTHER, F.R.S.

SOME time ago M. L. Bouton, of Port Louis, sent me for examination some Chelonian remains from Rodriguez and the Mauritius, and more especially, among those from the latter island, a nearly complete carapace. This collection has been supplemented by a series of bones in the Geological Department of the British Museum, which were discovered at the same time and at the same place with the skeleton of *Didus ineptus*.

As some time must elapse before the plates illustrating my description can be finished, I think it advisable to indicate the main results of my examination.

All these tortoises belong to a group of gigantic land-tortoises, characterized by a flat skull (type *Testudo platyceps* of Gray), and by a dilated (not vertically compressed) symphysial bridge between the foramina obturatoria.

The Rodriguez species is distinguished by very slender vertebræ and leg-bones, and by having the neural arch of the sixth cervical vertebra perforated by a pair of large foramina. This species I have named *T. rodericensis*.

Among the remains from the Mauritius two species can be readily distinguished:—

One appears to have been the more common; it has three serrated dental ridges along the lower jaw, a peculiarity hitherto unknown among recent land-tortoises: for this species I propose the name *Testudo triserrata*.

The other is more sparingly represented, and distinguished by various modifications in the form of the bones of all the limbs. I distinguish it by the name *Testudo inepta*.

On the Dorsal Shield of Tolypeutes. By Dr. J. E. GRAY, F.R.S. &c.

In the 'Catalogue of Carnivorous and Edentate Mammalia (*Bruta*, Linnæus) in the British Museum,' p. 385, I formed these animals into a family (*Tolypeutidæ*), from the manner in which they walk, and on account of the dorsal disk being partially free from the back of the body; but only being able to examine a living specimen, which I was afraid of injuring, I believed that the disk was attached to the middle of the back, which is found not to be the case when one can examine more carefully a specimen preserved in spirits.

Mr. Edward Gerrard, Jun., has sold two specimens of the Mataco (*Tolypeutes conurus*) to the British Museum, which had been preserved in spirits; and he has pointed out to me that these specimens show that the dorsal disk of these animals is quite free from the body of the animal, except in three places—(1st) at the front end round the neck, (2nd) on the sides at the margin inside the three median dorsal rings, and (3rd) over the pelvis and round the caudal end of the shield; so that, in fact, it is even more free than in *Chlamydophorus.*

In these places it is united by an extension of the skin of the body, which from these parts extends over the whole internal surface of the disk. The whole outer surface of the bony disk is also covered by a very thin skin, which is visible and easily rubs off the animal that has been preserved in spirit.

The male and female are very like one another in external appearance; but the penis of the male is very large, and fusiform.

Observations on the Structure of the Proboscis of an Hermaphrodite Nemertian from the Marseilles Coast. By M. E. Zeller.

M. Marion has described, under the name of *Borlasia Kefersteinii*, a curious Nemertian, the examination of which proves with certainty the occasional hermaphrodism of the Turbellaria of this group. The importance of this anatomical fact leads me to present to the Academy the results of some investigations made in the laboratory of the "École pratique des Hautes Études" of Marseilles, under the direction of M. Marion, in consequence of which it has been ascertained that the *Borlasia* parasitic upon *Phallusia mamillata*, so frequent in the gulf, must be united with *B. Kefersteinii*, with which it presents the same sexual organization. It will therefore in future be easy to meet with this species, which always exists in great abundance on the branchial tissue of the Ascidia. The anatomical examination of more than sixty individuals has revealed to me some peculiarities, often not very observable, in the structure and functions of the proboscis.

The greatly developed proboscis extends in the dorsal region of the animal from the ganglia to the anus, where it is recurved so as to attach itself to the walls of the general cavity. I have distinguished five parts, namely:—1, a protractile region; 2, a bulb of the style; 3, a poison-sac; 4, a glandular region; and 5, a muscular region.

The walls of the first four parts of this organ are formed by longitudinal and transverse muscles; the muscular region seems to be formed entirely by longitudinal muscles.

The protractile region is equal to about one third of the total length of the proboscis; it passes between the commissures of the cerebral ganglia, is reflexed, and fixed by its terminal portion to the membrane which covers these ganglia. On its muscular envelope we may distinguish a transparent homogeneous layer, roughened with pretty thick papillæ, resembling more or less elongated mamillæ, upon which I have not observed any vibratile cilia.

Behind this region is placed the bulb of the style, of a more or less rounded form, in the centre of which is arranged the apparatus of attack. The point, which is much drawn out, penetrates by a small aperture into the inferior portion of the protractile part. It is fixed at its base in a sort of ring or ridge which surmounts the haft. The mass of the haft appears to be granular and brownish.

The style does not float freely in the centre of the bulb. It is placed in a sac having the form of two truncated cones one above the other; that in which the haft plays rises nearly to the height of the ring. The margins of this sac appear to be attached to the haft by muscles destined to facilitate the movements of the style.

On the two sides of the upper region of the bulb are the styligenous pouches, three in number. These are ovoid cavities, two of which are placed horizontally on each side of the base of the haft, with ducts which, starting from the extremity near the base of the style, are directed towards its point. (I have not been able to determine exactly where these ducts open.) The third was on the right, and placed vertically. Most frequently they contain three darts; but in many individuals I have found four and even five, surrounded by their basal ring and arranged symmetrically in accordance with the longer axis of the pouches.

I have several times observed in these pouches, as Claparède had done in 1869 in *Tetrastemma varicolor*, the presence of a transparent vesicle; sometimes also I have seen this vesicle containing a dart in course of formation, as has been indicated in other species by Claparède, Schultze, and Keferstein.

In all these Nemertians I have detected above the styliferous apparatus a more or less blackish layer, which is no doubt a secretory apparatus. In those individuals in which the style was in process of formation this layer appeared to me to be thicker; it entirely enveloped the styligenous pouches. The mass which separates these pouches from the enveloping muscles is formed by fine pigment-granules.

The poison-sac follows the bulb of the style. It is rounded, and the muscular layer which envelops it is much thicker than in the other parts of the proboscis; it keeps in reserve the liquid produced by the glandular region. From this sac a duct starts, which traverses the bulb and opens near the point of the style.

Last comes the glandular region, which terminates the muscular region, and the interior of which is filled with numerous vesicles containing little granular drops of an oily appearance, penetrating into the poison-sac in proportion as the latter is projected out of the animal. I have always seen this part of the proboscis occupied by these vesicles, just as the poison-sac was filled with the liquid which has to flow from it.

When the animal has to project its proboscis we see the muscular region take on a vermicular movement, which is communicated to the glandular region, and carries with it the liquid of the general cavity, which collects in front of the cephalic lobes and compels the anterior part of the proboscis to fold like the finger of a glove and penetrate into the canal which separates it from the orifice of issue. The canal, formed of very powerful muscles, plays an important part in the projection of the proboscis. The protractile region penetrates into it with difficulty; but as soon as a part of it projects under the influence of the liquids accumulated in the *cul-de-sac*, we see it issue with very great rapidity, in consequence of the pressure of these muscles upon the part which is still in the interior.

The repeated movements of the inferior region of the proboscis quickly produce such a pressure in the anterior part that it is soon projected. Compressed at the same moment by the muscles of the canal just mentioned, the bulb becomes terminal; and we notice the jerking-movements of the style at the same time that a granular liquid flows through an aperture situated near its point.

The movements which act in the projection of the proboscis serve equally to accumulate the liquid of the glandular region at the entrance of the poison-sac. The muscles which surround this sac contract in such a way that the anterior region seems to approach the posterior region. The same mechanism is produced in the bulb. It is this combination of movements that causes the issue of the point of the style at the same time as the flow of poison. As soon as the poison-sac has allowed a certain quantity of liquid to escape, this is immediately replaced by that contained in the glandular region.

The return of the proboscis is effected by the inverse contraction of the muscles of the canal and protractile region. These observations justify us in regarding the muscular region as the principal motor of the proboscis.—*Comptes Rendus*, April 14, 1873, tome lxxvi. pp. 966–969.

French Measures. By Dr. J. E. Gray, F.R.S. &c.

French measure is being used by several scientific writers, being chiefly introduced by translators of French elementary books, who are too idle to reduce the French to the relative English measures; for there can be no doubt of the greater convenience of the English foot, inch, and line, being adapted to the different sizes of the things wished to be measured. Few people but can tell you what is a foot and what is an inch, and give a close approximation to the size in feet and inches of any thing you show to them; but I have never found a person using a French measure who could tell you the size of 190 millimetres, though he could tell what was the length of 7½ inches, which is within a very little of the same thing.

It may be of some advantage to give such persons an idea of a size mentioned to be informed that a decimetre, or 100 millimetres, is about the usual length of a man's fore finger, from the tip of the nail to the back of the knuckle when the finger is bent down, and that the first joint of the finger when bent down is as nearly as possible 25 millimetres, or a fourth part.

I challenged a well-known physiologist who has long used French measure to give me his idea of the measure of certain things lying before him; and he declined to guess, and was surprised at the accuracy with which I could guess them by this simple means. The decimetre is as nearly as possible 4 inches, which is the usual length of the fore finger; and the first joint, as nearly as possible a quarter the length of the fore finger, an inch or 25 millimetres long.

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XLV.—*On the Advantage of a Dominant Language for Science.* By ALPHONSE DE CANDOLLE, Corresponding Member of the Académie des Sciences, Foreign Member of the Royal and Linnean Societies, &c.*

AT the period of the Renaissance Latin was the language employed by all the learned men of Europe. It had been carefully preserved by the Romish Church; and not one of the modern languages presented, at that time, a sufficiently rich literature to become its rival. But at a later period the Reformation disturbed the unity of the Romish influence. Italian, Spanish, French, and English gained successively regular idioms, and became rich in literary productions of every kind; and at last, 80 or 100 years ago at most, the progress of science caused the inconvenience of the use of Latin to be felt. It was a dead language, and, in addition to that, was wanting in clearness, owing to its inversions, to its abbreviated words, and to the absence of articles. There existed at that time a general desire to describe the numerous discoveries that were being made, and to explain and discuss them without the necessity of seeking for words. The almost universal pressure of these causes was the reason for the adoption of modern languages in most sciences, natural history being the only exception: for this Latin is still employed, but only in descriptions—a special and technical part, where the number of words is limited and

* The fifth chapter of the 'Histoire des Sciences et des Savants depuis deux siècles,' 8vo, Genève, 1873: London, Dulau. Translated by Miss Miers, by permission of the author.

the construction very regular. Speaking truly, what naturalists have preserved is the Latin of Linnæus, a language in which every word is precise in meaning, every sentence arranged logically, clearly, and in a way employed by no Roman author. Linnæus was not a linguist: he knew but little even of modern languages; and it is evident that he struggled against many difficulties when he wrote in Latin. With a very limited vocabulary and a turn of mind which revolted equally from the periods of Cicero and the reticence of Tacitus, he knew how to create a language precise in its terms, appropriate to the description of forms, and intelligible to students. He never made use of a term without first defining it. To renounce this special language of the learned Swede would be to render descriptions less clear and less accessible to the *savans* of all nations. If we attempt to translate into the Latin of Linnæus certain sentences in modern Floras, written in English or German, we quickly perceive a want of clearness. In English the word *smooth* applies equally to *glaber* and *lævis**. In German the construction of sentences indicating generic or other characters is sometimes so obscure that I have found it impossible, in certain cases, to have them put into Latin by a German, a good botanist, who was better acquainted than myself with both languages. It would be still worse if authors had not introduced many words, purely Latin, into their language. But, exclusive of paragraphs relative to characters, and wherever successive phenomena or theories are in question, the superiority of modern languages is unquestionable; it is on this account that, even in natural history, Latin is every day less employed.

The loss, however, of the link formerly established between scientific men of all countries has made itself felt. From this has arisen a very chimerical proposal to form some artificial language, which should be to all nations what writing is to the Chinese. It was to be based on ideas, not words. The problem has remained quite devoid of solution; and even were it possible, it would be so complicated an affair, so impracticable and inflexible, that it would quickly drop into disuse.

The wants and the circumstances of each epoch have brought about a preference for one or other of the principal European languages as a means of communication between enlightened men of all countries. French rendered this service during two centuries. At present various causes have modified the

[* The word *glaber* in botany means bald, or not hairy, which is applied to other parts as well as the head; and *lævis* smooth, not rough; but I know they have both been carelessly translated "smooth," as M. de Candolle implies.—J. E. G.]

use of this language in other countries, and the habit has been almost everywhere introduced that each nation should employ its own tongue. We have therefore entered upon a period of confusion. What is thought to be new in one country is not so to those who read books in other languages. It is vain to study living languages more and more; you are always behindhand in the complete knowledge of what is being published in other countries. Few persons are acquainted with more than two languages; and if we try to pass beyond a certain limit in this respect, we rob ourselves of time for other things; for there is a point at which the study of the means of knowledge hinders our learning. Polyglott discussions and conversations do not answer the intentions of those who attempt them. I am persuaded that the inconvenience of such a state of things will be more and more felt. I also believe, judging by the example of Greek as used by the Romans, and French in modern times, that the need of a prevailing language is almost always recognized; it is returned to from necessity after each period of anarchy. To understand this we must consider the causes which make a language preferable, and those which spread its employment in spite of any defects it may possess.

Thus in the 17th and 18th centuries motives existed for the employment of French in preference to Latin throughout Europe. It was a language spoken by the greater part of the educated men of the period, a language tolerably simple and very clear. It had an advantage in its resemblance to Latin, which was then widely known. An Englishman, a German, was already half acquainted with French through his knowledge of Latin; a Spaniard, an Italian, was three parts advanced in his study of the language. If a discussion were sustained in French, if books were written or translations made in the language, all the world understood.

In the present century civilization has much extended north of France, and population has increased there more than to the south. The use of the English tongue has been doubled by its extension into America. The sciences are more and more cultivated in Germany, in England, in the Scandinavian countries, and Russia. The scientific centre of gravity has advanced from the south towards the north.

Under the influence of these new conditions a language can only become predominant by presenting two characters: 1st, it must possess sufficient German and Latin words or forms to be within reach at once of the Germans and of the people who make use of Latin tongues; 2nd, it must be spoken by a considerable majority of civilized people. In addition to these two essential conditions it would be well for the definitive success of a language that it should also possess the qualities of grammatical simplicity, of conciseness, and clearness.

English is the only language which may, in fifty or a hundred years, offer all these conditions united.

The language is half German and half Latin. It possesses German words, German forms, and also French words and a French method of constructing sentences. It is a transition between the principal languages used at present in science, as French was formerly between Latin and several of the modern languages.

The future extension of the Anglo-American tongue is evident. It will be rendered inevitable by the movement of the populations in the two hemispheres. Here is the proof, which it is easy to give in a few words and a few figures.

At the present time the population stands thus (Almanach de Gotha, 1871) *:—

English-speaking peoples—in England 31 millions, in the United States 40, in Canada &c. 4, in Australia and New Zealand 2: total 77.

German-speaking peoples—in Germany and a portion of Austria 60, in Switzerland (German cantons) 2: total 62.

French-speaking peoples—in France 36½, in Belgium (French portion) 2½, in Switzerland (French cantons) ½, in Algeria and the Colonies 1: total 40½.

Now, judging by the increase that has taken place in the present century, we may estimate the probable growth of population as follows †:—

	millions.
In England it doubles in 50 years; therefore in a century (in 1970) it will be	124
In the United States, in Canada, in Australia, it doubles in 25; therefore it will be	736
Probable total of the *English*-speaking race in 1970 .	860
In Germany the northern population doubles in 56 to 60 years, that of the south in 167 years. Let us suppose 100 years for the average. It will probably be in 1970, for the countries of German speech, about .	124
In the French-speaking countries the population doubles in about 140 years. In 1970, therefore, it will probably amount to	69½

* [No notice is here taken of the English-speaking people in India and the East.—J. E. G.]

† Almanach de Gotha, 1870, p. 1039.

Thus the three principal languages spoken at the present time will be spoken a century hence with the following progression:—

			millions.
The English tongue	will	have increased	from 77 to 860
The German	"	"	from 62 to 124
The French	"	"	from $40\frac{1}{2}$ to $69\frac{1}{2}$

The individuals speaking German will form a seventh part, and those speaking French a twelfth or thirteenth part of those of English tongue; and both together will not form a *quarter* of the individuals speaking English. The German or French countries will then stand towards those of English speech as Holland or Sweden do at present with regard to themselves. I am far from having exaggerated the growth of the Anglo-Australian-American populations. Judging by the surface of the countries they occupy, they will long continue to multiply in large proportion. The English language is, besides, more diffused than any other throughout Africa and Southern Asia. America and Australia are not, I confess, countries in which the culture of letters and sciences is so much advanced as in Europe; and it is probable that, for a length of time, agriculture, commerce, and industry will absorb all the most active energies. I acknowledge this. But it is no less a fact that so considerable a mass of intelligent and educated men will weigh decisively on the world in general. These new peoples, English in origin, are mingled with a German element, which, in regard to intellectual inclinations, counterbalances the Irish. They have generally a great eagerness for learning and for the application of discoveries. They read much. Works written in English or translated into that tongue would, in a vast population, have a very large sale. This would be an encouragement for authors and translators that is offered by neither the French nor the German language. We know in Europe to what degree difficulties exist in the publication of books on serious subjects; but open an immense mart to publishers, and works on the most special subjects will have a sale. When translations are read by ten times as many people as at present, it is evident that a greater number of books will be translated; and this will contribute in no small degree towards the preponderance of the English language. Many French people already buy English translations of German books, just as Italians buy translations in French. If English or American publishers would adopt the idea of having translations made into their language of the best works that appear in Russian, Swedish, Danish, Dutch,

&c., they would satisfy a public dispersed over the whole world, and particularly the numerous Germans who understand English. Yet we are but at the beginning of the numerical preponderance of the English-speaking populations.

The nature of a language does not, at first sight, appear to have very great influence on its diffusion. French was preferred for two centuries; and yet Italian was quite as clear, more elegant, more harmonious, had more affinity with Latin, and, for a length of time, had possessed a remarkable literature. The number, the activity of the French, and the geographical position of their country were the causes of their preponderance. Yet the qualities of a language, especially those preferred by the moderns, are not without their influence. At the present time briefness, clearness, grammatical simplicity are admired. Nations, at least those of our Indo-European race, began by speaking in an obscure complicated manner; in advancing they have simplified and made their language more precise. Sanscrit and Basque, two very ancient languages, are exceedingly complicated. Greek and Latin are so in less degree. The languages derived from Latin are clothed in clearer and simpler forms. I do not know how philosophers explain the phenomenon of the complication of language at an ancient period; but it is unquestionable. It is more easy to understand the subsequent simplifications. When a more easy and convenient method of acting or speaking has been arrived at, it is naturally preferred. Besides, civilization encourages individual activity; and this necessitates short words and short sentences. The progress of the sciences, the frequent contact of persons speaking different languages, and who find a difficulty in understanding each other, lead to a more and more imperious need for clearness. You must have received a classical education to avoid the perception of absurdity in the construction of an ode of Horace. Translate it literally to an uneducated workman, keeping each word in its place, and it will have to him the effect of a building the entrance-door of which is on the third story. It is no longer a possible language, even in poetry.

Modern languages have not all, to the same degree, the advantages now demanded, of clearness, simplicity, and briefness.

The French language has shorter words and less complicated verbs than the Italian: this, in all probability, has contributed to its success. The German has not undergone the modern evolution by which each sentence or portion of a sentence begins with the principal word. Words are also cut in two and the fragments dispersed. It has three genders, whereas

French and Italian have but two. The conjugations of many verbs are rather complicated. Nevertheless modern tendencies weigh with the Germans, and it is evident that their language is becoming a little modified. Scientific authors especially exert themselves to attempt the direct modes of expression and the short phrases of other countries, in the same way that they have abandoned the Gothic printed letters. Should they correspond with strangers, they often have the politeness to write in Latin characters. They willingly introduce in their publications terms taken from foreign languages, modifications sometimes merely of form, occasionally fundamental. These attest the modern spirit and the enlightened judgment of the learned men so numerous in Germany. Unhappily the modifications of form have no great importance, and the fundamental changes take place very slowly.

The more practical English language shortens sentences and words. It willingly takes possession of foreign words, as German does; but of *cabriolet* it makes *cab*, of *memorandum* it makes *mem.* It makes use only of indispensable and natural tenses—the present, the past, the future, and the conditional. There is no arbitrary distinction of genders: animated objects are masculine or feminine; the others are neuter. The ordinary construction is so sure to begin with the principal idea that in conversation you may often dispense with the necessity of finishing your sentences. The chief fault of the English language, its inferiority in comparison with German or Italian, consists in an orthography absolutely irregular, and so absurd that children take a whole year in learning to read *. The pronunciation is not well articulated, not well defined. I shall not go as far as Madame Sand in her amusing imprecations on this point; but there is truth in what she says. The vowels are not distinct enough. But, in spite of these faults, English, according to the same clever writer, is a well-expressed language, quite as clear as any other, at least when English people choose to revise their MSS., which they will not always do; they are in such a hurry!

English terms are adapted to modern wants. Do you wish to hail a vessel, to cry "stop" to a train, to explain a machine, to demonstrate an experiment in physics, to speak in few words to busy and practical people, it is the language *par excellence*. In comparison with Italian, with French, and, above all, with

* Surprised, on one occasion, by the slowness with which intelligent English children learnt reading, I inquired the reason. Each letter has several sounds, or you may say that each sound is written in several ways. It is therefore necessary to learn reading word for word. It is an affair of memory.

German, English has the effect, to those who speak several languages, of offering the shortest cut from one point to another. I have observed this in families where two languages are equally well known, which often occurs in Switzerland. When the two languages are German and French, the latter almost always carries the day. "Why?" I asked of a German Swiss established in Geneva. "I can scarcely tell you," he replied; "at home we speak German to exercise my son in the language; but he always falls back into the French of his comrades. French is shorter, more convenient." Before the events of 1870, a great Alsatian manufacturer sent his son to study at Zurich. I was curious to know the reason why. "We cannot," he said, "induce our children to speak German, with which they are quite as familiar as with French. I have sent my son to a town where nothing but German is spoken, in order that he may be forced to speak it." In such preferences you must not look for the causes in sentiment or fancy. When a man has choice of two roads, one straight and open, the other crooked and difficult to find, he is sure to take, almost without reflection, the shorter and more convenient one. I have also observed families where the two languages known in the same degree were English and French. In this case the English maintained supremacy, even in a French-speaking land. It is handed down from one generation to another; it is employed by those who are in haste, or who want to say something in as few words as possible. The tenacity of French or English families established in Germany in speaking their own language, and the rapid disappearance of German in the German families established in French or English countries, may be explained by the nature of the languages rather than by the influence of fashion or education.

The general rule is this:—In the conflict of two languages, every thing else being equal, it is the most concise and the most simple that conquers. French beats Italian and German; English beats the other languages. In short, it need only be said that the more simple a language is, the more easy it is to be learnt, and the more quickly can it be made available for profitable employment.

The English language has another advantage in family use: its literature is the one most suitable to feminine tastes; and every one knows how great is the influence of mothers on the language of children. Not only do they teach what is called "the mother tongue," but often, when well educated, they feel pleasure in speaking a foreign language to their children. They do so gaily, gracefully. The young lad who finds his language-master heavy, his grammar tiresome, thinks very differently when his mother, his sister, or his sister's friend addresses herself to him in some foreign tongue. This will often be English—and for the best of reasons: there is no language so rich in works (written in a spirit of true morality) upon subjects which are interesting to women—religion, education, fiction, biography, poetry, &c.

The future preponderance of the language spoken by English, Australians, and Americans thus appears to me assured. The force of circumstances leads to this result; and the nature of the language itself must accelerate the movement.

The nations who speak the English tongue are thus burthened with a responsibility which it is well they should recognize at once. It is a moral responsibility towards the civilized world of the coming centuries.

Their duty, as it is also their interest, is to maintain the present unity of the language, at the same time admitting the necessary or convenient modifications which may arise under the influence of eminent writers, or be arranged by common consent. The danger to be feared is that the English language may, before another century has passed, be broken up into three languages, which would be in the same relation to each other as are Italian, Spanish, and Portuguese, or as Swedish and Danish.

Some English authors have a mania for making new words. Dickens has invented several. Yet the English language already possesses many more words than French, and the history of its literature shows that there is greater need to suppress than to add to the vocabulary. No writer for three centuries past has employed nearly so many different words as Shakspeare; therefore there must have been many unnecessary ones. Probably every idea and every object had formerly a term of Saxon origin and one of Latin or French origin, without counting Celtic or Danish words. The very logical operation of time has been to suppress the double or triple words. Why reestablish them? A people so economical in its use of words does not require more than one term for each thing*.

The Americans, on the other hand, make innovations of accent or orthography (they almost always spell *labour* "labor," and *harbour*, "harbor"). The Australians will do the same if they do not take care. Why should not all possess the noble am-

* A clever English writer has just published a volume on the institutions of the people called *Swiss* in English. He names them *Switzers*. For what reason? Will there soon be *Deutschers*?

bition of giving to the world one uniform concise language, supported by an immense literature and spoken in the next century by 800 or 1000 millions of civilized men? To other languages it would be as a vast mirror in which each would become reflected, thanks to newspapers and translations, and all the friends of intellectual culture would have a convenient medium for the interchange of ideas. It would be rendering an immense service to future races; and at the same time the authors and men of science of English-speaking race would give a strong impulsion to their own ideas. The Americans, above all, are interested in this stability, since their country is to be the most important of those of English tongue. How can they acquire a greater influence over Old England than by speaking her language with exactness?

The liberty of action permitted amongst people of English race adds to the danger of a division in the language. Happily, however, certain causes which broke up the Latin language do not exist for English nations. The Romans conquered nations the idioms of which were maintained or reappeared here and there in spite of administrative unity. The Americans and Australians, on the contrary, have before them only savages, who disappear without leaving any trace. The Romans were conquered and dismembered in their turn by the barbarians. Of their ancient civilization no evidence of unity remained, unless it was in the Church, which has itself felt the influence of the universal decline. The Americans and Australians possess many flourishing schools; they have the literature of England as well as their own. If they choose, they can wield their influence by means of maintaining the unity of the language. Certain circumstances make it possible for them to do so; thus the teachers and professors mostly come from the States of New England. If these influential men truly comprehend the future destiny of their country, they will use every effort to transmit the language in its purity; they will follow classic authors and discard local innovations and expressions. In this question of language, real patriotism (or, if you will, the patriotism of Americans really ambitious for their country) ought to be to speak the English of Old England, to imitate the pronunciation of the English, and to follow their whimsical orthography until changed by themselves. Should they obtain this of their countrymen, they would render to all nations and to their own an unquestionable benefit for futurity.

The example of England proves the influence of education upon the unity of a language. It is the habitual contact of educated people and the perusal of the same books which, little by little, is causing the disappearance of Scotch words and accent. A few years more, and the language will be uniform throughout Great Britain. The principal newspapers, edited by able men, also exercise a happy influence in preserving unity. Whole columns of 'The Times' are written in the language of Macaulay and Bulwer, and are read by millions of people: the result is an impression which maintains the public mind in a proper literary attitude.

In America the newspaper articles are not so well written; but the schools are accessible to all classes, and the universities count amongst their professors men especially accomplished in their use of the English tongue. If ever there should arise a doubt in the opinions of the two countries as to the advisability of modifying the orthography, or even making changes in the language, it would be an excellent plan to organize a meeting of delegates from the principal universities of the Three Kingdoms, of America, and Australia, to propose and discuss such changes. Doubtless they would have the good sense to make as few innovations as possible; and, thanks to common consent, the advice would probably be followed. A few modifications in the orthography alone would render the English language more easy to strangers, and would contribute towards the maintenance of unity in pronunciation throughout Anglo-American countries.

Notes by Dr. J. E. Gray.

It may be observed, in addition, that the people who use the English language in different parts of the world are a reading and book-buying people, and especially given to the study of scientific or quasi-scientific books, as is proved by the fact of the extensive sale which they command.

In support of this assertion I may quote the Baron Férussac's review of Wood's 'Index Testaceologicus,' in the Bull. Sci. Nat. Paris, 1829, p. 375. He remarks:—

"We observe with interest the number of subscribers that exist in England for an octavo volume on shells, costing 186 francs. It is a curious fact, which booksellers and authors will appreciate, as it will afford them the means of seeing how a return is obtained for their outlay on such works in England, compared with other countries. The number of subscribers is 280, of which 34 are females and 6 foreigners. Certainly all the rest of Europe could not produce as many, nor perhaps even the half of that number."

How much more astonished would M. Férussac have been, if informed that these were only the subscribers before publication, and that 1000 copies were sold! Since 1829 the sale of scientific books has much increased, as is shown, for example, by the many editions of the works of Lyell and other naturalists, each edition being of 1000 copies.

Most scientific books in France and other continental countries can only be published when the Government furnishes the cost; and they are chiefly published in an expensive form as a national display, and are almost confined to their public libraries, except the sale of copies that are bought by English collectors.

In England such works are generally published by individual enterprise, and depend on the general public for their support, and are published in a style to suit the different classes. Thus there are works of luxury for the rich, often published by individuals who confine themselves to the production of that class of books, very cheap works for the student and mechanic, and books of all intermediate grades, produced by the regular publishers. The females of all grades are extensive readers of this class of books, which I believe is chiefly the case with English-speaking races.

Some of the scientific Swedes and Russians have published their papers in the English language, or appended an abstract in English to them, as Thorell on European spiders, Prof. Lilljeborg on *Lysianassa*, and Prof. Wackerbarth on the planet Leda, &c. &c. The Danes and Dutch often publish *their* scientific papers in French, as Temminck, Reinhardt, and the late Prof. Van der Hoeven, who themselves read and write English; but it appears they regard French as the polite language of courts, and forget that courtiers generally have a contempt for science and that they should look among the people for their readers.

It is to be observed that Professor de Candolle himself uses the French language with a very English construction; but we believe that his work would have commanded the greatest number of readers if written in the English language, which he reads and writes so fluently.

See also Mr. Galton's interesting article on the Causes which create Scientific Men, in the 'Fortnightly Review' for March 1873, p. 346, which contains some interesting observations on M. de Candolle's work.

XLVI.—*Notes on the Palæozoic Bivalved Entomostraca.* No. X. Entomis *and* Entomidella. By Prof. T. Rupert Jones, F.R.S., F.G.S.

These two genera of Palæozoic Bivalved Entomostraca are little known, though comprising several wide-spread species, found in Silurian, Devonian, and Carboniferous strata. To draw attention to these small but well-marked and abundant fossils, by offering a synopsis of their species, will be useful, it is hoped, to palæontologists.

I. Entomis, Jones, 1861.

Cypridina, De Koninck, 1841. Mém. Acad. R. Sc. Belg. vol. xiv. p. 18; 1844. Descr. Anim. foss. Terr. Carb. Belg. p. 587.
Cypridina, G. Sandberger, 1842. Leonh. u. Bronn's Jahrb. f. 1842, p. 226; 1845. Jahrb. Ver. Nat. Nassau, Heft ii. p. 121; G. & F. Sandberger, Verst. Rhein. Sch. Nassau, p. 4.
Cypridina, F. A. Römer, 1854. Palæontographica, vol. iii.; Beitr. Harzgeb. pp. 19, 28, 42.
Cypridina, Richter, 1856. Denksch. math.-nat. Cl. k. Akad. Wien, vol. xi.; Beitr. Paläont. Thür. Waldes, p. 35.
Entomis, Jones, 1861. Mem. Geol. Surv. Gt. Brit., Geol. Edinburgh (Map 32), p. 137.
Entomis, Jones & Kirkby, 1863. Geologist, vi. p. 460; 1864. Rep. Brit. Assoc. Newcastle, 1863, Trans. Sect. p. 80; Neues Jahrb. f. 1864, p. 54; Canad. Nat. Geol. n. s. vol. i. p. 237.
Entomis, Bigsby, 1868. Thesaurus Siluricus, p. 74.
Entomis, Jones, 1869. Palæoz. Biv. Entom. (Geol. Assoc.), pp. 2 & 5; 1870. Month. Microsc. Journ. vol. iv. pp. 185, 187.
Entomis, Barrande, 1872. Crust. Poiss. Sil. Bohême (Extrait &c.), p. 41; Syst. Sil. Bohême, vol. i., Suppl. p. 513.

Entomis is a bivalved Entomostracon of uncertain alliance. It has an ovato-oblong, bean-like carapace. The valves are strongly indented by a transverse furrow, which begins on the dorsal margin, at about one third of its length from the anterior extremity, and reaches halfway or more across the valve. This is the usual place of the dorsal or nuchal sulcus in several Palæozoic Ostracoda, as:—*Aristozoe*, Barrande; *Orozoe*, Barr.; *Cypridella*, De Koninck; *Cyprella*, De Kon.; *Primitia*, Jones & Holl; *Isochilina*, Jones; *Leperditia*, Rouault; *Beyrichia*, M'Coy; and *Hippa*, Barr.

The surface of each valve sometimes presents in front of the sulcus a rounded tubercle: but this is variable in position and shape; sometimes it is a spine, sometimes it is wanting.

The anterior margin is not indented by any sinus or notch, and is therefore without beak or hood.

In *Entomis tuberosa* a radiate muscle-spot, in connexion with the tubercle, is shown on casts in Silurian mudstone from the Pentland Hills, Scotland (Messrs. Haswell and Brown's Collections).

The surface of the valves in some species is ornamented with delicate riblets, transverse, longitudinal, or concentric.

As far as the shape of the carapace is concerned, *Entomis* stands in the same relation to *Cypridella* of De Koninck as *Polycope* of Sars to *Cypridina* of Milne-Edwards, the anterior notch having disappeared in both *Polycope* and *Entomis*. The *animals*, however, may have respectively differed very much; for *Polycope* and *Cypridina* belong to different *families*, and the deep nuchal furrow in *Entomis*, far more impressed than in *Cypridella*, was probably in direct relation with the structure of its internal organs, under modifications not present in other genera.

The physiological meaning of the nuchal furrow in these Entomostraca is not understood. It is faintly indicated in *Philomedes* and *Halocypris*; it is stronger in *Pleopsis* and *Daphnella*, belonging to quite another group of Entomostraca.

The known *Entomides* are:—

1. *Entomis concentrica* (De Koninck), 1841.

Cypridina concentrica. De Kon. 1841. Mém. Acad. Roy. Belg. vol. xiv. p. 18, f. 10; 1844. Desc. Anim. foss. Terr. Carb. Belg. p. 587, pl. 52. figs. 4, 5.
Cythere concentrica, Dupont, 1863. Bull. Acad. R. Sc. Belg. ser. 2, vol. xv. p. 110.
Entomis concentrica, Jones & Kirkby, 1864. Neues Jahrb. für 1864, p. 54; Canad. Nat. Geol. n. s. vol. i. p. 237.

Lower Carboniferous: Belgium.

2. *Entomis serratostriata* (G. Sandberger), 1842.

Cypridina serratostriata, G. Sandberger, Leonh. u. Bronn's Jahrb. 1842, p. 226; Jahrb. Ver. Nat. Nassau, Heft ii. 1845, p. 121, pl. 1. fig. 6; G. & F. Sandberger, Verstein. Rhein. Schicht. Nassau, 1850, p. 4, pl. 1. fig. 2. From the Cypridinen-Schiefer of Nassau.
Cypridina serratostriata, F. A. Römer, 1854. Palæontogr. iii. Beitr. geol. Kennt. nordw. Harzgeb. p. 42, pl. 6. fig. 15. From the Cypridinen-Schiefer of the Harz.
Cypridina? serratostriata, Jones, in Morris's Catal. Brit. Foss. 1854, p. 104. Devonshire?
Cypridina serratostriata, Richter, 1856. Denkschr. Akad. Wien, vol. xi., Beitr. Pal. Thür. Waldes, p. 35, pl. 2. figs. 20–29. Thuringia.
Cypridina serratostriata, Ferd. Römer, 1856. In Bronn's Leth. Geogn. 3rd edit. vol. i. p. 532 (not including the synonyms). Germany.
"*Entomis* of the Cypridinen-Schiefer," Jones & Kirkby, 1863. Geologist, vi. p. 460; 1864. Rep. Brit. Assoc. Newcastle, 1863, Trans. Sect. p. 80.

Devonian: Europe; England (*fide* Ferd. Römer & Godwin-Austen*).

* Quart. Journ. Geol. Soc. vol. xiii. p. lxxxix.

3. *Entomis nitida* (F. A. Römer), 1854.

Cypridina nitida, F. A. Römer, 1854. Palæontographica, vol. iii.; Beiträge Harzgebirge, p. 28, pl. 4. fig. 20.

Goniatite Limestone of the Harz.

4. *Entomis fragilis* (F. A. Römer), 1854.

Cypridina fragilis, F. A. Römer, 1854. Palæontogr. vol. iii.; Beiträge Harzgebirge, p. 19, pl. 3. fig. 31.

Weissenbach Schists of the Harz.

5. *Entomis globulus* (Richter), 1856.

Cypridina globulus, Richter, 1856. Denkschr. Akad. Wien, vol. xi.; Beitr. Pal. Thür. Waldes, p. 36, pl. 2. figs. 30–32.

Cypridinen-Schiefer, Thuringia.

6. *Entomis gyrata** (Richter), 1856.

Cypridina gyrata, Richter, 1856. *Ibid.* figs. 33, 34.

Cypridinen-Schiefer, Thuringia.

7. *Entomis tæniata* (Richter), 1856.

Cypridina tæniata, Richter, 1856. *Ibid.* fig. 35.

Cypridinen-Schiefer, Thuringia.

8. *Entomis tuberosa*, Jones, 1861.

Entomis tuberosa, Jones, 1861. Mem. Geol. Surv. Gt. Brit., Neighb. Edinburgh (Map 32), p. 137, pl. 2. fig. 5.

Upper Silurian: Aymestry, and Bow Bridge, near Ludlow, Shropshire; Pentland Hills, Scotland; Yarra Lumla, New South Wales.

9. *Entomis impendens*, Haswell, 1865.

Entomis impendens, Haswell, 1865. Silur. Form. Pentland Hills, p. 38, pl. 3. fig. 11.

Upper Silurian: Pentland Hills, Scotland.

10. *Entomis biconcentrica*, Jones, 1870.

Entomis biconcentrica, Jones, 1870. Month. Microsc. Journ. vol. iv. p. 185, pl. 61. fig. 13.

Lower Carboniferous: England; Ireland.

* Illustrated by a so-called "back view" of the carapace. This and other "back views" of carapaces among Dr. Richter's figures are not clear to me; and I wait for a fuller description of these species. Figs. 36–38 illustrate a very curious form, "*Cypridina calcarata*" (p. 37), which, possibly a link between *Cyprella* and *Entomis*, requires further examination.

11. *Entomis aciculata*, Jones, MS. 1871.

Entomis aciculata, Jones, MS. 1871 (Mr. D. J. Brown's Collection. See Rep. Brit. Assoc. Edinburgh, 1871, Trans. Sect. p. 93).

Upper Silurian : Pentland Hills, Scotland.

12. *Entomis dimidiata*, Barrande, 1872.

Entomis dimidiata, Barrande, 1872. Crust. Poiss. Sil. Bohême (Extrait &c.), p. 41; Syst. Sil. Bohême, vol. i., Suppl. p. 513, pl. 24. figs. 7–9.

Upper Silurian; Stages III. E e 2, F f 2, G g 1 : Bohemia.

13. *Entomis migrans*, Barr. 1872.

Entomis migrans, Barr. 1872. *Ibid.* p. 514, pl. 24. figs. 10–14, & pl. 27. fig. 22.

Upper Silurian; Colony in D d 5, and E e 1, E e 2 : Bohemia.

14. *Entomis pelagica*, Barr. 1872.

Entomis pelagica, Barr. 1872. *Ibid.* p. 515, pl. 24. figs. 1–6.

Upper Silurian; Stage F f 2 : Bohemia.

15. *Entomis rara*, Barr. 1872.

Entomis rara, Barr. 1872. *Ibid.* p. 516, pl. 25. figs. 23, 24.

Lower Silurian; Stage D d 5 : Bohemia.

In the Carboniferous Limestone of Belgium *Entomis concentrica* (De Koninck) is a characteristic fossil. In the same great geological formation in the British Islands four species have been met with by Mr. Joseph Wright, F.G.S., and Mr. J. H. Burrow, M.A. *Entomis biconcentrica* from Little Island, Cork, Ireland, has been already noticed; another, *E. obscura*, Jones & Kirkby MS., from the same locality and from the North of England, and two from Settle in Yorkshire, *E. Burrovii* and *E. Koninckiana*, J. & K. MS., have yet to be described.

II. Entomidella, gen. nov.

In 1861 the genus *Entomis* was intended to include *E. divisa*, in which the nuchal furrow, altogether crossing the valves, divides off the anterior moiety. But it is now proposed to make a distinct generic group, Entomidella, for *E. divisa* and *E. buprestis*, in which the furrow is continued across the valve, and no tubercle is present.

1. *Entomidella divisa*, Jones.

Entomis divisa, Jones, 1861. Mem. Geol. Surv. Gt. Brit., Edinburgh

(Map 32), p. 137; 1870. Month. Microsc. Journ. vol. iv. p. 185, pl. 61. fig. 12.

Upper Silurian: Builth and Ludford.

2. *Entomidella buprestis* (Salter).

Leperditia buprestis, Salter, 1866. Rep. Brit. Assoc. p. 285.
Leperditia? punctatissima, Salter, Siluria, 1867, Appendix, p. 519.
Entomis buprestis, Jones, 1872. Quart. Journ. Geol. Soc. vol. xxviii. p. 183, pl. 5. fig. 15.

Menevian: St. David's, Wales.

On account of their extremely developed nuchal furrow, *Entomis* and *Entomidella* stand apart from the other known Ostracoda, recent and fossil, and may be grouped in a family as ENTOMIDIDÆ.

In an undescribed bivalved Entomostracon (*Sulcuna*, gen. nov., with two species, from the Carboniferous Limestone of Cork, Ireland) the nuchal sulcus, passing very obliquely downwards and forwards, is so well defined as to cut off the antero-dorsal region of each valve, and raises it into a hump or a sharp process, pointing upwards and backwards. This genus, however, cannot be allied to *Entomis*; for it presents evidence of the Cypridinal notch on the anterior margin, and is far more closely related to *Cypridella*.

XLVII.—*Contribution to our Knowledge of* Ceratophrys *and* Megalophrys. By Dr. ALBERT GÜNTHER, F.R.S.

Ceratophrys Fryi.

No bony dorsal shield. Skin densely covered with small tubercles unequal in size; the two dorsal lines of tubercles, which are so conspicuous in *C. Boiei*, are absent on the anterior and middle portions of the back, but represented by two short series commencing in the sacral region and converging into a point above the vent. Supraciliary horn long and pointed. The upperside of the head deeply concave, bordered on each side by a blunt-edged ridge terminating on the occiput, and in front by a rough prominent crest running from the eye to the nostril. Tympanum not visible. The vomerine teeth stand on a rather long transverse ridge slightly interrupted in the middle, between the choanæ. Tongue much smaller than in *C. Boiei*, not covering the bottom of the buccal cavity. Digits rather long, with the tubercles on the lower side much developed; carpus with three ovate flattish tubercles, the middle of which is a little larger than the outer. Metatarsal tubercle long, as long as its distance from the end of the inner toe; third toe rather longer than fifth. Web between the toes very short, but conspicuous.

Upper parts brown, indistinctly marbled with darker. The upperside of the snout milk-white, the boundary between the brown and white being marked by a black line. Lower parts white, with irregular brownish-black spots.

	lines.
Length of the body	35
Width between the angles of the mouth	16
Length of fore leg	23
,, first finger	$4\frac{1}{3}$
,, second finger	$3\frac{3}{4}$
,, third finger	$5\frac{1}{2}$
,, hind leg	40
Distance between heel and end of fourth toe	18
Length of metatarsal tubercle	$2\frac{1}{4}$

A female of this fine species, from the Serra de Mantiqueira, Minas Geraes, has been presented to the British Museum by A. Fry, Esq., a gentleman who has contributed numerous valuable specimens from Brazil to the National Collection.

Ceratophrys appendiculata.

Allied to *C. Boiei*; but the upper parts are covered with skinny appendages instead of with tubercles, and the snout terminates in a triangular flap. A pair of prominent glandular ridges on the back, running from the long supraciliary horns to the vent; a similar transverse ridge between the two horns. Snout more depressed than in the other species, and crown of the head but slightly concave. Tympanum not visible. Vomerine teeth on two short prominences between the choanæ. Tongue not covering the bottom of the buccal cavity. The two outer carpal tubercles very small, much smaller than the inner; metatarsal tubercle long, nearly as long as its distance from the inner toe. Third toe rather longer than fifth. Web between the toes very short.

Upper parts greyish, with symmetrical brown markings; throat brown; lower parts densely speckled with brown.

	lines.
Length of the body	25
Width between the angles of the mouth	13
Length of fore leg	17
,, hind leg	33
Distance between heel and end of fourth toe	15

One male specimen; purchased. It is from Brazil, but it could not be ascertained from what part.

Megalophrys montana and *Megalophrys nasuta.*

At the time of the publication of the 'Reptiles of British India' (1864) I had seven examples for examination. Three of them were provided with a rostral appendage, and consequently belonged to "*Ceratophrys nasuta* of Schlegel;" they were *males*. The four others had no such appendage, and proved to be *females*. In this curious coincidence some excuse may be found for my drawing the inference that these examples, so extremely similar to one another in other respects, were of the same species, and that the rostral appendage was a secondary sexual character peculiar to the male (Rept. B. Ind. p. 413).

However, in the course of last month the British Museum received three additional examples, every one of which shows that I have fallen into an error. Two of them (larger than any example I had previously seen, the body being 5 inches long), from Matang in Borneo, have a well-developed rostral appendage, but they are females. The other (probably from Java) is a male and lacks the appendage.

Therefore there can be no further doubt that there exist in reality two species of *Megalophrys* with a somewhat singular distribution; for whilst *M. nasuta* appears to be rather common in Borneo, the Malayan peninsula, and Sumatra, *M. montana* is limited to Java and Ceylon.

I regret to have fallen into this error, the more so as Mr. Darwin, whose attention I had directed to *Megalophrys*, has referred to these frogs in his 'Descent of Man,' 1871, ii. p. 26, and figured the heads of the two species as those of the male and female of the same animal.

XLVIII.—*Note on the Discovery of* Ligidium agile, *Persoon* (=Zia Saundersii, *Stebbing*), *in Great Britain.* By the Rev. A. M. Norman, M.A.

The Crustacean which Mr. Stebbing has described in the 'Annals' for April, p. 286, under the name *Zia Saundersii*, and which was found by him near Copthorn Common, is a well-known European species, which it is astonishing that Mr. Spence Bate, to whom it would appear that it was submitted, should not have immediately recognized. It is an interesting addition to our Crustacean fauna.

The Rev. T. R. R. Stebbing quotes the following words from Spence Bate and Westwood's 'British Sessile-eyed Crustacea' with reference to the genus *Philoscia*:—"It is a curious circumstance that the animals of this genus, common as they are, and well described by Latreille and Zaddach, should have been unknown to Brandt, Lereboullet, and Milne-Edwards, who have affirmed that the genus ought to be re-united to *Oniscus*, whereas it is in fact more nearly allied in several respects to *Ligia*. The typical species appears to have been figured by Koch under the name of *Ligia melanocephala*, which in his generic table he subsequently altered into the generic name of *Zia*, giving, however, fifteen joints to the antennæ, the flagellum being represented as composed of ten articulations."

Now, while the authors to whom Spence Bate and Westwood refer were undoubtedly wrong in mistaking a certain species of *Oniscus* for the genus *Philoscia*, Bate and Westwood have themselves fallen into as serious an error in merging *Zia*, with its fifteen-jointed antennæ and other strongly marked characters, with *Philoscia*. The genus *Zia* of Koch is synonymous with the previously described genus *Ligidium*, Brandt; and our recently discovered British Crustacean is the typical species, the *Ligidium Persooni*, Brandt, the specific name of which must, however, yield to the prior appellation of Persoon himself, and the Oniscoid must bear the name of *Ligidium agile* (Persoon).

Mr. Stebbing's woodcut is very characteristic, and agrees very closely with the admirable figures of Lereboullet.

The following is the complete synonymy of the species as far as it is known to me. As here in the country I have no means of referring to such works as are not in my own library, I am unable personally to verify four of the references, namely those to Koch, Panzer, Brandt, and Cuvier, the first of which I quote on the authority of Budde-Lund in his 'Danmarks Isopode Landkrebsdyr,' and the last three on the authority of Lereboullet. Zaddach gives *Zia melanocephala*, Koch, as a synonym, and adds "*Zia paludicola* et *Zia agilis*, quas Koch describit, varietates tantum hujus speciei esse videntur."

Ligidium agile (Persoon).

Oniscus agilis, Persoon; Panzer, Faun. Germ. fasc. ix. fig. 24.

Oniscus hypnorum, Cuvier, Journ. d'Hist. Nat. vol. ii. p. 19, pl. xxvi. figs. 3–5; Fabricius, Syst. Entom. Suppl. p. 300.

Ligia hypnorum, Latreille, Gen. Crust. et Insect. vol. i. p. 68, Hist. Nat. des Crust. et Insect. vol. vii. p. 51; Bosc (edit. Desmarest), Hist. Nat. des Crust. vol. ii. p. 179; Desmarest, Consid. Gén. sur la Classe des Crust. p. 318; Lucas, Hist. Nat. des Crust. p. 263.

Lygidium Persooni, Brandt, Conspectus Crust. Onisc. p. 174; Milne-Edwards, Hist. Nat. des Crust. vol. iii. p. 158; Lereboullet, Mém. sur les Cloportides, p. 14, pl. i. fig. 1, & pl. ii. figs. 20–31; Johnsson,

Synop. Frams. af Sveriges Oniscider (1858), p. 10; Zaddach, Synop. Crust. Prussic. Prod. p. 17; Frič, Die Krustenthiere Böhmens (1872), p. 256.
Zia agilis, Koch, Deutschl. Crust. xxxiv. f. 22, 23.
Ligidium {*hypnorum*, Budde-Lund, Naturhistorisk Tidsskrift, 1871, p. 226.
Zia Saundersii, Stebbing, Ann. & Mag. Nat. Hist. 1873, ser. 4. vol. xi. p. 286.

Ligidium agile has a wide European distribution, and has been found in Sweden, Denmark, Prussia, Bohemia, and France. It might therefore have been expected to be found in Great Britain, especially as Latreille's specimens had been received from the shores of the British Channel ("Habitat in littoribus Oceani Britannici, ab entomologo Brébisson mihi transmissus").

The relationship of the species to *Ligia* rather than to *Oniscus* was first pointed out by Fabricius, who, in his 'Suppl. Entom. Syst.,' though he assigns it to *Oniscus*, asks "An potius *Ligia*?"

As has been already mentioned, Koch described two other species, which, however, are perhaps mere varieties of *L. agile*. More recently Schöbel has described a form, under the name of *Ligidium amethistinum*, as distinct from *L. agile*. Perhaps this species also is destined hereafter to reward the careful search of some British carcinologist. Very little has as yet been done among our *land* Crustacea, my lamented friend Dr. Kinahan being the only British naturalist who has paid any attention to the Isopoda Aërospirantia.

XLIX.—*On the* Calcispongiæ, *their Position in the Animal Kingdom, and their Relation to the Theory of Descendence.* By Professor Ernst Häckel.

[Continued from p. 262.]

II. The Calcispongiæ and the Theory of Descendence.

1. *Principles of Classification.*

The task which we had set before us as the primary object in this monograph of the Calcispongiæ, *the analytical solution of the problem of the origin of species*, has been followed out in different ways in the first and second volumes. In the first volume, and especially in its second section, the "Morphology of the Calcispongiæ," I have endeavoured to describe all the characters of form occurring in this group in their general connexion, and to explain the perfect "unity of their plan of structure" by the *common descent of all Calcispongiæ from the Olynthus.* In the second volume, on the other hand, I have sought to demonstrate the stock-relationship of all the forms of this group by subjecting the species of Calcispongiæ to the most exact anatomical analysis; in doing which I found myself compelled, in opposition to the existing rules of classification, to set side by side two perfectly different systems, a natural and an artificial one.

The principles of classification which I have followed will manifest themselves to the thoughtful reader from a comparative study of the two systems. The *natural system* is "carried out in accordance with the phylogenetic principles of the theory of descendence, with an average extension of the idea of species." It contains 21 genera with 111 species. The *artificial system* is "carried out in accordance with the principles hitherto followed in the classification of the sponges, with an average extension of the idea of species." It includes 39 genera with 289 species.

The logical principles upon which the artificial system is founded are quite different from the genealogical principles upon which the natural system rests. The former takes into consideration especially the products of *adaptation*, the latter the constancy of *inheritance*. The artificial system furnishes as definite a distinction as possible, and a summary arrangement of the various forms founded on those characters which strike one as specific characters on a logical comparison merely directed to the *external* morphological connexion of the forms. The natural system, on the contrary, strives after the more profound recognition of their *internal* morphological connexion, and seeks, in accordance with this, to approach the genealogical tree of the species. As a matter of course, this object will never be completely attained among the sponges, any more than with other organisms, for the simple reason that the three great documents of the natural history of Creation (Comparative Anatomy, Ontogeny, and Palæontology) are accessible to us only in imperfect fragments. Nevertheless, by continued phylogenetic attempts, the natural system will gradually approach more and more to the true genealogical tree.

How far this approximation has been successful in the natural system of the Calcispongiæ, the thoughtful reader will best see by the study of the second volume, and especially from the estimation of the generic and specific, connective and transitory varieties. The approximation to the true genealogical tree is more possible than with other groups of organisms, because the conditions of *inheritance* and *adaptation* may be unusually clearly reviewed in the Calcispongiæ. The part taken by these two formative functions in the production of the individual form may be here determined more accurately and certainly than is usually the case.

2. *Idea and Descendence of Species.*

The idea of the species is the central point of attack of the theory of descendence, and the true nucleus of all discussions on "development or creation." To investigate this idea again here would be completely superfluous. I have explained my views upon it in such detail in my criticism of the morphological, physiological, and genealogical idea of species in my 'General Morphology' (Bd. ii. pp. 323–364) that I should merely have to repeat what I have there said. All attempts up to this time to give the idea of the species a decided limit and contents have failed, and by this negative result itself have led to the conviction that the positive idea sought for cannot be defined. The genealogical definition of the idea attempted by me is just as unsatisfactory and untenable as all the rest. This lies in the nature of the thing. The species is just as arbitrary an *abstraction* produced by the subjective contemplation of the author, just as much a category of only relative significance, as the ideas of the variety, genus, family, &c. All these categories have their value only in their reciprocal relations to one another, and owe their origin to the *subjective law of specification* (*l. c.* p. 331).

Moreover we have only to glance at the practice in zoological and botanical classification to be convinced that the *practical distinction of species has nothing at all to do with all these theoretical definitions of the idea of species.* On the contrary there prevails in that distinction the greatest subjective arbitrariness, and hence an endless dispute between the various systematists. No two systematists, who have thoroughly worked upon the same group of forms, have ever yet agreed perfectly as to the number and limitation of the species united in it.

In the Calcispongiæ the practical distinction of species is subject to much greater difficulties than in most other groups of animals. According as the systematist conceives the idea of the species in a wider or narrower form, according as he estimates most highly the principles of the artificial or the natural system, he may considerably increase or diminish the number of 21 genera and 111 species of the natural system which are described in the first section of my second volume. The *natural system* might, for example, be founded upon any one of the following six conceptions:—A. 1 genus with 1 species; B. 1 genus with 3 species; C. 3 genera with 21 species; D. 21 genera with 111 species; E. 43 genera with 181 species; F. 43 genera with 289 species. On the other hand the *artificial system* might experience the following six arrangements:—G. 1 genus with 7 species; H. 2 genera with 19 species; I. 7 genera with 39 species; K. 19 genera with 181 species; L. 39 genera with 289 species; M. 113 genera with 591 species. Every one of these twelve systems might cite in its support arguments such as every systematist brings forward in favour of his subjective conception. None of them, however, could ever be demonstrated as the absolutely true system. This circumstance shows most clearly that no absolute species exists, and that species and variety cannot be sharply separated *.

3. *Generic and Specific, Connective and Transitory Varieties.*

The different forms which I have cited in the system of the Calcispongiæ as generic and specific, connective and transitory

* The twelve systems here cited as examples (in which, moreover, the external form is not taken into consideration) would be as follows:—

A. I. Natural system with the widest conception of the idea of species (in the first degree): a single genus with one species, *Calcispongia grantia.*

B. II. Natural system with a very wide extension of the idea of species (in the second degree): a single genus with three species: 1. *Calcispongia ascon*, 2. *C. leucon*, 3. *C. sycon.*

C. III. Natural system with a narrower conception of the idea of species (in the third degree): 3 genera (*Ascon*, *Leucon*, *Sycon*) with 21 species. Here the 21 groups of forms which the next system accepts as genera (*Ascetta*, *Leucetta*, *Sycetta*, &c.) are reckoned as species.

D. IV. Natural system with average extension of the idea of species (in the fourth degree): three families (*Ascones*, *Leucones*, *Sycones*) with 21 genera and 111 species.

E. V. Natural system with a narrower extension of the idea of species (in the fifth degree): 3 families with 43 genera and 181 species. This system is attained when the subgenera cited in the natural system in the second volume are accepted as "good genera," and the "specific varieties" or incipient species as "good species." Their characters are sufficiently sharply marked and relatively constant.

F. VI. Natural system with a very narrow extension of the idea of species (in the sixth degree): 3 orders, with 21 families, 43 genera, and 289 species. This system is attained by a further analytical specification of the fifth system, the "generic varieties" of the latter being raised to the value of distinct species.

G. VII. Artificial system with the widest conception of the idea of species (in the first degree): all Calcispongiæ form a single genus, *Grantia* (Fleming, 1828), or *Leucalia* (Grant, 1829), or *Calcispongia* (Blainville, 1834). We may then distinguish the following as seven species:—1. *Calcispongia dorograntia*; 2. *C. cystograntia*; 3. *C. cormograntia*; 4. *C. cœnograntia*; 5. *C. tarrograntia*; 6. *C. cophograntia*; 7. *C. metrograntia.*

varieties, are of the greatest importance to the theory of descendence and the object of this monograph, namely to ascertain analytically the origin of species as exemplified by a single group. The thoughtful and unprejudiced systematist, who has followed carefully the method of classification followed by me in the second volume, will comprehend without further explanation the extraordinary phylogenetic importance of these four different varieties. I may, however briefly sum up the most important points connected with them.

1. The *generic varieties* of the natural system are the *genera of the artificial system.* Within one and the same natural species many different forms may be developed by multifarious stock-formation and mouth-formation; and these the artificial system (having no knowledge of their close genealogical connexion) must regard unconditionally as representatives not only of distinct species but even of distinct genera. Thus, for example, *Ascandra variabilis* includes forms which the artificial system would divide among eleven different genera;

H. VIII. Artificial system with a very wide extension of the idea of species (in the second degree): 2 genera with 19 species, namely:—I. Monograntia, with 6 solitary species: 1. *M. olynthus*; 2. *M. disycus*; 3. *M. sycurus*; 4. *M. clistolynthus*; 5. *M. lipostomella*; 6. *M. sycocystis*: II. Polygrantia, with 13 social species, namely: 1. *P. soleniscus*; 2. *P. amphoriscus*; 3. *P. sycothamnus*; 4. *P. nardosus*; 5. *P. cœnostomus*; 6. *P. tarrus*; 7. *P. artynas*; 8. *P. auloplegma*; 9. *P. aphroceras*; 10. *P. sycophyllum*; 11. *P. ascometra*; 12. *P. leucometra*; 13. *P. sycometra.*

I. IX. Artificial system with a narrower extension of the idea of species (in the third degree): 7 genera with 39 species. The genera would be:—1. *Dorograntia*; 2. *Cystograntia*; 3. *Cormograntia*; 4. *Cœnograntia*; 5. *Tarrograntia*; 6. *Cophograntia*; 7. *Metrograntia.* The 39 species would be represented by the 39 forms which are cited as genera in the artificial system in the second volume. Thus, for example, the second genus (*Cystograntia*) would contain three species:—1. *C. clistolynthus*; 2. *C. lipostomella*; and 3. *C. sycocystis.*

K. X. Artificial system with a still narrower extension of the idea of species (in the fourth degree): 7 families, with 19 genera and 181 species. The 7 genera of the ninth system are here raised to the rank of families, and the 19 species of the eighth system to that of genera; and the 181 species are the same that in the fifth system were divided into 43 essentially distinct genera.

L. XI. Artificial system with an average extension of the idea of species (in the fifth degree): 7 orders, with 19 families, 39 genera, and 289 species. This system is carried out in the second section of the second volume on the principles hitherto followed in the classification of sponges.

M. XII. Artificial system with a very narrow extension of the idea of species (in the sixth degree): 7 orders, with 19 families, 113 genera, and 591 species. Here those groups of forms are regarded as genera which in the eleventh system had only the rank of subgenera (*Olynthettus*, *Dyssycettus*, *Sycurettus*, &c.), and as species those forms which figure in the eleventh system as subspecies.

Leucetta primigenia represents seven different genera of the artificial system; and *Sycandra compressa* furnishes the artificial system with no fewer than nine distinct genera.

2. The *specific varieties* of the natural system are *incipient species of the natural system* in the sense of the theory of descendence. By further development and increasing constancy of the characters by which the specific varieties of a natural species are distinguished they would raise themselves to the rank of "*bonæ species.*" An analytical system that takes a very narrow conception of the idea of species might already recognize them as species. Thus, for example: *Ascandra variabilis* would divide into four natural species (*A. cervicornis*, *confervicola*, *arachnoides*, and *hispidissima*); *Leucetta primigenia* would form three good species (*L. isoraphis*, *microraphis*, and *megaraphis*); and *Sycandra compressa* would even break up into six natural species (*S. foliacea*, *pennigera*, *clavigera*, *rhopalodes*, *lobata*, and *polymorpha*). Many of these specific varieties have, in fact, already been described as species.

3. The *connective varieties* of the natural system are *direct transition forms between the genera of the natural system.* The foundations of a new natural genus are laid by very trifling changes in the constitution of the skeleton. Thus, when certain triradiate spicules of the skeleton of *Ascetta* (*Leucetta* or *Sycetta*), which is composed only of triradiate spicules, develop a fourth ray, this genus passes into *Ascaltis* (*Leucaltis* or *Sycaltis*). For example:—*Ascandra variabilis* furnishes transition forms to four natural genera (*Ascaltis*, *Ascortis*, *Asculinus*, *Ascyssa*); *Leucetta primigenia* produces connective forms towards three genera of the natural system (*Leucaltis*, *Leucortis*, *Leucandra*); and *Sycandra compressa* passes into *Sycortis*.

4. The *transitory varieties* of the natural system are *direct transition forms between the species of the natural system.* They are the "transitions from one good species to another" which horrify the opponents of the theory of descendence. Such intermediate forms, the existence of which is denied by dogmatic species-makers, occur in abundance among the Calcispongiæ. Thus we have transitions from *Ascandra variabilis* to *A. pinus*, *A. Lieberkühnii*, and *A. complicata*; transitory intermediate forms between *Leucetta primigenia* and *L. pandora* and *sagittata*; and direct transitions from *Sycandra compressa* to *S. utriculus* and *lingua*.

4. *Polymorphosis and Polymorphism.*

One of the most remarkable peculiarities of the Calcispongiæ, by which they are most strikingly distinguished from most other organisms, is *the extraordinary instability of the outer form of the body*. It is this that renders their study so instructive in connexion with the problem of species. Every systematist knows how great and decisive is the significance of the external form in the distinction of species in almost every class of animals; indeed the great majority of species are distinguished merely by more or less important differences in the details of the external form. In complete opposition to this, the external form in the Sponges, and especially in the Calcispongiæ, is so variable that it cannot be employed at all for characterizing species, either in the natural or the artificial system. What I have observed in this respect among the Calcispongiæ exceeds all previous conceptions, and goes much further than the wonderful variability of the external form in the Fibrospongiæ, which have been indicated as quite extraordinary by all recent spongologists, especially Oscar Schmidt. A systematist who should adopt the external form alone as a specific character in the case of *Ascandra variabilis*, *Leucetta primigenia*, or *Sycandra compressa* might at his pleasure distinguish among the individuals of any one of these extremely variable species from a single locality ten, twenty, or more than a hundred species.

It may perhaps seem still more remarkable that this excessive instability affects even the most important organs, such as the stomachal cavity and the mouth. In very many natural species we find side by side individuals with and without a mouth. Among the Fibrospongiæ also the loss of both mouth and stomach appears to be very frequent. This singular phenomenon is probably to be explained by the fact that in the Sponges (as in the parasitic worms, Crustacea, &c.) the mouth-opening does not possess the same physiological importance as in the higher animals. It becomes rudimentary and is finally lost (Cestodea, Rhizocephala, lipogastric Sponges). The quadruply different nature of the mouth in the Calcispongiæ is also very variable.

I have particularly described this remarkable multiformity of the species of Calcispongiæ in the second volume, and elucidated it by many figures. In the explanation of the plates it is called *polymorphosis*, in contradistinction to the well-known *polymorphism* of the Siphonophora and of many of the higher animals. The latter is well known to be a product of physiological division of labour. *Polymorphosis*, on the contrary, is a *polymorphism without division of labour*; its cause is to be sought merely in adaptations to external conditions of existence of quite subordinate importance.

The most remarkable form of polymorphosis among the Calcispongiæ is *the union of polymorphotic persons upon one stock*, which I have called *metrocormism*. In the artificial system these *metrocormotic Calcispongiæ* form the order of the Metrograntiæ (*Ascometra*, *Leucometra*, *Sycometra*). Forms which the artificial system regards as representatives of different genera and species here grow united upon a single stock. This fact is quite irreconcilable with the species-dogma.

5. *Causes of the Production of Form.*

Besides the great interest which the biology of the Calcispongiæ possesses in connexion with the theory of descendence and the critical conception of the organic species, it is also of extraordinary general significance, because in this small and simply constructed group of animals *the true causes of biological phenomena*, and especially the causes of the production of form, may be reviewed with particular clearness and recognized with particular certainty. These causes prove throughout to be *purely mechanical unintelligent causes* (*causæ efficientes*), while we seek in vain for any *designedly active intelligent causes* (*causæ finales*).

If we briefly sum up the most essential points relating to this matter, we arrive at the following results:—

1. *The general external form of the Calcispongiæ, both that of the social stocks and that of the individual persons, is a product of growth* which is principally governed by *adaptation to the external conditions of existence* of the locality and surroundings; the mode of growth is only to the smallest extent inherited within the species. The same applies to the quadruply different *formation of the mouth* in the persons.

2. The triply different *structure of the wall of the stomach* by which the three natural families are distinguished is in part a product of *inheritance* and in part of *adaptation*. The original structure of the wall of the stomach, as it occurs in the *Ascones*, is inherited from *Olynthus*, the stock-form of all Calcispongiæ: *Olynthus*, however, inherited it from the *Archispongia*, the latter from the *Protascus*, and this from the *Gastræa*. The structure of the wall of the stomach in the *Leucones* has been produced from that of *Olynthus* by growth of the exoderm and stabilization and ramification of the inconstant pores, and the structure in the *Sycones* by strobiloid budding.

3. The multifarious other characters of the *gastro-canal system* are mere products of special adaptations, in which the *flow of water* is especially effective; this, again, is dependent on the movement of the flagella of the cells of the entoderm.

4. The extremely remarkable conditions of the *intercanal system* are brought about merely by *concrescence.* By this purely mechanical process of growth very complicated and characteristic stock-forms and personal forms are produced, in which *enclosed portions of the sea become constituent organs of the organism.*

5. The exceedingly characteristic primary *form of the calcareous spicula* is a purely mechanical product of two co-operating factors, the *capacity for crystallization of calc-spar* and the *secretory activity of the sarcodine.* In the production of the secondary forms of spicules the formative current of water and adaptation to other, more subordinate, external conditions of existence are effective.

6. The orderly, often very regular, elegant, and apparently artificial *constitution of the skeletal system* is for the most part a *direct product of the current of water*; the characteristic position of the spicules is produced by the constant direction of the current of water; to a very small extent it is the consequence of adaptations to subordinate external conditions of existence.

7. *All other characters of form* which might come into consideration here may be referred to the formative activity of the *cells* of which the two constituent lamellæ of the sponge-body, the *entoderm* and the *exoderm*, are composed; but these are inherited from the *Protascus*, and further from the *Gastræa.* The *motile phenomena* of these cells are particularly efficacious in this respect—on the one hand the *amœboid movement*, and on the other the *flagellar movement*, which is to be referred to the latter.

8. The special properties of these cells in the Calcispongiæ are due to the *chemical composition* of their body—of the protoplasm on the one hand and of the nucleus on the other. Of these two constituents of the cell, the *protoplasm* is especially to be regarded as the *biorgan of adaptation*, and the nucleus as the *biorgan of inheritance.*

9. The (chemical) properties of the two albuminoid compounds which form the *protoplasm* and the *nucleus* are to be referred to the *peculiar affinities of carbon.* Originally they were active in the simplest manner in the constitution of the *plasson* which formed the entire body of the simplest *Moneron.* From this was produced, only by *adaptation* (differentiation of the plasson into nucleus and protoplasm), the first cell, an *Amœba.* This is recapitulated, in accordance with the biogenetic fundamental law, by the ovicell. The specific properties which the ovicell of the Calcispongiæ possesses were acquired by it *by inheritance* from the most ancient *Olynthus.*

6. *The Calcispongiæ and Monism.*

The most general results furnished by the present monograph of the Calcispongiæ are of a purely philosophical nature, and may be summed up in the statement that *the biogeny of the Calcispongiæ is a coherent proof of the truth of monism.* In my 'General Morphology' I sought to demonstrate synthetically that all the phenomena of the organic world of forms can be explained and understood only by the monistic philosophy; and now this demonstration is furnished *analytically* by the morphology of the Calcispongiæ. The great contradictions of the philosophical conceptions of the world, or between *monism* or the *mechanical* and *dualism* or the *teleological* conception of nature, which are rendered evident by every consistent reflection, may be tested in detail in the biology of the Calcispongiæ; and every examination turns out favourable to the former and disadvantageous to the latter.

All the phenomena met with in the morphology of the Calcispongiæ may be completely explained by the reciprocal action of two physiological functions, *inheritance* and *adaptation*; and we need no other causes to comprehend their production. All the causes which are found to be effective in the morphology and physiology of the Calcispongiæ are unintelligent mechanical causes (*causæ efficientes*); and nowhere do we meet with intelligent designedly active causes (*causæ finales*). Everywhere we can detect the prevalence of unalterable natural laws, nowhere the interposition of a preconceived plan of creation.

It might appear that in the form-production of the Calcispongiæ *every thing depended upon chance.* But *chance* no more exists in nature than *design* or *freedom.* All processes are performed with absolute necessity, as the complex result of the coincidence of numerous causes, each of which is of purely mechanical nature, and itself again conditioned by more distant *causæ efficientes.* What we call *chance* is merely the coincidence, unexpected by us, of circumstances each of which is finally brought about with absolute necessity by a chain of efficient causes.

As all the phenomena presented to us by the biology of the Calcispongiæ may be perfectly understood by the theory of evolution, as a matter of course all assumption of a creation is completely excluded in this department. But as the body of the Calcispongiæ in the developmental stage of the *Gastrula* already consists of the same two germ-lamellæ which compose the body of man and of all the higher animals at an early period of embryonic development, we must consistently assume the same mechanical development for man also. This indication shows in the clearest manner the high importance of the Calcispongiæ for the monistic philosophy.

L.—*Observations on Pigs* (Sus, *Linnæus*; Setifera, *Illiger*) *and their Skulls, with the Description of a new Species.* By Dr. J. E. Gray, F.R.S. &c.

The Pigs (*Setigera*) are a well-marked group, which have been recognized from the earliest times and are distinguished by the least-informed persons. They may almost be considered the best and most anciently known thick-skinned Mammalia, or *Belluæ* of Linnæus, or *Multungula* of Illiger.

Some palæontologists, who have only a rudimentary knowledge of zoology and anatomy, and chiefly confine their attention to the imperfect skeletons found in a fossil state, have separated the Pigs from the other Belluæ or thick-hided Mammalia, with which they agree in all their chief external and internal characters, and placed them with the Ruminants, because they have four toes on their feet, and call them *Artiodactyla*—thus destroying a group which has been acknowledged by the Greek philosophers and by the Jewish historians, and by Ray, Cuvier, and, indeed, naturalists of all times, to combine them with a series of animals to which they have little or no affinity.

There can be no doubt that a group that has been so universally adopted as the Ruminants or Pecora should not be destroyed without very weighty reasons and on account of most important characters; and I think that every one must allow that the habit of ruminating their food, and their strictly herbivorous diet, are much more important characters than the mere fact of the animals having four toes, and constitute a good reason for not placing with them in one group animals that do not ruminate, have a quite different dentition, live on a heterogeneous diet, and have entirely different habits, fighting with tusks instead of horns. This union is only to be compared to the separation of Marsupials from the other Mammalia on account of a character that can only be observed during parturition, and which no doubt is of the greatest importance to the physiologist, but is scarcely recognizable by the zoologist.

The palæontologists, in choosing to use the group Artiodactyla for the Ruminants and some of the Belluæ with four toes, have not only destroyed a well-established group, but they have separated the Pigs and Hippopotami from their real affinities to unite them to the Pecora by a character of comparatively little importance, and one which varies in almost all the groups that they refer to it, to define which they have been obliged to separate as two distinct suborders the Hyraces and the Elephant (Hyracoidea and Proboscidea) from the Ungulata, which are as truly Belluæ or thick-skinned animals as any of the rest, and are at once known as such by any person who has an eye to the natural grouping of Mammalia.

The division of the hoofed animals (Ungulata) into the Artiodactyla and the Perissodactyla has been regarded by many as an important discovery, especially by certain palæontologists; but if they had taken the trouble to read the history of zoology they would find that these terms are only Greek names for groups recognized and named in Latin by Ray, Latreille, and others.

It is amusing but sad to see the various explanations and the different theories which are put forth to make the tapirs, that have four toes before and three behind, and the horse, that has only one toe, odd-toed Ungulates or Perissodactyla, like the rhinoceros, that has only three toes on each foot; and they have been obliged to put *Hyrax* and the elephant into a separate order, because it is rather difficult to explain into which it ought to go (see Flower's 'Osteol. Mam.' pp. 264–267, figs. 90–98).

At the same time I do not at all underrate the importance of observing the structure and proportion of parts in the arrangement and definition of the minor groups. Thus it would appear that the equality of the two middle toes, which represent the middle and ring fingers of the human hand, is an important character in the Pecora or ruminant animals, and in the pigs (Setifera) and the Obesa (Hippopotami); while the greater length and thickness of the middle toe, representing the middle finger of the human hand, makes a modification in the form of the feet of these animals—especially as this toe is always present, while one or more of the side toes may be rudimentary or entirely absent, as may be expressed in the following table:—

	Toes of fore feet.	Toes of hind feet.
Elephas	1, 2, 3, 4, 5.	1, 2, 3, 4, 5.
Hyrax	0, 2, 3, 4, 5.	0, 2, 3, 4, 0.
Tapirus	0, 2, 3, 4, 5.	0, 2, 3, 4, 0.
Rhinoceros	0, 2, 3, 4, 0.	0, 2, 3, 4, 0.
Equus	0, 0, 3, 0, 0.	0, 0, 3, 0, 0.

Sometimes, as in the elephant, the middle toe is very little longer than the rest.

The name *Perissodactyla* has been given to the three latter genera; but I cannot conceive a slight difference in the proportion of these toes to be of ordinal importance. It is no doubt an important character in the definition of minor groups, but scarcely of higher importance, as having little influence on the habits and manners of the animals, and as separating groups nearly allied to each other and having the same habits and appearance.

Artiodactyla and Perissodactyla are very good technical terms to define that form of the feet in which the middle finger is longer and thicker, and that in which the middle and ring fingers are equally thick—just as one might apply Chirodactyla to those animals that have the thumb-like great toe larger than the rest, and Ptychodactyla to those that have the outer and inner toes longer and stronger than the intermediate three, as in the hind feet of the seals.

The real fact is that each group of animals has a peculiar kind of foot, that will not bend itself to human systems without being distorted to suit their authors' views or theories. I think it is much better to take the facts as they are, and admit that in the bones of the feet, as in all other parts of the body, there is a network of affinities, not in a single line, but in various directions.

SETIGERA.

Section A. Homodontina. *The premolars permanent, forming with the molars a continuous series; molars solid, with a tubercular crown.*

Subsection 1. Pseudoperissodactyla. *Hinder feet with three toes; the short external lateral toe of the hind feet wanting.* Western Hemisphere or America.

The two middle front toes of the fore and hind feet are of equal size, as in the pigs; and these animals are placed in the Artiodactyla, although they have an odd number of toes on the hind feet, which we are told are more to be depended upon than the front feet as giving a character of the group. It has been well observed that "the attempt to define these groups will break down with the increase of our knowledge of fossil forms," overlooking the fact that they did break down when the recent genera were properly studied. As regards number of toes they agree with the tapirs, which are referred to the Perissodactyla or odd-toed Ungulata.

True pigs are found in America, but only in a domestic or semidomestic state, having been introduced from Europe or Asia.

Family **Dicotylidæ**, Gray, Cat. B. M. p. 300.

The sides of the skulls are dilated and much expanded in front of the orbit as far as the zygomatic arch. Both the peccary or tajacu and the taguicati (or white-lipped peccary) are at birth of a pale brown colour, not striped; and the peccary has the white collar well marked in this stage, but it much sooner assumes its dark livery than the white-lipped peccary.

This family contains only two recent species, *Notophorus torquatus* and *Dicotyles labiatus.* The skulls of the two genera are very different, and are immediately known from one another—the skull of *Notophorus* having a groove of a vessel over the eye curved to the lateral margin, then bent back over the canines and continued to the end of the nose. In *Dicotyles labiatus* the groove of the vessel over the orbit is only continued to the lateral margin of the front of the zygomatic arch. It is to be observed that De Blainville, in his 'Ostéographie,' figures them both under the name of *Sus torquatus*, t. iii. & v.

Subsection 2. Artiodactyla. *Fore and hind feet with four toes; the lateral toe of each side much shorter.* The Eastern Hemisphere, or Europe, Asia, and Africa.

Family **Suidæ.**

Head conical. Upper canines of the males elongate and more or less recurved, and enclosed in a bony sheath at the base. Teeth 40–44; cutting-teeth $\frac{3.3}{3.3}$; premolars $\frac{3.3}{3.3}$ or $\frac{4.4}{4.4}$. Teats ten, rarely eight. Skull with the sides of the nose in front of the orbit more or less deeply concave. Tail elongate.

The males have a large thick canine and a longitudinal ridge over the sheath of its base; this ridge is wanting in the females.

The swine of the western hemisphere have four toes on the front and hind feet.

Tribe I. *Potamochœrina.*

Ears elongate, attenuated and pencilled at the end. The concavity in front of the orbit without any ridge on the lower part from the front of the zygomatic arch. The sheath of the upper canines expanded out, of the males largest and with a ridge across its upper surface, of the females often bent up at the outer margin.

1. Potamochœrus. Africa.

Tribe II. *Suina.*

Ears rounded, in the domestic state elongate, drooping, not pencilled at the end. The concavity in the skull in front of the orbit with a ridge on the lower part from the front of the zygomatic arch. Cutting-teeth $\frac{3.3}{3.3}$. The front grinders close to the back of the upper canine, which in the males is bent upwards and outwards. The sheath of the upper canine of the males is spread out, with a ridge or crest across its upper surface; that of the females is often slightly bent up at the end.

Wild Swine. Ears moderate, hairy.

1. Euhys.

Head elongate, twice as long as high at the occiput. Cheeks and throat covered with long projecting hairs. Lower canines of the males elongate, slender, convex on the sides and rounded in front. The front false grinders near the base of the canines separated from the other grinders by a rather broad diastema. Sheath of the upper canines in the males with an elongated ridge, which has a straight top.

Euhys barbatus.

Sus barbatus, Müller.

2. Aulacochœrus.

Head conical, about once and a half as long as high at the occiput. Male, the upper canines keeled in front with a very high keel across the base of the sheath; the lower canines triangular, flat on the sides, and keeled in front.

Aulacochœrus vittatus.

Head, body, and legs covered with black bristles; bristles of forehead and neck white-tipped; streak round angle of mouth and lower part of cheek white.

Sus vittatus, Müller.

3. Dasychœrus.

Head elongate conical, more than once and a half the length of its height at the occiput. Nose with a large flat-topped wart on each side over the angle of the mouth, with a tuft of elongate pale bristles on the lower part of each cheek. Males with a compressed ridge across the sheath of the upper canines; lower canines triangular, flat on the outer side and keeled in front. Black, with a tuft of yellow hair on each side of the jowl.

Dasychœrus verrucosus.

Head nearly twice as long as high at the occiput. Black, underside and front of thighs pale.

Sus verrucosus, Müller.

Dasychœrus celebensis.

Head about once and a half as long as high at the occiput. Animal black below.

4. Sus.

Head conical, about once and a half as long as high at the condyles, without any or only a very small wart on the side of the head. Ears ovate. The upper canines of the males recurved, with a more or less keeled ridge across the sheath at their base; lower canines of the males triangular, flat on the outer side, and keeled in front.

Sus scrofa.

Hab. Europe. And other species.

Sus mystaceus, n. sp.

Brown, with scattered black bristles on the muzzle, forehead, sides of cheek, and sides of body; crest and hinder part of body browner; streak on each side of nose and over angle of mouth elongate; whiskers (on the black cheeks), gullet, throat, chest, front of shoulders, thighs, and underside of body whitish.

Skull: concavity on the sides broad and deep, only separated from the orbits by a very narrow ridge; the sheath of the upper canines with a keeled ridge, and convex on the outside of it.

From the Zoological Gardens. Said to have come from Java; but I think that very doubtful. It is not like any of the animals described by the Dutch zoologists.

Domestic Swine. Ears more or less dependent, often very large.

Scrofa.

Scrofa domestica.

Centuriosus.

Centuriosus pliciceps.

Tribe III. *Babirussina.*

Ears rounded, not pencilled at the end. Cutting-teeth $\frac{2.2}{3.3}$; the front grinders separated from the upper canines by a long diastema. Upper and lower canines of the male much elongated and recurved; the sheath of the upper canines elongate, arising from the outer side of the margin of the upper jaw, and closely applied to, but separate from, the side of the nose, without any or only a very slight indication of a cross ridge; not developed in the females, and its usual situation indicated by a sharp-edged ridge just above the lower margin of the upper jaw in front of the grinders. The males have a deep concavity on each side of the roof of the hinder upper part of the inner nostrils; in the females this part is only slightly concave. I cannot find any exit from these pits, which are very deep.

Blainville figures the skeleton of a female and gives a cross section of its skull, and also the skull of a male. He represents the canine tooth of the female as just appearing out of a very short sheath on the side of the upper jaw, considerably above the lower edge. It probably may be the skeleton of a young male; at least the skull in the museum, said to be a female, does not show any indication of the canine.

The bullæ of the ears are oblong and elongate. No such concavity exists in the back of the nasal cavity in any of the pigs that I have examined; but there is a deep pit on each side of the centre of the hinder part of the nasal cavity in *Phacochœrus*, which is small in the young and larger in the more adult skulls. In the adult skulls there is a very deep concavity on each side of the roof of the inner nostrils in front of these pits, which are separated from each other by a thin, erect, longitudinal plate. These concavities are scarcely perceptible in the skulls of the very young animals.

The bullæ of the ears of the skulls of the very young *Phacochœrus* are large, nearly hemispherical, and very prominent; but in the adult skulls they are small and scarcely separated from the rest of the skull.

Babirussa.

Canines of the males elongate, convex at the sides, the lower ones rounded, scarcely keeled in front; of the females, wanting in the upper jaw, and only short, conical, and slightly recurved in the lower.

Babirussa alfurus.

The skulls of the adult males present two very distinct varieties. In one the upper and lower canines are very long and gradually arched; in the other the upper and lower canines are short, not more than three inches long, the upper ones being very much curved, sometimes nearly into a circle.

Section B. Eurodontina. *Premolars deciduous, their places being filled up by the development of the molars; molars formed of laminæ, many-rooted.*

Family **Phacochœridæ.**

Phacochœrus.

Zygomatic arch very broad, with only a very slight broad concavity in front of the orbit. Lower canines triangular; the upper canines bent upwards and outwards, very large and thick, with a ridge across their sheath as in the Suidæ, but in both sexes. Lower canines flat on the outer sides and keeled in front. The sheath of the upper canines with a very obscure ridge across the middle in skulls said to belong to the two sexes which were living in the Zoological Gardens. The sheath and upper canines of the females are rather smaller and more elongate than those of the males.

Phacochœrus æthiopicus.

Phacochœrus Æliani, Rüppell.

Phacochœrus Sclateri, Gray, Ann. & Mag. Nat. Hist. 1870.

Phacochœrus Æliani and *P. africanus*, Sclater.

Dr. Sclater described a young female African pig, with very small canines and small ovate ears with short hair, in the Zoological Gardens, as distinct from *P. æthiopicus*, under the name of *P. Æliani* (Proc. Zool. Soc. 1869, pp. 276, 277, fig. head, & t. xx. animal). In the 'List of Vertebrate Animals in the Zoological Gardens,' 1872, p. 83, the figure of the head is repeated as that of the young of "*P. africanus*, Gmelin," with the English name of "Ælian's Wart-hog." Gmelin established *Sus africanus* on the "Sanglier du Cap Vert" of Buffon (xiv. p. 209, xv. p. 148), and on the "Cape-Verd Hog" in Pennant's 'History of Quadrupeds,' vol. i. p. 146, which was established from Buffon's description and from a head in the Leverian Museum; and he adds to Buffon's description that the ears are "narrow, upright, pointed, and tufted with very long bristles." Buffon only describes the skull, tail, and hoofs of this animal, but says it has two teeth in the upper jaw, and says nothing about its ears.

The animal described and figured by Dr. Sclater is still living in the gardens, and no longer has small short canines; they have become elongate, conical, and bent upwards, like the canines of the female *Phacochœrus æthiopicus*, which, as Rüppell and Sundevall say and the specimen in the museum proves, are very like those of the male, only they are smaller and more elongate.

There is a skull of this pig in the British Museum from the Cape-Verd Islands, which is exactly like the skulls of the other *Phacochœrus æthiopicus.*

If the animal is to be distinguished from the common *Phacochœrus æthiopicus* by the small size and oval form of and short hair on its ears, it is not the Cape-Verd hog of Buffon and certainly not of Pennant, from which Gmelin described *Sus africanus.* Indeed it is very probable that the head which Pennant described from the Cape of Good Hope in the Leverian Museum, which he says has the ears "narrow, upright, pointed, and tufted with very long bristles," was the head of the common African pig (*Potamochœrus africanus*), peculiar for having "narrow elongate ears, with tufts at the end,"—and that his description is made up of two genera; for Buffon's description of the skull of the "Sanglier du Cap Vert" is evidently that of a *Phacochœrus*, and, I believe, of *P. æthiopicus* with broad hairy ears, because that animal always has two cutting-teeth in its upper jaw in the very young state, and there is no doubt that one or both drop out before the animal arrives at maturity, and their presence or absence is a mere accident, and not a specific character.

It cannot be Ælian's Phacochœre (*Phacochœrus Æliani* of Rüppell), as that was first described and figured as having (and the typical specimen that is in the British Museum has) large, broad, hairy ears, like the figure of the male given by Dr. Sclater as the type of *Phacochœrus æthiopicus.*

If the animal in the Zoological Gardens does not as it grows older have the ears become broader and more hairy, like the ears in the adult male and female *Phacochœrus æthiopicus*, it must be a distinct species, to which my name of *Phacochœrus Sclateri* will have to be given.

See Ann. & Mag. Nat. Hist. 1870, vi. pp. 189, 264, 455, and 1871, viii. p. 138. See also Proc. Zool. Soc. 1850, p. 78, t. xvii., where two young animals, then in the Zoological Gardens, from Natal, with small oval ears, are noticed and figured; they were said to be fifteen months old. But can these be the animals that were afterwards called in the Gardens *Phacochœrus æthiopicus*, and had large hairy ears?

LI.—*Note on the Appearance in Australia of the* Danais Archippus. By Frederick M'Coy, Professor of Natural Science in the Melbourne University, and Director of the National Museum of Victoria, &c.

This fine butterfly was sent to me about December 1870 from Lord Howe's Island, on the north-east coast of Australia, by a collector for the museum who was wrecked there; but as I had never seen it in any of the North-Australian, or Queensland, or New-South-Wales collections, and knew it to be an inhabitant of the Southern States of America, I suspected that the specimen might have been obtained from some collector on board some American ship in those seas. A few months after, a specimen was sent to me by a collector established on the Clarence River, in New South Wales, as something he had not seen before, and another friend fond of insects, travelling in the far north of the continent, also sent me an example as something strange. As there were no exact accounts of the actual capture of these specimens, I fancied they all might have come from some one American source, and paid little attention to the matter. On the last Sunday in April last (or about a year and five months after) I was walking in my garden at Brighton, a place on the sea-shore about eight miles south of Melbourne, and was astonished to see that a larger butterfly, with a more bat-like flight than any inhabitant of the colony, which attracted my attention amongst the flower-buds, was the *Danais Archippus*; and presently the two sexes were seen. Being Sunday they escaped; but next morning, going through the grounds of the University on the north side of Melbourne to the Museum to make the teeth water of my assistant (who had collected Lepidoptera for twenty years in Victoria) by mentioning what I had seen, I observed two more before me, and on going to my room found the collector in a great state of excitement at having caught one in my botanic garden in the University grounds, and having the previous day seen one five miles south of Brighton. So that the insect had made its appearance for the first time in the colony simultaneously at places fourteen miles apart, and with no community of character or vegetation—Brighton and to the south being a sandy bush in a state of nature, with houses few and far between, each surrounded by several acres of land, while about the University is a clay soil, densely populated. On the three following Sundays I saw two or three specimens in fine condition, which could not, therefore, have been those seen at first; and last week I saw some in the street leading to the University; and on the same day the collector came across them at the Treasury, situated at the opposite side of the city. The specimens vary a little in the width of the black border and the number of the white spots in it, but to no greater extent than in the American specimens with which I compared them.

This sudden American invasion of the whole continent seems worth recording.

Melbourne, March 26, 1873.

LII.—*Descriptions of new Species of Fossorial Hymenoptera in the Collection of the British Museum.* By Frederick Smith, Assistant in the Zoological Department, British Museum.

The species described in the present paper were collected by Mr. H. W. Bates in the Amazons Valley, in Brazil, and formed part of his private collection; they were purchased by the Trustees of the British Museum, and are nearly all unique in the National Collection. The most valuable additions made to the Fossorial tribe are the species now added to the following genera:—to *Ceropales* four species, to *Aporus* three, to *Ampulex* one, to *Trigonopsis* two, and to *Trachypus* two; many new and beautiful additions are made to the Pompilidæ, Larridæ, Crabronidæ, and the Philanthidæ.

Tribe Fossores, Latr.

Family **Pompilidæ.**

Genus Pompilus, Fabr.

Pompilus fervidus.

Female. Length 7 lines. Ferruginous, with the wings fuscous. Head: the eyes, ocelli, tips of the mandibles, and the seven apical joints of the antennæ, as well as the eighth joint above, black. Thorax: the posterior margin of the prothorax, the tegulæ, postscutellum, and the posterior margin of the metathorax yellow; the wings dark fuscous and iridescent, with their apical margins and hinder margin of the posterior pair paler; the tibiæ and tarsi with ferruginous spines. Abdomen with the apical margins of the segments bordered with fusco-ferruginous bands, indistinctly defined.

Hab. Para.

Pompilus decedens.

Female. Length $9\frac{1}{4}$ lines. Head, thorax, legs, and base of the abdomen yellow, the rest of the latter black. The antennæ reddish yellow, with the six apical joints fuscous; the eyes black at their outer margins; the tips of the mandibles black. Thorax of a reddish yellow above; the metathorax, tegulæ, the scutellum at the sides, the postscutellum, and the posterior margin of the metathorax paler, the latter being yellowish white; legs reddish, with a line on the posterior femora, within, and the posterior tarsi black; wings flavo-hyaline, palest at their apical margins, the nervures ferruginous; the costal nervure fuscous. Abdomen: above black at the extreme base; the rest of the first segment reddish yellow, and with a pale spot next to the black base; the second segment at its base, as well as the third, has a yellow fascia, the latter narrowest and attenuated in the middle; the second segment reddish yellow, with two large black maculæ, which occupy nearly the entire segment, except a central line and the apical and lateral margins; beneath, the three basal segments are pale yellow, except the apical margin of the third, which is black.

Hab. Para.

Pompilus diversa.

Female. Length 5–6 lines. Black, variegated with silvery pile; wings hyaline, with two transverse fuscous fasciæ. Head: the face covered with silvery pile, in very fresh examples it has a golden lustre; the anterior margin of the clypeus, which is transverse, more or less obscurely ferruginous; the mandibles ferruginous at their apex and the palpi of the same colour, but paler; the head is wider than the thorax; the antennæ fulvous towards their apex, sometimes obscurely so. Thorax: the posterior margin of the prothorax angulated; a silvery spot on each side of the scutellum close to the lateral margins, and the metathorax silvery at its apex, which is rounded; an impressed line extends from the base to the apex of the metathorax; in small specimens the legs are obscurely ferruginous beneath. Abdomen: the basal margins of the segments more or less ornamented with silvery pile, glittering brightly in certain lights.

Male. Length 5 lines. Of a much more slender form than the female, and more brightly decorated with silvery pile; the face, coxæ, and abdomen at its base very bright; the basal segment much attenuated; the legs elongate, slender, and spinose.

Hab. Ega; Para.

A series of specimens of this species, on being carefully examined, show that in all probability, on the insect being freshly disclosed, the disk of the mesothorax is covered with pale golden pile; some examples have traces of it.

Pompilus varietatis.

Female. Length 4–5½ lines. Black; the thorax and abdomen more or less maculated with minute yellow spots. Head rather wider than the thorax; the anterior margin of the clypeus widely truncate; the palpi pale testaceous; the antennæ fulvous beneath. Thorax: the posterior margin of the prothorax arcuate, and frequently bordered with yellow; the mesothorax, in some examples, with two very narrow longitudinal yellow lines; a minute spot on each side of the scutellum, the post-scutellum, two longitudinal lines on the metathorax, and its posterior margin yellow; the extreme apex of the coxæ, trochanters, femora, and of the anterior tibiæ rufo-testaceous; the calcaria and spines on the tibiæ and tarsi pale rufo-testaceous; the anterior half of the fore wings dark fuscous; the anterior margin of the posterior pair with a slight fuscous tint. Abdomen covered with a fine glossy cinereous pile; the basal segment with two yellow circular spots; in some examples the spots are larger and of an irregular shape, and form a large only slightly interrupted transverse macula; in other examples there is a minute spot at the extreme lateral basal margins of the second and third segments.

Hab. St. Paulo; Ega; Para (Amazons).

All the varieties received are described; but probably others exist. The longitudinal lines on the metathorax are in different examples more or less obsolete, sometimes entirely so. The smaller specimens appear to be the most highly coloured.

Pompilus vividus.

Male. Length 5 lines. Black, and covered with silvery pile, which is most dense on the face, coxæ, femora beneath, and also on the three basal segments of the abdomen beneath, the other segments being black. The posterior margin of the prothorax with a white band, which is slightly interrupted in the middle; the wings hyaline, the anterior pair with a dark fuscous cloud, which extends to the base of the marginal cell; a narrow fuscous fascia crosses the wing at the apex of the externo-median cell; a space at the base of the metathorax black, being without a covering of pile; a portion of the apical margins of the three basal segments of the abdomen black and without pile, the third margin narrowest; the anterior tibiæ and tarsi slightly, and the intermediate and posterior pairs very spinose.

Hab. Santarem.

Pompilus detectus.

Male. Length $5\frac{1}{2}$ lines. Black, abdomen partly red, and with dark fuscous wings. The face with a covering of silvery pile; the clypeus widely truncate, the lateral angles rounded, and having a brownish pile. The posterior margin of the prothorax arcuate and with a yellow border, somewhat obscure; the metathorax smooth, covered with brownish pile, and of a blue tinge in certain lights; the wings slightly iridescent in some positions. Abdomen: the three basal segments ferruginous, and the basal margin of the fourth narrowly so; the four apical segments with a thin cinereous pile.

Hab. Santarem.

Pompilus vitabilis.

Female. Length 5 lines. Head and thorax black, the abdomen blue-black; the wings dark fuscous, with a splendid violet iridescence, which varies to purple in certain lights. The face covered with silvery pile; the anterior margin of the clypeus sinuated; the apex of the mandibles ferruginous. Thorax: above, in certain lights, with more or less of a blue tinge, particularly the metathorax, which is smooth and opaque. Abdomen subpetiolate; the apical portion of the fourth segment, and the fifth and sixth and seventh entirely, covered with a thin cinereous pubescence; the abdomen beneath, as well as the coxæ and femora, covered with a changeable silvery pile.

Hab. Para.

Pompilus exclusus.

Male. Length $5\frac{1}{2}$ lines. Blue, with green tints in certain lights; wings dark fuscous; antennæ, mandibles, and clypeus black, the latter widely truncate. The posterior margin of the prothorax angulate; the metathorax smooth and rounded posteriorly; the wings have a violet and purple iridescence; the first submarginal cell as long as the two following; the second cell subquadrate, receiving the recurrent nervure near its apex; the third submarginal cell much restricted towards the marginal cell. Abdomen of a bright blue-green.

Hab. Para.

Pompilus iratus.

Male. Length $4\frac{3}{4}$ lines. Head and thorax black, with yellow markings; abdomen red. The head and thorax covered with short cinereous pile; the scape of the antennæ yellow in front, and covered with cinereous pile; the flagellum fulvous beneath and fuscous above. Thorax: the tegulæ and posterior margin of the prothorax broadly yellow; wings hyaline, and with a dark fuscous cloud beyond the third submarginal cell, the nervures dark fuscous; the posterior tibiæ, their apical calcaria and their tarsi, as well as the intermediate pair and the spurs of the tibiæ, pale yellowish white; the tips of the tarsal joints and of the posterior tibiæ black, as are also their spines. Abdomen ferruginous, with cinereous bands at the base of the segments.

Hab. Para.

Pompilus conterminus.

Female. Length 3⅔ lines. Black, with a broad yellow fascia on the abdomen, and hyaline wings. Head: a narrow line behind the eyes and a broader one at their inner orbits yellowish white; the clypeus covered with silvery pile. The thorax, coxæ, and femora, as well as the base of the abdomen, with a coating of silvery pile; the posterior margin of the prothorax, which is arcuate, with a narrow yellow fascia; wings hyaline, their nervures fuscous, and the anterior pair with a fuscous cloud beyond the third submarginal cell, covering the apex of the wing; the intermediate femora at their apex, and the posterior pair as well as the tibiæ, ferruginous. Abdomen: the basal segment covered with silvery pile; a broad yellow fascia at the base of the third segment, slightly narrowed in the middle.

Hab. Para.

Genus AGENIA, Schiödte.

Agenia agitata.

Female. Length 3–4 lines. Black; wings hyaline, with a fuscous macula; the abdomen petiolated. Covered with a thin slate-coloured sericeous pile; on the face, coxæ, and posterior portion of the metathorax it is silvery. The mandibles ferruginous at their apex; in small examples the apical margin of the clypeus is testaceous; the antennæ fulvous beneath, brightest in small examples. Thorax: the posterior margin of the prothorax arcuate; wings clear hyaline, with a fuscous cloud occupying the second submarginal cell, and usually extending more or less into the third discoidal cell; the third submarginal cell twice as long as the second and slightly restricted towards the marginal one; the anterior tibiæ and tarsi, and all the calcaria that arm the apex of the tibiæ, rufo-testaceous; these are palest in small examples. Abdomen with a short petiole at its base.

Hab. Para; Ega; Santarem.

Agenia multipicta.

Male. Length $6\frac{1}{2}$ lines. Black; the head and thorax spotted and striped with pale yellow. Head: the labrum, clypeus, scape in front, a broad stripe on each side of the face, and a narrow line behind the eyes pale yellow. Thorax: the posterior margin of the prothorax, the outer margin of the tegulæ, a stripe over the tegulæ, an ovate spot before the scutellum and a larger one on it, the postscutellum, three spots at the base of the metathorax, and its apical portion pale yellow; wings flavo-hyaline; the nervures black, with a fuscous cloud over the marginal and two submarginal cells, and from them to the apex of the wings; the anterior coxæ in front, a stripe on the inner margin of the intermediate pair, and on both margins of the posterior ones pale yellow; the posterior femora yellow beneath. Abdomen subsericeous, and with a blue tinge; its apical segment pale.

Hab. Para.

It is probable that the yellow markings will be found to be more vivid in some examples. The unique one in the Museum collection is mutilated, and the wings are ragged at their apical margins; it is probable that it had been long disclosed at the time of its capture.

Agenia gloriosa.

Male. Length $7\frac{1}{2}$ lines. Black, and covered with a bright golden pile, exceedingly brilliant in certain lights. Head: the anterior margin of the clypeus sinuate; the sixth, seventh, and eighth joints of the antennæ orange-yellow. Thorax: the wings flavo-hyaline, with a faint cloud in the marginal, second submarginal, and over the apex of the third discoidal cell; the tips of all the wings faintly clouded; the legs without golden pile, except the coxæ, which are brightly adorned. Abdomen petiolate.

Hab. Para.

Agenia comparata.

Female. Length 5 lines. Black; wings hyaline; posterior femora ferruginous. The insect covered with fine hoary pile; on the clypeus and sides of the thorax it has a silvery lustre; the cheeks, sides of the thorax, and the metathorax with a long thin white pubescence; the palpi testaceous. Thorax:

the posterior margin of the prothorax arcuate; the tarsi obscure ferruginous; the nervures of the wings nearly black; the wings iridescent. Abdomen petiolated; the apical margin of the second and following segments narrowly testaceous.

Hab. Para.

Agenia cœruleocephala.

Female. Length 5 lines. Head and thorax blue, exhibiting tints of purple, green, and violet in certain lights; abdomen ferruginous. Head purple, covered with silvery pile below the insertion of the antennæ; the mandibles, palpi, and scape of the antennæ beneath pale testaceous; the flagellum fulvous beneath. Thorax: the posterior margin of the prothorax subangular, and bordered with silvery pile; the sides of the thorax silvery; the metathorax with a central longitudinal impressed line, which widens towards the apex; wings hyaline and iridescent, the nervures ferruginous; legs ferruginous. Abdomen petiolated; the base of the petiole blue.

Hab. Para; St. Paulo.

Agenia deceptor.

Female. Length 4 lines. Pale ferruginous, abdomen darkest, with the vertex and thorax above dark fuscous. Head: above the insertion of the antennæ nigro-æneous, and with a pale stripe at the margin of the eyes; the apical half of the antennæ fuscous above. Thorax: the posterior margin of the prothorax arcuate, and bordered with a pale ferruginous band; the postscutellum, tegulæ, and apex of the metathorax pale ferruginous; wings hyaline, the superior pair with their anterior margin slightly fuscous. Abdomen petiolated.

Hab. Para.

Agenia timida.

Male. Length $3\frac{1}{2}$ lines. Head and thorax blue; abdomen black, with the petiole ferruginous. Head wider than the thorax; the face and clypeus silvery; the margins of the clypeus, apex of the mandibles, palpi, inner orbits of the eyes not as high as their vertex, and the scape of the antennæ in front very pale ferruginous. The posterior margin of the prothorax arcuate; the metathorax with a central longitudinal depression, and the sides with silvery pubescence; wings hyaline and iridescent, the nervures and tegulæ testaceous; the legs ferruginous, the apical joints of the anterior and intermediate pairs, and the posterior pair entirely, as well as the apex of the tibiæ, fuscous. Abdomen: the petiole and basal margin of the second segment ferruginous; the apical segment white.

Hab. Para.

Agenia reversa.

Female. Length $3\frac{3}{4}$ lines. Ferruginous, with the anterior wings, beyond the second submarginal cell, dark brown. Head rather wider than the thorax; the three basal joints, and a portion of the fourth, of the antennæ ferruginous, the rest black; the joints of the antennæ widest at their base, most obviously so when viewed on the underside; the scape of the antennæ beneath, the lower portion of the inner orbits of the eyes, the clypeus, labrum, mandibles, and palpi white. Thorax: the prothorax transverse, narrow, and very slightly curved; the anterior coxæ white beneath; the posterior tarsi fuscous. Abdomen narrow, and acuminate both at the base and the apex.

Hab. Para.

This species is very remarkable in having the base of the antennal joints wider than their apex; in this particular it agrees with the male of the British and European species, *Agenia variegata.*

Agenia gracilenta.

Male. Length 3 lines. Black, covered with hoary pile; wings hyaline; the base of the second segment of the abdomen yellow. Head: the mandibles and palpi pale testaceous; a line on the scape of the antennæ and the third joint yellow beneath; three or four of the following joints obscurely ferruginous. The posterior margin of the prothorax arcuate; the anterior femora in front, the tibiæ and tarsi, the tips of the intermediate femora, and the tibiæ rufo-testaceous; the calcaria at the apex of all the tibiæ white; wings hyaline and iridescent, their tegulæ testaceous, the nervures fuscous; a faint cloud in the second submarginal cell, and extending over the apical portion of the third discoidal one; there is also a slight fuscous stain at the apex of the externo-median cell. The first segment of the abdomen forming a petiole, which is pale beneath.

Hab. Para.

Agenia modesta.

Male. Length $3\frac{1}{2}$ lines. Black, the legs variegated with white; the abdomen fuscous at the base, and with a white fascia, which covers the apical margin of the first segment very narrowly, and a broader portion of the base of the second segment; the apical segment also white. Head: the scape of the antennæ in front, the clypeus, mandibles, and palpi white; the coxæ, anterior legs, and the base of all the tibiæ white; the wings hyaline and iridescent; the tegulæ testaceous, a fuscous cloud occupying the marginal and second and third submarginal cells; the prothorax with a white fascia on its posterior margin. Abdomen: the three basal segments white beneath.

Hab. Para.

Agenia ordinaria.

Female. Length $5\frac{1}{3}$ lines. Black, with the abdomen red, and anterior wings fuscous. Head: a pale abbreviated line at the inner orbits of the eyes; the palpi also pale. Thorax: the posterior margin of the prothorax arcuate; the metathorax narrowed to, and truncate at, the apex; the third submarginal cell nearly twice as wide as the second, and much narrowed towards the marginal cell; the posterior wings hyaline and beautifully iridescent. The extreme base of the abdomen black. The entire insect covered with a thin hoary pile.

Hab. Santarem.

Agenia aureicornis.

Female. Length $3\frac{3}{4}$ lines. The head and thorax olive-green; the abdomen blue; the wings with two fuscous fasciæ. Head: the clypeus with a changeable silvery pile; the scape of the antennæ in front, and the five apical joints of the antennæ, bright orange-yellow; the rest of the joints obscure fulvous beneath. Thorax: the first fascia crosses the anterior wings at the apex of the externo-median cell and the base of the first submarginal, the second from the base of the marginal. Abdomen smooth and shining, and thinly covered with hoary pile; a few long black hairs at its apex.

Hab. Santarem.

Agenia gratiosa.

Female. Length 4 lines. Green, with the anterior margin of the fore wings narrowly fuscous. Head a little wider than the thorax; the lower part of the face and the clypeus covered with silvery pile; the antennæ fulvous beneath and fuscous above; mandibles ferruginous towards their apex, and the palpi pale testaceous. Thorax: the posterior margin of the prothorax, and the base, sides, and apex of the metathorax, with short glittering silvery pubescence; wings hyaline, the fuscous stain covering the marginal, first and second submarginal cells, and extending at each end a little way beyond; the nervures pale testaceous, with those towards the margin of the anterior wings fuscous; legs pale ferruginous, with the coxæ, and femora above, green, the outside of the tibiæ more or less tinted with green, and the apical joints of the tarsi fuscous. Abdomen petiolated, smooth, and shining.

Hab. Ega.

Agenia tarsata.

Female. Length 4 lines. Green; legs ferruginous, with the tarsi of the intermediate and posterior legs black. Head a little wider than the thorax; the clypeus and lower part of the face silvery; the apex of the mandibles, the palpi, and scape in front pale ferruginous; the flagellum fulvous beneath. Thorax: the sides and the metathorax with a changeable silvery pubescence; wings hyaline, nervures ferruginous. Abdomen petiolate, shining, and covered with a thin hoary pile.

Hab. Ega.

Agenia lætabilis.

Female. Length 7 lines. Black; wings subhyaline, with a brown spot at their apex; abdomen with ferruginous spots. Head and thorax thinly covered with hoary pile; the legs stout and destitute of spines; the metathorax rounded; wings subhyaline, and with a fuscous spot at the apex of the anterior pair, which extends from the base of the third submarginal cell to the apex of the wing. Abdomen: a large ferruginous spot on each side of the first and second segments, those on the second nearly uniting; the fourth (except its extreme base) and the two following ferruginous.

Hab. Para.

Agenia fortipes.

Male. Length 6 lines. Black, with dark brown wings. The face covered with silvery pubescence, brilliant in certain lights; the clypeus widely truncate. The thorax has on the sides and beneath a thin hoary pubescence; the prothorax, margins of the mesothorax and of the metathorax with a bright silvery pile; the coxæ are adorned in the same way, but it is only observable in certain lights; the wings have violet, purple, and coppery iridescence. Abdomen petiolate, and with an obscure blue tinge; the three apical segments have a thin, hoary, short pubescence.

Hab. Para.

Agenia conspicua.

Female. Length 5 lines. Black; wings subhyaline and clouded; abdomen variegated with white and yellow. Head scarcely as wide as the thorax, and both covered with silky white pile; the palpi pale testaceous. The posterior margin of the prothorax arcuate; the metathorax longitudinally depressed; the wings fusco-hyaline, a darker cloud occupying the marginal and second and third submarginal cells; the anterior legs in front and their tarsi ferruginous. Abdomen subsessile, having a fine silky pile; the apical margins of the first and second segments, and the following segments entirely, reddish yellow; a large pale yellowish-white macula on each side of the second segment.

Hab. Para.

Agenia cursor.

Male. Length $5\frac{1}{4}$ lines. Black, with a fine silky pile; legs elongate, the posterior pair longer than the insect; anterior wings dark fuscous, and having a clear hyaline space that occupies the three discoidal as well as the first apical cell. Head transverse, as wide as the thorax; the face below the insertion of the antennæ and the clypeus covered with silky pile. Thorax: the sides, beneath, and the apex of the metathorax silvery; the anterior tibiæ beneath and the tarsi obscure ferruginous. Abdomen: the first segment forming a petiole which is longer than the metathorax; the other segments have a blue tinge.

Hab. Para.

[To be continued.]

LIII.—*Observations on M. Favre's Paper on a New Classification of Ammonites.* By Dr. J. E. Gray, F.R.S. &c.

As to M. Keferstein's theory that the *Aptychus* is "a protecting organ of the nidamentary glands of the female Ammonite," which M. Favre considers certain—and he further goes on to say, "the soft tissue of this gland has a great resemblance in its various parts to the structure of the different types of *Aptychus*, and the form of the *Aptychus* corresponds very well with that of the outer part of this gland" (p. 366)—I do not offer any decided opinion on this extraordinary theory, as I have never studied the question; at the same time I may observe that it is not supported by any thing I have observed in the structure or habits of recent Mollusca, and is, indeed, entirely opposite to all my experience as a student in the structure and development of shells.

A protecting organ of a gland, or a gland itself, becoming shelly would be an entirely new fact in malacology; and the notion should not be entertained without very strong reasons, of which M. Favre gives none.

All true shells are secreted by the mantle of the mollusk, and not by any other part of the animal. The operculum of Univalves, which is the analogue of the second valve in the Bivalves, has a peculiar mantle on the foot of the animal for its secretion; and when the operculum is formed of several layers (that is to say, when its inner and outer surfaces are covered with an additional calcareous coat) the outer coat is secreted by a peculiar lobe of the mantle, as the outer coat of the cowrie, *Marginella*, &c. is secreted; and I have no doubt that the outer coat of *Aptychus* is secreted by a lobe of the pedal mantle, like the outer coat of the operculum of Gasteropods.

The only instance that has occurred to me of a body secreted by a mollusk having the slightest resemblance to a shell, and yet not being secreted by the mantle of the animal, is that of the three shelly plates that encase the gizzard of *Bulla lignaria* and *B. aperta*. These plates are only the hardening of the cartilaginous tubercles that are found in the stomach of *Aplysia* and other allied genera, and have not the structure or texture of true shells; they certainly bear no resemblance to the shells of *Aptychus*, which, as M. Favre describes them, have the regular texture of shells.

The structure of the *Aptychi* that I have examined, as well as the account of it given by M. Favre (p. 365), is quite the same as that observed in many opercula of Univalve shells.

It certainly is against all my experience of fossil shells (which has been extensive) if the *Aptychus* is a fossil nidamentary gland, or that a soft glandular part should be fossilized so as to produce a body formed of three layers, each with a peculiar structure, and that the structure which they produce by becoming fossilized should be similar to the structure observed in *opercula*, which are often formed of three layers, as M. Favre describes them. The reasons which he gives that they cannot be opercula show M. Favre's slight acquaintance with the structure and economy of living Mollusca; for otherwise he would have known that the majority of opercula, although found in the aperture and protecting the animal, evidently "could not have served to close the aperture of the shell."

M. Favre observes:—"The shell of *Nautilus* is composed of two layers—an external layer formed of an aggregate of cells of different sizes, and the largest of which are those nearest the outside (it forms the most important part of the shell properly so called, and M. Suess has named it *ostracum*), and an internal nacreous layer formed of very small cells, which constitutes the septa and lines the inner surface of the *ostracum*. *The former is secreted by the mantle; the latter by the body of the animal.*"

Thirdly, he states, "The whole animal (of the *Nautilus*), the posterior part excepted, is therefore united to the shell, and the chamber is hermetically closed;" and goes on to say, "the mantle extends in front of this attaching ring (*Haftring*); it is composed of two parts—one, which is very short, corresponding to the antisiphonal region of the animal; the other, which is much longer, corresponds to the siphonal region, and secretes the shell, with which it is connected by its outer margin."

These observations come within my study; and I may observe that they are directly at variance with all my experience in the structure and growth of the shells or opercula of Mollusca, and appear to me only to be compared to the Swiss author, living in the centre of Europe, who described ships being built of brick.

The *Nautilus*-shell is composed of two layers, the outer chalky and opaque, the inner pearly: the outer is first formed, and forms the edge of the shell; the inner pearly layer is deposited on the inside of the outer as it is enlarged, the two going on *pari passu*; and both are deposited by the mantle of the animal, as all shells are deposited, and as may be seen both in the univalve *Turbo* and the bivalve *Uniones* or *Aviculæ*, which exactly agree with *Nautilus* in structure; and I should like to know how the body of the bivalve got out of the large mantle to deposit the pearly layer of the inner surface of the shell, which is quite out of its reach and influence. It is quite a new fact to me that the whole animal of a mollusk should be united to the shell, and so hermetically close it; if true, it would require an entire change in the definition of Mollusca, which are always entirely free from the shell, and only attached to it by peculiar muscles; and I can vouch for this being the case in the *Nautilus* from the examination of several specimens preserved in spirit; and, further, I can assure M. Favre that the edge of the mantle in these animals is quite free from the edge of the shell, and that the chambers of these shells are formed in the same way as the septa in other shells—as, for example, the septa across the vertex of *Bulimus decurtatus* and other decurtated shells.

I am willing to allow that there are things to be explained in regard to the formation of the septa and the siphons and the use of the *Aptychus* to the Ammonite; but this is not to be settled by the wild theories of persons who are evidently deficient in elementary knowledge of the structure and economy of living Mollusca. This is one of the evils of the palæontologists (as they call themselves) considering palæontology a separate science, and confining their study to fossil bones, shells, &c., and not paying sufficient attention to the study of recent animals, instead of studying them as parts of the same subject, the former only to be explained by the latter—as Cuvier demonstrated in his 'Ossemens Fossiles,' by a careful study of the existing animals and their parts before he attempted to determine the fossils he then knew: instead of this we find the palæontologists describing and forming genera on mere fragments, and putting forth the wildest and most erroneous theories. If the recent and fossil species were studied together by the same person all this would be got rid of; and we cannot expect that any reliable information as to the determination, structure, or distribution of fossils will be obtained until this course is adopted. One can have no confidence in palæontologists who describe numerous species and genera from fragments, when they fail in describing or determining the osteology or conchology of recent species.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 20, 1873.—Mr. George Busk, Vice-President, in the Chair.

"On the Temperature at which *Bacteria*, *Vibriones*, and their Supposed Germs are killed when immersed in Fluids or exposed to Heat in a moist state." By H. Charlton Bastian, M.A., M.D., F.R.S., Professor of Pathological Anatomy in University College, London.

For more reasons than one we may, perhaps, now look back with advantage upon the friendly controversy carried on rather more than a century ago between the learned and generous Abbé Spallanzani and our no less distinguished countryman Turberville Needham. Writing concerning his own relation to Needham, the Abbé said*, "I wish to deserve his esteem whilst combating his opinion;" and, in accordance with this sentiment, we find him treating his adversary's views with great respect, and at the same time repudiating much of the empty and idle criticism in which so many of Needham's contemporaries indulged with regard

* Nouvelles Recherches sur les Découvertes Microscopiques et la Génération des Corps Organisés, &c. London and Paris, 1769, vol. i. p. 69.

to his work. This criticism, Spallanzani says*, "Without looking into details, contented itself by throwing doubt upon some of the facts, and by explaining after its own fashion others whose possibility it was willing to admit." He moreover warmly reprobated the ignorant and disrespectful statements made by an anonymous writer who had shown himself little worthy of being heard upon the subjects in dispute. Spallanzani on this occasion very wisely said †:—"When it is a question concerning observations and experiments, it is necessary to have repeated them with much circumspection before venturing to pronounce that they are doubtful or untrustworthy. He who will allow himself to speak of them with contempt, and who can only attempt to refute them with writings composed by the glimmer derived from a treacherous lamp, will not find himself in a condition to retain the esteem of learned men." The anonymous writer (in his 'Lettres à un Américain') to whom Spallanzani referred had gone so far as to doubt the statements of Needham as to the constant appearance of organisms in infusions which had been previously boiled, and also intimated that even if they were to be found, it was only because they had been enabled to resist the destructive influence of the boiling fluid. This latter assertion was emphatically denied by Spallanzani, his denial being based upon a most extensive series of experiments with eggs in great variety and with seeds of all degrees of hardness; these were all found to be killed by a very short contact with boiling water. Spallanzani had thoroughly satisfied himself that even very thick-coated seeds could not resist this destructive agent; whilst he thought that the idea, entertained by some, of the eggs of the lowest infusoria being protected from the injurious influence of the boiling water by reason of their extreme minuteness, was a supposition so improbable as scarcely to deserve serious consideration. Such a notion was, he thought, wholly opposed to what was known concerning the transmission of heat. Whilst, therefore, the opinion of those who believe that eggs have the power of resisting the destructive influence of boiling water could be fully refuted, Spallanzani thought it by no means followed that the infusoria which always, after a very short time, appeared in boiling infusions had arisen independently of the existence of eggs. The infusions being freely exposed to the air, it was very possible that this air had introduced eggs into the fluids, which by their development had given birth to the infusoria ‡.

After the lapse of a century it has at last been clearly shown that this supposition of aërial contamination advanced by Spallanzani (warrantable and natural as it was at the time) is one

* *Loc. cit.* p. 9. † *Loc. cit.* p. 114.

‡ A few pages further on this view is thus shortly expressed:—"Il est évident que toutes les tentatives faites avec le feu, peuvent bien servir à prouver que les animaux microscopiques ne naissent point des œufs que l'on supposait exister dans les infusions avant qu'on leur fit sentir le feu; mais cela n'empêche pas qu'ils n'aient pu être formés de ceux qui auront été portés dans les vases après l'ébullition."

which, in the great majority of cases, is devoid of all foundation in fact, so far as concerns the organisms essentially associated with processes of putrefaction, viz. *Bacteria* and *Vibriones*. The means of proving this statement, based upon independent observations made by Professor Burdon Sanderson and myself, were recently submitted to the consideration of the Royal Society*. Before the reading of this communication I was under the impression that almost every one of those who had taken part in the controversies which had been carried on both here and abroad concerning the Origin of Life were prepared to admit, as Spallanzani had done, that the eggs or germs of such organisms as appear in infusions were unable to survive when the infusions containing them were raised to the temperature at which water boils. This impression was produced in part by the explicit statements on this subject that had been made by very many biologists, and also in part by a comparatively recent and authoritative confirmation which this view as to the destructive effects of boiling infusions upon *Bacteria* had received. Little more than two years ago Professor Huxley, as President of the British Association for the Advancement of Science, recorded experiments in his Inaugural Address which were obviously based upon this belief as a starting-point; and subsequently, in one of the Sectional Meetings, after referring to some of my experiments, and to the fact that all unmistakably vital movements ceased after *Bacteria* had been boiled, Professor Huxley added†:—"I cannot be certain about other persons, but I am of opinion that observers who have supposed they have found *Bacteria* surviving after boiling have made the mistake which I should have done at one time, and, in fact, have confused the Brownian movements with *true living* movements." Some eminent biologists do not now (in reference to the experiments cited in my last communication) suggest that the organisms found in the infusions were dead and had been there before the fluids were boiled: they express doubts concerning that which seems formerly to have been regarded as established, and now wish for evidence to show that the germs of *Bacteria* and *Vibriones* are killed in a boiling infusion of hay or turnip, as they have been proved to be in "Pasteur's Solution" and in solutions containing ammonic tartrate and sodic phosphate.

With the view of removing this last source of doubt more effectually, and also of refuting the unwarrantable‡ conclusion of M. Pasteur, to the effect that the germs of *Bacteria* and *Vibriones* are not killed in neutral or slightly alkaline fluids at a temperature of 212° F., I almost immediately after the reading of my last communication commenced a fresh series of experiments.

* See Proceedings of Royal Society, No. 141, 1873, p. 129.

† See Report in Quart. Journ. of Microscop. Science, Oct. 1870.

‡ Reasons for this opinion have been fully set forth in 'The Beginnings of Life,' vol. i. pp. 374 *et seq.*; or the discriminating reader may at once find my justification for this expression by reading pp. 58–66 of M. Pasteur's memoir in 'Ann. de Chim. et de Physique,' 1862.

Nearly two years ago, in my 'Modes of Origin of Lowest Organisms,' I brought forward evidence to show that *Bacteria*, *Vibriones*, and their supposed germs are killed at a temperature of 140° F. (60° C.) in neutral or very faintly acid solutions containing ammonic tartrate and sodic phosphate, and also evidence tending to show that these living units were killed in neutral infusions of hay and in acid infusions of turnip at the same temperature.

The crucial evidence adduced concerning the degree of heat destructive to *Bacteria*, *Vibriones*, and their germs, in the saline solution, was of this nature. The solution had been shown to be incapable of engendering *Bacteria* and *Vibriones* (under all ordinary conditions) after it had been boiled, although it still continued capable of supporting the life and encouraging the rapid multiplication of any of these organisms which were purposely added to it. Some of this boiled solution, therefore, was introduced into flasks previously washed with boiling water; and when the fluids had sufficiently cooled, that of each flask was inoculated with living *Bacteria* and *Vibriones*—in the proportion of one drop of a fluid quite turbid with these organisms to one fluid ounce of the clear saline solution*. These mixtures containing an abundance of living organisms were then heated to various temperatures, ranging from 122° F. (50° C.) to 167° F. (75° C.); and it was invariably found that those which had been heated to 122° or 131° F. became quite turbid in about two days, whilst those which had been raised to 140° F. or upwards as invariably remained clear and unaltered. The turbidity in the first series having been ascertained to be due to the enormous multiplication of *Bacteria* and *Vibriones*, and it being a well-established fact that such organisms when undoubtedly living always rapidly multiply in these fluids, the conclusion seemed almost inevitable that the organisms and their germs must have been killed in the flasks which were briefly subjected to the temperature of 140° F. How else are we to account for the fact that these fluids remained quite unaltered although living organisms were added to them in the same proportion as they had been to those less-heated fluids which had so rapidly become turbid? Even if there does remain the mere possibility that the organisms and their supposed germs had not actually been killed, they were certainly so far damaged as to be unable to manifest any vital characteristics. The heat had, at all events, deprived them of their powers of growth and multiplication; and these gone, so little of what we are accustomed to call "life" could remain, that practically they might well be considered dead. And, as I shall subsequently show, the production of this potential death by the temperature of 140° F. enables us to draw just the same conclusions from other experiments, as if such a temperature had produced a demonstrably actual death†.

* Fuller details concerning these experiments may be found in the little work already mentioned at pp. 51–56, and also in 'The Beginnings of Life,' vol. i. pp. 325–332.

† See p. 462.

Seeing also that these saline solutions were inoculated with a fluid in which *Bacteria* and *Vibriones* were multiplying rapidly, we had a right to infer that they were multiplying in their accustomed manner, "as much by the known method of fission, as by any unknown and assumed method of reproduction." So that, as I at the time said*, "These experiments seem to show, therefore, that even if *Bacteria* do multiply by means of invisible gemmules, as well as by the known process of fission, such invisible particles possess no higher power of resisting the destructive influence of heat than the parent *Bacteria* themselves possess."

This is, in fact, by far the most satisfactory kind of evidence that can be produced concerning the powers of resisting heat enjoyed by *Bacteria* and *Vibriones*, because it also fully meets the hypothesis as to their possible multiplication by invisible gemmules possessed of a greater power of resisting heat, and because no mere inspection by the microscope of dead *Bacteria* can entitle us positively to affirm that they are dead, even though all characteristically vital or "true living" movements may be absent.

Facts of a very similar nature were mentioned in the same work strongly tending to show that *Bacteria* and *Vibriones* are also killed at the same temperature in other fluids, such as infusions of hay or turnip. These facts were referred to in the following statement†:—"Thus, if on the same slip, though under different covering-glasses, specimens of a hay-infusion turbid with *Bacteria* are mounted, (*a*) without being heated, (*b*) after the fluid has been raised to 122° F. for ten minutes, and (*c*) after the fluid has been heated to 140° F. for ten minutes, it will be found that in the course of a few days the *Bacteria* under *a* and *b* have notably increased in quantity, whilst those under *c* do not become more numerous, however long the slide is kept. Facts of the same kind are observable if a turnip-infusion containing living *Bacteria* is experimented with; and the phenomena are in no way different if a solution of ammonic tartrate and sodic phosphate (containing *Bacteria*) be employed instead of one of these vegetable infusions. The multiplication of the *Bacteria* beneath the covering-glass, when it occurs, is soon rendered obvious, even to the naked eye, by the increasing cloudiness of the film."

The facts just cited concerning the behaviour of thin films of turbid infusions which had been heated to different temperatures gave me the clue as to the proper direction of future work. It would seem that, when mounted in the manner described, such thin films of infusion continue capable of supporting and favouring the multiplication of any already existing *Bacteria* and *Vibriones*, although under such conditions no new birth of living particles appears to take place even in these fluids. The question then arose as to whether, by subjecting larger quantities of the same infusions to any particular sets of conditions, we could ensure

* Modes of Origin of Lowest Organisms, 1871, p. 60. † *Loc. cit.* p. 60.

that they also should continue to manifest the same properties—because, if so, it would be almost as easy to determine the death-point of *Bacteria* and *Vibriones* when exposed to heat in these infusions as it had been to determine it for the saline solutions already mentioned.

It was pointed out by Gruithuisen early in the present century, that many infusions, otherwise very productive, ceased to be so when they were poured into a glass vessel whilst boiling, and when this was filled so that the tightly fitting stopper touched the fluid. Having myself proved the truth of this assertion for hay-infusion, it seemed likely that, by having recourse to a method of this kind, I should be able to lower the virtues of boiled hay- and turnip-infusions to the level of those possessed by the boiled saline solution with which I had previously experimented—that is, to reduce them to a state in which, whilst they appear (under these conditions) quite unable of themselves to engender *Bacteria* or *Vibriones*, they continue well capable of favouring the rapid multiplication of such organisms.

This was found to be the case; and I have accordingly performed upwards of one hundred experiments with inoculated portions of these two infusions raised to different temperatures. The mode in which the experiments were conducted was as follows:—

Infusions of hay and turnip of slightly different strengths were employed. These infusions, having been first loosely strained through muslin, were boiled for about ten or fifteen minutes, and then whilst boiling strained through ordinary Swedish filtering-paper into a glass beaker which had previously been well rinsed with boiling water. A number of glass bottles or tubes were also prepared, which, together with their stoppers or corks, had been boiled in ordinary tap water for a few minutes*. They were taken out full of the boiling fluid; and the stoppers or corks being at once inserted, the vessels and their contents were set aside to cool. When the filtered infusion of hay or turnip had been rapidly cooled down to about 110° F. (by letting the beaker containing it stand in a large basin of cold water), it was inoculated with some of a turbid infusion of hay swarming with active *Bacteria* and *Vibriones*—in the proportion of one drop of the turbid fluid to each fluid ounce of the now clear filtered infusion†. The beaker was then placed upon a sand-bath, and its contained fluid (in which a thermometer was immersed) gradually raised to the required temperature. The fluid was maintained at the same temperature for five minutes by alternately raising the beaker from

* The vessels employed have varied in capacity from two drachms to four ounces; some have been provided with glass stoppers and others with very tightly fitting corks; and the latter I find have answered quite as well as the former. On the whole I have found tightly corked one-ounce phials to be about the most convenient vessels to employ in these inoculation experiments.

† It was found desirable to filter the infusions after they had been boiled, because the boiling generally somewhat impaired their clearness.

and replacing it upon the sand-bath. The bottles to be used were then one by one uncorked, emptied, and refilled to the brim with the heated inoculated fluid*. The corks or stoppers were at once very tightly pressed down, so as to leave no air between them and the surface of the fluids. The beaker was then replaced upon the sand-bath and the gas turned on more fully, in order that the experimental fluid might be rapidly raised to a temperature 9° F. (5° C.) higher than it had been before. After five minutes' exposure to this temperature other bottles were filled in the same manner, and so on for the various temperatures the influence of which it was desired to test.

Thus prepared, the bottles and tubes have been exposed during the day to a temperature ranging from 65° to 75° F. And generally one had not to wait long in order to ascertain what the results were to be. In some cases, if the contents of the vessels were to become turbid, this was more or less manifest after an interval of forty-eight hours; in other cases, however, the turbidity manifested itself three or more days later: the reason of this difference will be fully discussed in a subsequent communication.

For the sake of simplicity and brevity, the necessary particulars concerning the 102 experiments have been embodied in the opposite Table.

The experimental results here tabulated seem naturally divisible into three groups. Thus, when heated only to 131° F., all the infusions became turbid within two days, just as the inoculated saline solutions had done‡. Heated to 158° F. all the inoculated organic infusions remained clear, as had been the case with the saline solutions in my previous experiments when heated to 140° F. There remains, therefore, an intermediate heat zone (ranging from a little below 140° to a little below 158° F.) after an exposure to which the inoculated organic infusions are apt to become more slowly turbid, although inoculated saline solutions raised to the same temperatures invariably remain unaltered. The full explanation of these apparent anomalies I propose to make the subject of a future communication to the Royal Society; meanwhile we may quite safely conclude that *Bacteria*, *Vibriones*, and their supposed germs are either actually killed or else completely deprived of their powers of multiplication after a brief exposure to the temperature of 158° F. (70° C.).

This evidence now in our possession as to the limits of "vital resistance" to heat displayed by *Bacteria*, *Vibriones*, and their supposed germs in neutral saline solutions, and in neutral or acid organic infusions, is most pertinent and valuable when considered in relation to that supplied by other sets of experiments bearing upon the all-important problem of the Origin of Life. These

* At this stage, of course, *very great care* is needed in order to avoid all chance of accidental contamination either with living organisms or with unheated fragments or particles of organic matter.

‡ In the experiments already referred to.

Inoculation Experiments made with the view of ascertaining the Temperatures at which *Bacteria*, *Vibriones*, and their supposed Germs are killed in Organic Infusions.

Neutral Hay-Infusion.			
Temp. to which exposed.	Number of experiments made.	Date of Turbidity, if any.	Results at Expiration of the 8th day.
122° F. (50° C.)	1	24 hours.	Turbid.
131° F.	7	48 hours.	All turbid.
140° F.	9	1 in 48 hours. 6 in 60 hours. 1 in 3 days. 1 in 8 days.	All turbid.
149° F.	4	2 in 5 days. 1 in 8 days.	Three turbid. One clear.
158° F.	15	....	All clear.
167° F.	4	....	All clear.
176° F. (80° C.)	12	....	All clear.

Acid Turnip-Infusion.			
Temp. to which exposed.	Number of experiments made.	Date of Turbidity, if any.	Results at Expiration of the 8th day.
122° F.	....	....	....
131° F.	7	5 in 24 hours. 2 in 48 hours.	All turbid.
140° F.	12	6 in 40 hours. 4 in 3 days. 2 in 4 days.	All turbid.
149° F.	10	1 in 3 days. 3 in 5 days. 1 in 7 days. 2 in 8 days.	Seven turbid. Three clear.
158° F.	17	....	All clear.
167° F.	4	....	All clear.
176° F.	....	....	....

latter experiments alone may possibly leave doubt in many minds; but the more thoroughly they are considered in relation to the evidence brought forward in this communication, the more fully, I venture to think, will every lingering doubt as to the proper conclusion to be arrived at be dispelled.

Thus we now know that boiled turnip- or hay-infusions exposed to ordinary air, exposed to filtered air, to calcined air, or shut off altogether from contact with air are more or less prone to swarm with *Bacteria* and *Vibriones* in the course of from two to six days; but, placed under slightly different conditions, such as were employed in the inoculation experiments above quoted, although infusions of the same nature do not undergo "spontaneous" putrefactive changes, yet when living *Bacteria* and *Vibriones* are added, and not subsequently heated, putrefaction *invariably* takes place and the fluids thus situated rapidly become turbid. There is therefore nothing in the conditions themselves tending to hinder the process of putrefaction, so long as living units are there to initiate it. Our experiments now show that as long as the added *Bacteria*, *Vibriones*, and their supposed germs are subjected to a heat not exceeding 131° F. (55° C.), putrefaction invariably occurs within two days; whilst, on the contrary, whenever they are subjected to a temperature of 158° F. (70° C.) putrefaction does not occur. To what can this difference be due, except to the fact that the previously living organisms, which, when living, always excite putrefaction, have been killed by the temperature of 158° F.? It would be of no avail to suppose that the absence of putrefaction in these latter cases is due to the fact that a heat of 158° F., instead of killing the organisms and their germs, merely annuls their powers of reproduction, because in the other series of experiments (with which these have to be compared), where similar fluids are exposed to ordinary or purified air, or are shut off from the influence of air altogether, the most active putrefaction and multiplication of organisms takes place in two, three, or four days, in spite of the much more potent heat of 212° F. to which any preexisting germs or organisms must have been subjected. The supposition, therefore, that the *Bacteria*, *Vibriones*, and their germs were not killed in our inoculation experiments at the temperature of 158° F., but were merely deprived of their powers of reproduction, would be no gain to those who desire to stave off the admission that *Bacteria* and *Vibriones* can be proved to arise *de novo* in certain cases. Let us assume this (which is indisputably proved by these inoculation experiments), viz. that an exposure to a temperature of 158° F. (70° C.) for five minutes deprives *Bacteria*, *Vibriones*, and their germs of their usual powers of growth and reproduction—that is, that it reduces them to a state of potential, if not necessarily to one of actual death. What end would be served by such a reservation? The impending conclusion could not be staved off by means of it. The explanation of what occurs in the other set of experiments, where the much more potent heat of 212° F. is employed, still would not be possible without having recourse to the supposition of a *de novo* origination of living units, so long as those which may have preexisted in the flasks could be proved to have been reduced to such a state of potential death. It would be preposterous, and contrary to the whole order of Nature, to assume that the vastly increased destructive influence of a heat of 212° F. had restored vital properties which a lesser amount (158° F.) of the same influence had completely annulled.

The evidence supplied by these different series of experiments, in whichever way it is regarded, as it seems to me, absolutely compels the logical reasoner to conclude that the swarms of living organisms which so often make their appearance in boiled infusions treated in one or other of the various modes already proved to be either destructive or exclusive of preexisting living things are the products of a new brood of "living" particles, which, in the absence of any coexisting living organisms, must have taken origin in the fluid itself. For this mode of origin of living units, so long spoken of and repudiated as "spontaneous generation," I have proposed the new term Archebiosis.

MISCELLANEOUS.

Habits of Xenurus unicinctus, *or Cabassou.* By Dr. J. E. Gray, F.R.S., F.Z.S., &c.

A specimen of this animal has been living in the Zoological Gardens for this last three or four months.

It feeds freely on chopped meat and vegetables.

The head is very blunt, with a broad, truncated, flesh-coloured nose with large nostrils. The ears are very large and covered with scales; they are usually open and spread out, but always have a keel on the inner side; the fore and hinder flat surfaces are frequently completely closed by compressing the two sides of the ear very closely together, perhaps to protect the cavity of the ear from the sand of the places they are said to inhabit. The body is broad, depressed, and sunk in the middle of the back, and the dorsal disk is very soft and flexible. The tail is elongate, subcylindrical, blackish, naked, and smooth, with three longitudinal series of calcareous tubercles on each side of the under part of the hinder half of the tail, which are of a roundish shape and are sunken into its substance so as to be level with the surface. The front claws are very large, and squarely truncated at the end, from the animal's habit of walking on the tips of them. The front fingers are very mobile; and the animal is constantly spreading them out, so that they radiate from one another and can make a very broad foot, if required by the place it inhabits. The hind claws are similar, but not quite so large or unequal. The penis is long, fusiform, and entirely retractile. The front claws of the wild specimens in the Museum are not so much truncated as those of the specimen in the Zoological Gardens; and though the tubercles on the tail are present in the dried specimens, they are not so regular, well-marked, and distinct as in the living animal.

The way of walking is somewhat similar to that of *Tolypeutes*. The generality of stuffed specimens give a very wrong idea of the form of the nose, dorsal shield, and of the feet. Though *Xenurus* and *Tolypeutes* walk on the tips of the claws, they stand and walk in a very different manner. In the Cabassou (*Xenurus*) the toes are short, and have very strong elongate claws, which spread out horizontally, and are rather divergent; the animal walks on the tips of its claws, the remainder of the claws and the soles of the feet being parallel to, but raised from the soil. In *Tolypeutes* the toes are very short; the claws are slender, elongate, and bent down perpendicularly, so that the animal walks on the tips of its claws, as on stilts.

Several persons to whom I have mentioned these facts doubt their truth, especially in the latter genus; but I have repeatedly verified them with my own eyes. The stuffed specimens and the figures of the animals, and also the figures of the bones of the feet, though very accurate in all their details, give a very erroneous idea of the manner in which these animals stand and, more especially, walk. The Cabassou walks about with the nostrils of his broad truncated nose expanded, sniffing very much like a pig; and from the way it turns over the hay of its cage with its nose, I think that very probably it searches for its food in the same manner as pigs do, thereby justifying the English name generally given to the armadilloes, "hog in armour."

On the Fauna of Nowaja-Semlja. By Prof. Ehlers.

Prof. Ehlers has published a list of marine animals from Nowaja-Semlja, belonging to the classes Insecta, Arachnoidea, Ascidia, to the Vermes, Bryozoa, Echinodermata, Cœlenterata, and Sponges. He concludes it with the following remarks.

Although this catalogue cannot claim to even approximate completeness in the enumeration of the animals belonging to the classes treated in it which occur on the shores of Nowaja-Semlja, it is nevertheless large enough to show that in general the fauna is that of the European north sea; but it further shows that on these islands animals occur together which we should otherwise regard as endemic forms of two distinct zoogeographical provinces. Thus, if we indicate the coasts of Spitzbergen, Greenland, and perhaps polar America as parts of an arctic province, and those of Iceland and northern Scandinavia as parts of a boreal province, and distinguish those animals which have hitherto been found in one province or the other as boreal and arctic animals, it appears that on the shores of Nowaja-Semlja arctic and boreal animals occur side by side, besides those animals which are distributed through all provinces of the northern seas.

It seems probable that the behaviour of the Gulf-stream has some influence upon this distribution, inasmuch as a part of its current attains the southern shore of Nowaja-Semlja, and so on this coast a neutral territory is produced, in which the conditions of the arctic province, scarcely, if at all, affected by the Gulf-stream, may meet more or less with those of the boreal province ; whilst boreal animals may the more easily be carried northwards to Nowaja-Semlja from the neighbouring Scandinavian coasts, as the Gulf-stream passing by the latter carries them to this island.

The following summary furnishes evidence of this. In it I have referred only to those animals of whose distribution in the northern sea we are accurately informed.

There have been found on the shores of Nowaja-Semlja:—

I. Animals which were known only as arctic:
Castalia arctica, Mlmg., Spitzbergen. *Nereis zonata*, Mlmg., Spitzbergen and North Greenland. *Euchone analis*, Kr., Spitzbergen and Greenland. *Chone Duneri*, Mlmg., Spitzbergen. *Asteracanthion grönlandicus*, Steenstr., Greenland. *Myriotrochus Rinkii*, Steenstr., Greenland.

II. Animals which were known only as boreal, or which had their northern limit of distribution in the boreal province:
Evarne impar, Johnst., Iceland, Norwegian, English, and French coasts. *Pista cristata*, Müll., Norwegian and English coasts. *Euchone papillosa*, Sars, Norway.

III. Animals found everywhere in the northern sea:
Harmothoe imbricata, Linn. *Pholoe minuta*, Fab. *Lumbriconereis. Cirratulus cirratus*, Müll. *Amphitrite cirrata*, Müll. *Terebellides Strömii*, Sars. *Priapulus caudatus*, Lam. *Alcyonidium gelatinosum*, Linn.

Here also must be placed *Erigone longipalpis*, Sund., which, as Dr. Koch kindly informs me, has been observed in England, occurs in Sweden, and has been found in Spitzbergen. *Bdella arctica*, Thor., appears to be widely distributed in high northern latitudes, and to occur particularly abundantly in Greenland.

As regards the animals collected on the coast of Finmark, I have only to remark that among them there are some which have hitherto been known only from more northern coasts, such as:—*Scione lobata*, Mlmg., Spitzbergen and Greenland; *Phascolosoma boreale*, Kef., Greenland; *Ophiocten sericeum*, Forb., Ljungm., Polar America, Greenland, and Spitzbergen.—*Sitzungsber. phys.-med. Soc. zu Erlangen*, January 12, 1873.

On "Le Rat de Madagascar." By Dr. J. E. Gray, F.R.S. &c.

Buffon, in the third volume of the 'Supplement' to the 'Histoire Naturelle,' p. 49, t. xx., describes and figures "le Rat de Madagascar" from a specimen that lived several years in the collection of Madame la Comtesse de Massam. This figure has been referred to the *Lemur murinus* of Gmelin and to several other nominal species.

Unfortunately the size of the animal is not mentioned; but if the figure is of the size of the living specimen there can be little doubt that it is the same as a small Lemuroid in spirits that we have lately purchased, labelled "La plus petite Macque de Madagascar entre Manham et Téneriffe."

It agrees with Buffon's figure in all particulars, especially in the acuteness and prominence of the nose beyond the lips. As the animal has only been described from a stuffed specimen, I may add:—The muzzle naked, having a central longitudinal groove on the underside to the border of the lip; the whiskers are long; the ears are rather large, about half the length of the head from their front edge, rather naked, with short close hairs on the outer surface. The hind legs and feet are strong.

The head is $1\frac{3}{8}$ inch long, the body $3\frac{3}{4}$ inches. The tail is cylindrical, $3\frac{3}{8}$ inches long, covered with close hair, and with scattered, longer, soft hair near the end. The hind leg is $1\frac{1}{2}$ inch long, and the hind foot $1\frac{1}{8}$ inch long, when the animal is measured taken out of spirit.

The examination of the skeleton has proved this animal to be the *Azema Smithii*; and, like this, it has the nose and the intermaxillary bones produced not so much as in the *Galago Demidoffii*. This prominence of the intermaxillaries at once distinguishes it from *Murilemur murinus*, which is otherwise very like it and comes from Madagascar, the skull of which is also at once known by the existence of a large round perforation on each side of the hinder edge of the palate, well figured by Mr. Mivart, and not found in the skull of either *Azema Smithii* or *Galago Demidoffii.*

Note on the Anatomy of Comatula rosacea. By E. Perrier.

Last summer, at the laboratory of experimental zoology of M. Lacaze-Duthiers, at Roscoff (Finisterre), I endeavoured to clear up the obscure points which still exist in the anatomy of the *Comatulæ*, the last remains of the rich fauna of Crinoids presented to us by geological strata. Our *Comatulæ* are provided with ten arms, arranged in pairs, and radiating round a disk, upon which is placed a visceral sac containing the digestive apparatus. The arms are furnished on each side with a row of alternate *pinnules*, each joint of the arms bearing a pinnule upon one of its sides. The pinnules seem to be a repetition on a small scale of the arms themselves, but they do not bear secondary pinnules.

On the disk we see two orifices—one central, which is the mouth; the other lateral, corresponding to the interval between two pairs of arms, and situated at the extremity of a sort of fleshy chimney terminated by eight lobes; this is the anus. Round the mouth there is a vascular ring, which, opposite to the base of each pair of arms, emits a vascular branch; and this, bifurcating at the base of each pair, furnishes each arm with a canal called the *radial* or *tentacular canal*. The vascular ring in the intervals between the five primary radial canals gives origin, on its inner margin, to eight or ten contiguous digitiform tentacles, which are largest at the middle of each interval, and become smaller in the neighbourhood of the canals which separate them. In traversing the disk the latter canals also give origin to small, simple, and alternate digitiform tentacles. The five radial canals of the disk cut off five sectors upon it. If we examine the integument upon each of these sectors, we find it perforated with about twenty perfectly circular orifices, irregularly arranged, about 0·005 millim. in diameter, and bordered by an epithelial ring of which the cells are 0·001 millim. in diameter. These orifices lead into little ovoid cæca, lined with the same epithelium; I do not know what may be the function of these singular organs. The very young *Comatula* only presents one of them in each sector; their number consequently increases greatly with the age of the animal. Some of the orifices touch each other, as if their multiplication took place by a longitudinal division of preexistent cæcal organs. The tegumentary membrane of the disk is lined internally with a number of calcareous plates, of irregularly circular form, often marked with annular striæ, and presenting a sort of central star thicker than the plate itself, and having its arms sometimes bifurcated. Some of the plates are destitute of stars; others are perforated; their study may be of some importance in specific determinations. These plates and the cæcal organs just described have not previously been indicated, so far as I am aware.

I have made the arms of the *Comatula* the subject of particular study. Their calcareous skeleton is formed of pieces of an hourglass-shape, having at the lower part of their anterior margin a certain number of spines, which prevent the complete reversal of the joints upon each other. It is surrounded by a sheath of soft tissues, which is developed laterally into a membranous lamella, festooned on each side in such a manner that the festoons of one side alternate with those of the other; between two consecutive festoons there is always a group of three unequal tentacles, the largest of which is towards the extremity of the arm. These tentacles, which are all extremely mobile, present no external orifice; they bear two or three rows of papillæ terminated by a small dilated head, which bears three slender rigid and divergent setæ. The three tentacles of each group spring *by a common branch* from the tentacular canal. The largest tentacle exactly separates two festoons from each other; the two smaller ones repose upon the festoons, to which they partially adhere; and this has led Prof. Wyville Thomson to think that they formed part of it and opened into the tentacular canal by a different orifice from that of the large tentacle.

The tentacular canal adheres to the vibratile epithelium of the upper surface of the arms; it is composed of two envelopes, separated by brilliant stellate corpuscles; and these two envelopes assist in the formation of the walls of the tentacles. Seen in profile they simulate the appearance of two or even three superimposed vessels beneath the tentacular canal, which is the cause of the notions that have hitherto prevailed as to the organization of the *Comatulæ*. There is, however, absolutely no other canal in the arms of the *Comatulæ*, although this canal does not rest directly upon the skeleton, but is separated from it by a vacant space, which is more or less apparent according to the state of flexure of the arms, and which is nothing but the prolongation of the general cavity. It is to this cavity that Dr. Carpenter has given the name of the *cœliac canal*. The calcareous joints are besides enveloped by a delicate membrane, beneath which are seen stellate conjunctive corpuscles. The tentacular canal terminates cæcally in the arms and in the pinnules, a little beyond the middle of the antepenultimate calcareous joint. Muscular fibres unite the groups of tentacles to the point where they spread into three branches; a muscular ribbon also runs all along the median line of the arms beneath the epithelium of the ambulacral furrow. Each tentacle, moreover, has its proper muscles, situated between the external epithelium and the first envelope proceeding from the tentacular canal. We cannot, therefore, accept the opinion of Professor Wyville Thomson, who regards the tissues of the *Comatulæ* as sarcodic.

I could find no trace of a nervous system.

I have cut off the arms of several of these animals, and witnessed their regeneration, which takes place very rapidly.—*Comptes Rendus*, March 17, 1873, p. 718.

On Mammalia from the Neighbourhood of Concordia, in New Granada. By Dr. J. E. Gray, F.R.S. &c.

Mr. Edward Gerrard, Jun., has just received a series of Mammalia from Concordia or Antioquia, which is very interesting as showing that several species have a more northern distribution on the western side of the subtropical part of South America north of the equator.

1. *Ateles ater*. A fine large specimen.

2. *Cebus hypoleucus*. A large specimen, with the upper part of the forearms white.

3. *Nyctipithecus Commersonii*. Like the other monkeys of a large size.

4. *Nasua dorsalis*, Gray, P. Z. S. 1866, t. xvii. There are four specimens of this species, of different ages, but very nearly alike. The younger one is the darkest, and most resembles the single one figured, on which was established the species, which the present specimens confirm.

5. *Galera barbata*. The specimen is peculiar for having a white lunar mark on the front of the back; but this mark is not quite symmetrical, and most probably accidental.

6. *Grisonia vittata*. The specimen is of very large size, larger than those we usually have from Demerara.

7. *Didelphys cancrivora*.

8. *Erethizon rufescens*, Gray, P. Z. S. 1865, p. 321, t. xi. Only one specimen of this species before known; and this confirms the habitat (Columbia) assigned to it, and also the distinctness of the species, and enables us to examine its skull.

9. *Dasyprocta nigra*, Gray, Ann. & Mag. Nat. Hist. 1842; Zool.

Ereb. & Terr. t. This is the first time that the habitat of this species has been recorded. The specimen has a much greener tinge than the two specimens in the British Museum; but this may arise from its freshness.

10. *Sciurus griseogena*, Gray, Ann. & Mag. Nat. Hist. The Concordian specimen differs from the others in the Museum from Venezuela in having a black streak on the whole length of the back, as in *Macroxus medellinensis*, Gray (Ann. & Mag. Nat. Hist.), which we received from Concordia on a former occasion; but that has a white throat and belly, and is of a smaller size.

11. *Tatusia granadina*, Gray, Ann. & Mag. Nat. Hist. 1873.

12. *Cholœpus Hoffmanni*.

13. *Tamandua tetradactyla*, var. *leucopygia*.

Additional Note on Tolypeutes conurus. By Dr. J. E. Gray, F.R.S. &c.

Since I examined this animal, taken out of spirit, and sent a note on it to the 'Annals,' Mr. Edward Gerrard has made a beautiful skeleton of that animal, on which I may further observe:—

1. The dorsal and the head shield of these animals are much thicker and harder than the shields of other armadilloes, in this respect showing much affinity to the fossil genera, especially *Glyptodon*.

2. The whole internal surface of the dorsal disk is lined with skin, the entire front margin of the front ring being attached to the animal by the skin; and the central part of the hinder dorsal disk is attached by cartilage to the central ridge of the pelvis. This cartilage leaves a rough line on the central crest of the pelvis and on the inside of the dorsal disk, showing the extent of its adhesion.

According to Dr. Burmeister's figure, the pelvis and internal part of the dorsal shield of the *Glyptodon* are attached in the same manner (see 'Anales del Museo Publico de Buenos Aires,' 1873, ii. part 10, t.). Indeed there seems great analogy in the pelvis and shields between the genera; but the skulls and teeth are very different. A figure of the skeleton and dorsal shield of this animal will shortly appear in the 'Hand-list of Mammalia.'

On the Respiration of the Psammodromi. By M. J. Jullien.

The lung of the *Psammodromi* is traversed internally by very voluminous muscular bundles composed of smooth fibres anastomosing with each other and forming a sort of interior framework, which seems to support the pulmonary tissue properly so called, as in all reptiles.

These muscular bundles have a most important part in the respiration of these animals. They do not swallow the air like the Batrachians; but when they respire, the muscular bundles contract (as the heart itself would do), the air is expelled, and after the contraction reenters the lungs by virtue of the elasticity of the thorax, aided, no doubt, by the elevator muscles of the ribs. Contractions of the thoracic muscles take no part in the expiration, which is due solely to the muscles of the lungs themselves. It does not seem probable that these pulmonary muscles are subjected to the will of the animal; it appears to me that they must act like the muscles of the iris, which contract independently according to the intensity of the light. When we observe one of these lizards breathing, the longest respiratory period is that of expiration, followed immediately by a sudden inspiration. When a mammal respires, the contrary is the case; a long inspiration precedes a shorter expiration. The respiration of the *Psammodromi* therefore differs profoundly, both from an anatomical and a physiological point of view, from that of Mammalia and Birds. It belongs to an intermediate type, which must take its place below that of the two classes just mentioned and above that of the Batrachia.—*Comptes Rendus*, March 3, 1873, tome lxxvi. p. 585.

M. Gervais on the Skeleton of the Luth (Sphargis coriacea).

Two specimens of this Turtle were caught on the coast of France in May 1872. One specimen was sent to Paris; but it arrived in such a bad state that it could only be made into a skeleton, there being none previously in the Anatomical Museum of Paris.

M. Gervais has published a paper on this specimen, which, though called adult, is evidently a young one, though the size is not stated; and he has added some indications of the skeleton of a much younger animal, in the eighth volume of the 'Nouvelles Archives du Muséum,' illustrated with five beautiful plates, and describes the skin of a new fossil species as *Sphargis pseudostracion*, found in the blue calcareous strata of Valergues (Hérault).

This paper confirms the account of the skeleton of this animal given by Dr. Gray in a previous number of the 'Annals.' It would be curious to compare this skeleton with the perfect skeleton from the coast of Demerara in the museum at Stuttgard.

On an adult Skeleton of Tyrse nilotica *in the British Museum.* By Dr. J. E. Gray, F.R.S. &c.

Dr. Baikie sent home a very fine skeleton of an adult *Tyrse* from West Africa, which has just been mounted; and it shows peculiarities which have not heretofore been observed in this animal.

The sternal callosities are much broader and more developed. The lateral pair on each side are very broad and dilated on the inner side, forming an entire expanded disk; all the diverging lobes at the front inner and at the hinder inner margins are obliterated and covered with the callous outer surface. In the same manner the anterior outer process is reduced to a short, broad, blunt, simple process; and the hinder outer one is also reduced to a short thick process, bluntly divided into two lobes at the end.

The hinder pair of anal callosities are very large and triangular, nearly as broad as long. The pair are united to each other by a straight central suture, so as to form a broad triangular callosity, the anal and the hinder lateral bones being united by two sinuosities, being the remains of the usual lobes on the marginal plates in the young animal.

The most remarkable peculiarity, because there is no indication of it in the younger specimens, is that it possesses a moderate-sized triangular callosity, with a curved hinder side on the middle of the odd anterior sternal bone, showing an alliance in this respect to the *Emydina*, or Mud-Tortoises with valves over their feet, which generally have an odd anterior callosity; but I had never before seen it in a tortoise with exposed hind feet and legs.

Bryozoa of Florida.

F. A. Smitt has published the first part of the descriptions and figures of the Floridan Bryozoa, collected by Count L. F. de Pourtales, in the 'Kongl. Svenska Vetenskaps Akademiens Handlingar,' vol. x.

This paper, like many others published by the Royal Swedish Academy of Sciences, is entirely written in the English language, and is illustrated with five very large plates, showing the various changes of form that the species undergo.—J. E. Gray.

The late Robert M'Andrew, Esq., F.R.S.

We much regret having to announce the death on the 22nd inst. of Mr. Robert M'Andrew, F.R.S., at his residence, Isleworth House, in the 72nd year of his age. His researches by dredging in the North Atlantic from Hammerfest to the Canary Isles, as well as in the Mediterranean and Gulf of Suez, produced most important additions to our knowledge of the geographical distribution of the marine invertebrate fauna. He was an excellent conchologist, having derived his taste for that branch of natural history about thirty years ago from the lamented Edward Forbes. Mr. M'Andrew was at that time engaged in commerce, but latterly devoted his ample means and time to the pursuit of science. We believe he has left his extensive collection of shells to the University Museum at Cambridge. His contributions to this Journal were extremely valuable.—J. G. J.

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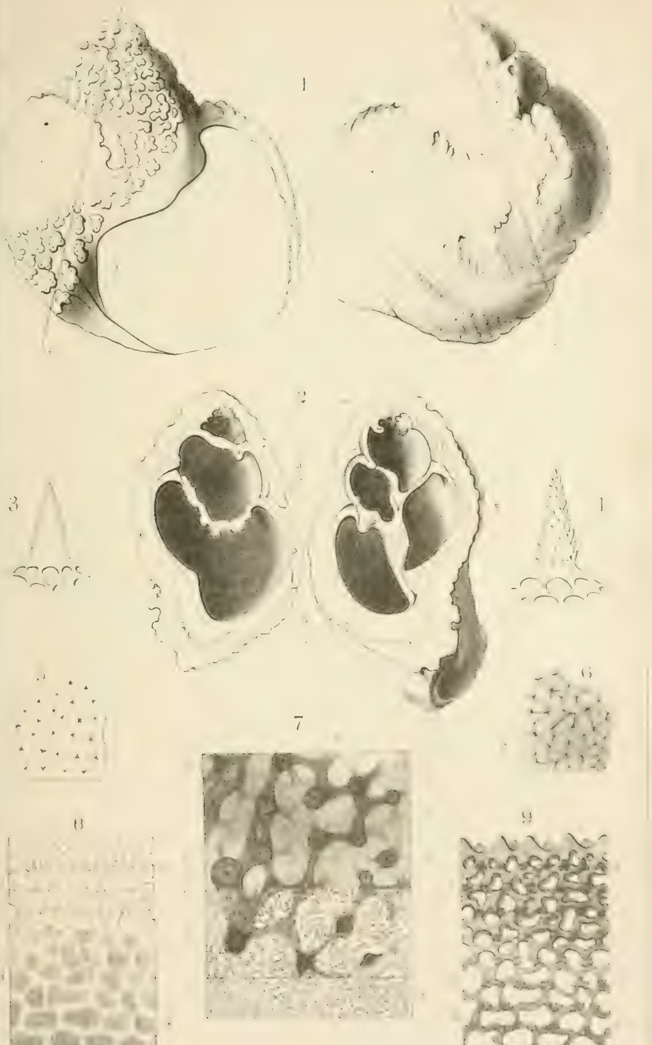
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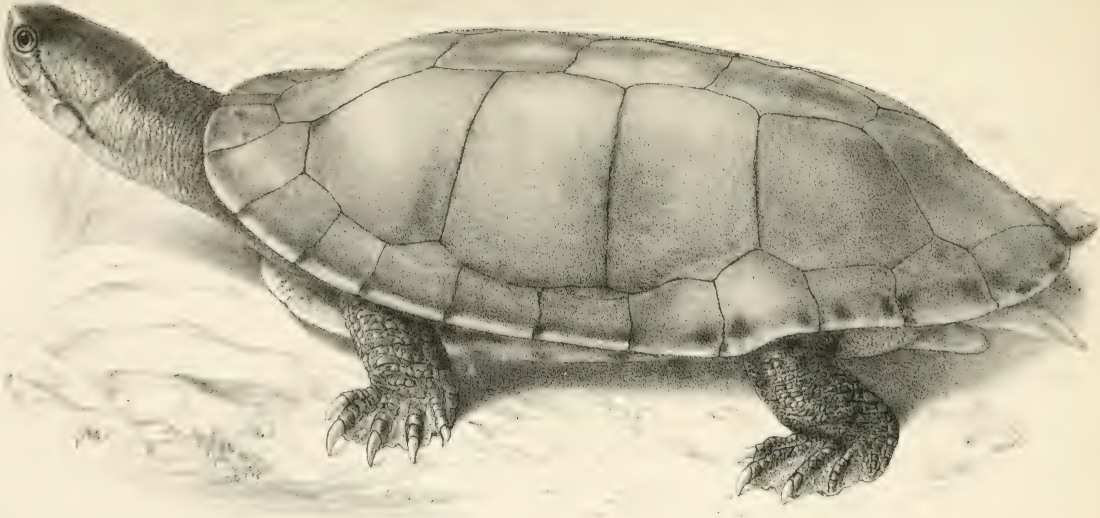

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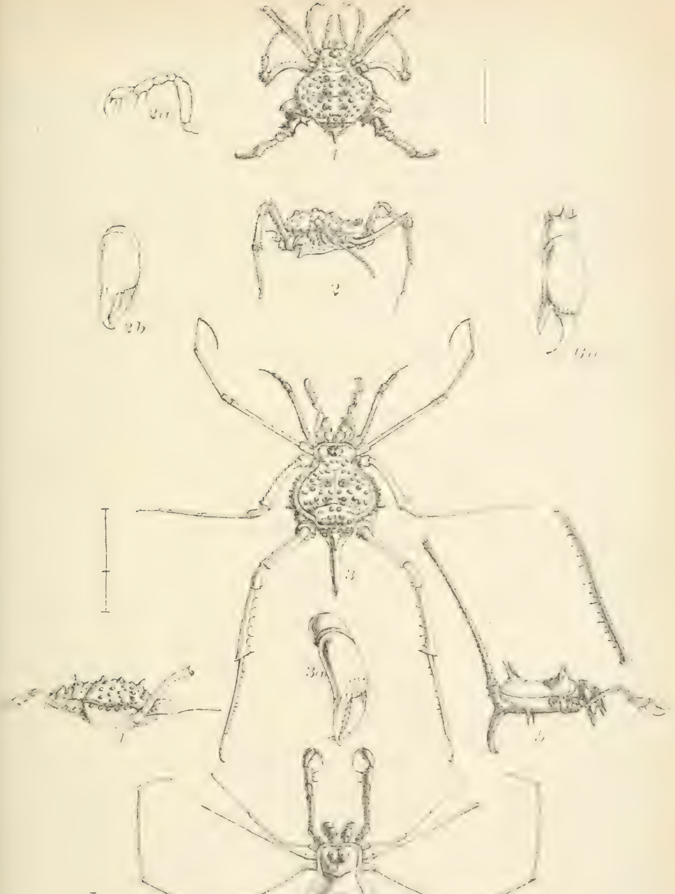

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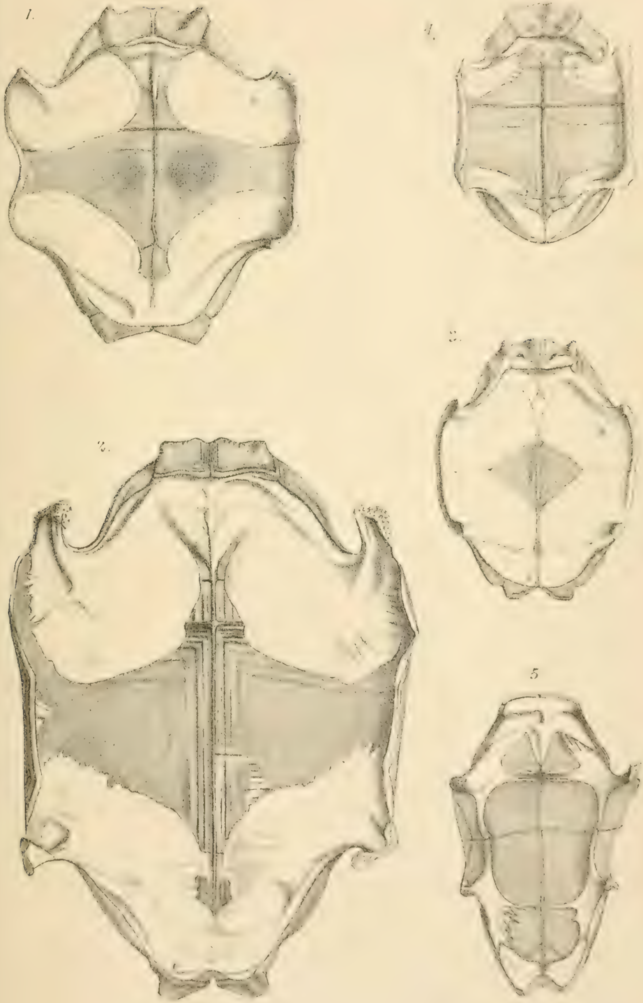

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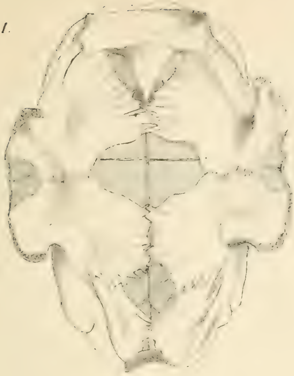

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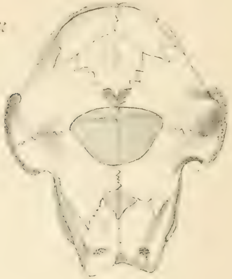

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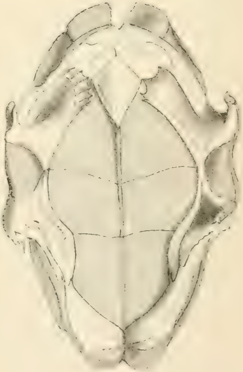

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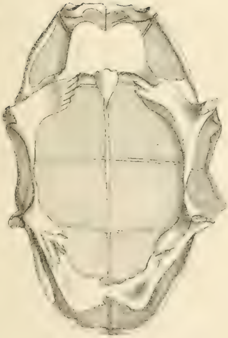

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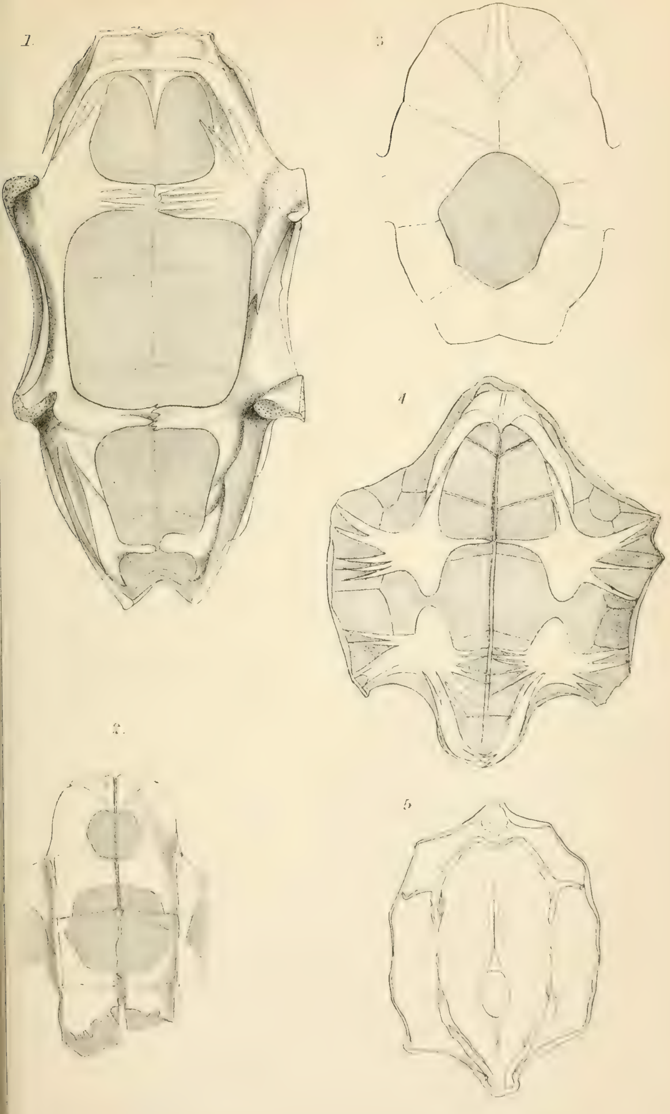

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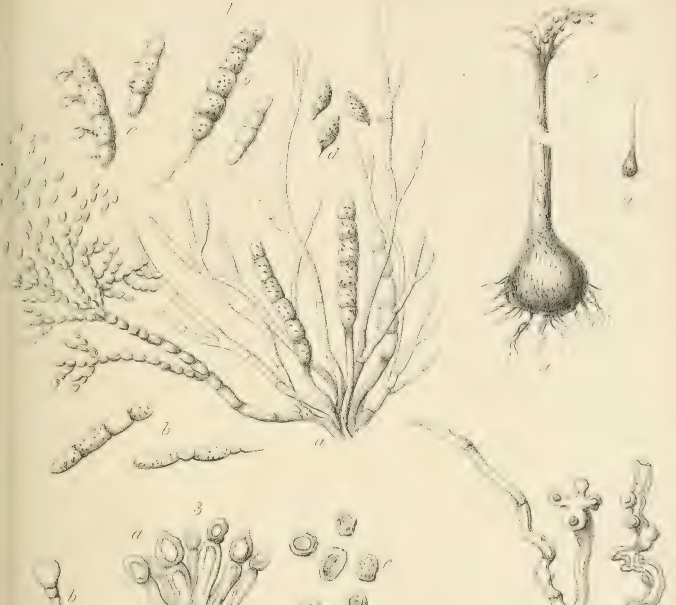
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