THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

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

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

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

J. Taylor, *Norwich,* 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

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

No. 79. JULY 1854.

I.—*On the Genus* Lycium. By JOHN MIERS, Esq., F.R.S., F.L.S. &c.

THIS genus is truly cosmopolitan, being found abundantly in Europe, Asia, Africa, and America, in the former more rarely in regard to the number of species, in the latter most abundantly. The species are mostly low straggling shrubs, or bushes of crooked and stunted growth, generally with thorny branches, often barren and knotty, the younger branches bearing usually fasciculated leaves: these branchlets commonly dwindle into short acute spines, which are both leafy and floriferous. They grow ordinarily in maritime situations, or in inland sandy deserts, where the soil is more or less impregnated with saline matter. Contrary to general rule, the leaves and the habit of the plants afford uncertain specific characters; for the leaves are often so polymorphous, that specimens of the same plant are sometimes mistaken for different species, and on the other hand, many species so closely resemble each other, in habit and form of their leaves, that they are frequently confounded together*. For

* This was long ago (1813) shown by Poiret, who says, Dict. Méthod. Suppl. iii. 427 :—" La plupart des espèces qui composent les *Lycium* sont

these reasons I have been led to search for more certain specific characters in the structure of the flowers, which appear to afford constant features that may be relied upon, and this has induced me to remodel the genus, and revise all the species within my reach. As *Lycium* has recently been so fully elaborated by M. Dunal, and the numerous species described by him have been accompanied with such copious and minute details, this may appear to be quite unnecessary; but my inquiries have convinced me, that for the purposes of specific distinction, little value is to be placed upon many of these ample definitions, and that it is requisite to examine the same materials again with more caution. M. Dunal enumerates only three South American species; I have here described thirty: during my travels thirty years ago, I met, on the confines of the Andes, with many plants hitherto unnoticed; and I find in Sir W. Hooker's rich herbarium, other new species, besides several from the northern portion of that hemisphere, as well as many of Asiatic and African origin, which I now propose to describe.

Of the 70 species I have enumerated (besides those that are dubious), 33 belong to the old, and 37 to the new world. Of these, 3 are found in Europe, 2 in Madeira and Barbary, 3 in Tartary, 6 in Arabia, Persia, Guzzerat and Scinde, and 19 in South Africa; and in the other hemisphere, 1 in the United States, 6 in California and Mexico, 1 in the West Indies, 2 in Peru, 6 in Chile, 3 in Southern Patagonia, 13 in the extensive shingle plains that skirt the eastern flanks of the Cordillera, or that penetrate its gorges, 3 in the vast mud deposit that forms the Pampas, and 2 in tropical Brazil. From this distribution it will be seen, that nearly one-fourth of the known species are found in South Africa, and another fourth on the two sides of

tellement rapprochées, qu'elles sont difficiles à bien caractériser, d'autant plus que la plupart cultivées, varient dans la forme et la grandeur de leur feuilles, dans le nombre des divisions du calice et de la corolle, d'où il est résulté de la confusion dans la synonymie, et beaucoup de doutes pour quelques espèces, établies par des auteurs modernes." Indeed the habit of *Lycium* is peculiar, where we observe a constant tendency to the abortion of its branchlets, especially when grown in arid and saline places; we then commonly find in each axil of the stems, a protuberant knotty excrescence, sometimes quite bare, which is, in fact, a leaf-bud or gemma, checked in its earliest development and lignified; generally, a few elementary leaf-scales succeed in escaping from the gemma, forming a fascicle of starved leaves, and often the node is at the same time expanded into a longer or shorter spine, which again bears several similar suppressed nodes. In the same plant, however, when exposed to circumstances that favour a more rapid growth, we observe the nodes expanded into regular lengthened branches and branchlets, with much larger alternate leaves, in each axil. Hence it is, that the appearance of each species may become, and usually is so varied, that we are liable to constant error in determining its individuality from its habit alone, and the form or size of its leaves or spines.

the Andes within the latitudes of Chile; the latter district, however, has been very little explored, and there is every reason to believe it will be found by far the most prolific in number of species of any quarter of the globe.

According to M. Dunal's distribution of the genus, I find it absolutely impossible to determine the sections to which this large number of new species should be referred. He divides *Lycium* into four sections, *Schistocalyx, Eulycium, Amblymeris,* and *Lyciobatos*: *Schistocalyx,* distinguished by its calyx cleft to the base, comprises only two species, which I have shown do not belong to *Lycium**; *Amblymeris,* another new section, is pre-

* *Huj. op.* xi. 97. The first plant (my *Salpichroma ciliatum,* Ill. So. Amer. Pl. i. p. 9 and 133; *Lycium ciliatum,* Schl.) is distinguished by its alternate pointed leaves, nearly as broad as long, almost cordate at base upon a short petiole, with ciliated margins, and covered with short jointed hairs, solitary axillary flowers with the peduncle afterwards reflected, its calyx split to the base into distinct linear segments covered with glandular hairs, especially on its margins, its corolla externally pubescent, with a short tube, and a border of 5 triangular reflected segments, the mouth of the tube closed by a densely villous ring of hairs around the place of insertion of the exserted stamens, the berry encircled by the longer enlarged calyx: such characters are foreign to *Lycium,* but closely correspond with *Salpichroma,* especially with its section *Perizoma*; this is strongly indicated by the triangular segments of the corolla, showing a valvate æstivation, while those of *Lycium* are always very rounded, and remarkably imbricated; this again is farther confirmed by the total absence of any induvial remains of the corolla after its fall, which is a constant feature in *Lycium.* The characters of this plant appeared to M. Dunal so different from others of that genus, as to draw from him the expression "an genus diversum?" I think there can be little doubt of its being allied to *S. rhomboidea* (Ill. So. Am. Pl. pl. 1).

In regard to the second plant, *L. serpyllifolium,* Dun., I observe, from M. Dunal's description, that its leaves are not fasciculated, its flowers are solitary and furnished beneath the calyx with narrow linear bracts, its calyx is split to the base into linear segments, its filaments are recurved at the apex, and its anthers subhemispherical and ciliated, with divaricated lobes; these are all characters quite foreign to *Lycium,* and more appertaining to *Scrophulariaceæ.*

Since the above was written, I have seen the original specimen in Dr. Burchell's collection, and find my previous inferences fully verified. As the plant is yet otherwise undescribed, I will here annex its characters: it is difficult to imagine upon what grounds it could have been referred to *Lycium.*

Peliostomum serpyllifolium. Lycium serpyllifolium, Dun. in DC. Prodr. xiii. 509;—suffruticosum, ramis e basi erectiusculis, subvirgatis, rugosis, striatis, albescentibus, ramulis brevibus, glabris, apice rigide et obsolete pubescentibus, foliosis; foliis alternis, viridibus, ovatis obovatisve, subobtusis, in petiolum brevem attenuatis, crassis, enerviis, glaberrimis; pedunculo axillari, brevi, uniflori, bracteolis 2 setiformibus, oppositis, infra calycem gerente, calycis persistentis sepalis 5 linearibus, rigidè puberulis, corolla calyce 3-plo longiore, tubo supra basin contracto, demum obconico, hinc late ampliato, nervis plurimis lineato, rigide glanduloso-pubescente, limbi laciniis 5, rotundis, reticulato-venosis et maculato-pictis; capsula ceded by a long string of characters, a mere repetition of the generic diagnosis, without a single differential feature to discriminate it from other sections; while *Eulycium* and *Lyciobatos* are simply adopted from Endlicher (the latter being the *Isodontia* of Don); these last are founded on the inequality or equality of the teeth of the calyx, and the greater or less inclusion of the stamens; the latter circumstance, of course, depends on the relative depth of the incisures of the corolla: the former character is so uncertain in its value, that in the same specimen the calyx is sometimes found regularly 5-toothed, while at other times it assumes a somewhat bilabiate form, caused during its partial growth by the splitting of two or three of its teeth: in regard to the relative depth of the segments of the border of the corolla, and the consequent amount of inclusion or exclusion of the stamens, I find the extremes of these opposite features mixed together in all the different sections, so that notwithstanding it has been proposed as the rule of distinction, this character has been wholly disregarded in the distribution of the species, as will be seen in the sequel. The best proof that can be shown of the small utility and value of these characters is evidenced by the fact, that while other botanists include in the *Isodontia* of Don (*Lyciobatos*, Endl.), *Lycium Afrum, tenue, propinquum, rigidum, cinereum, horridum* and *tetrandrum*, and exclude them from *Eulycium*, M. Dunal separates *L. Afrum, rigidum*, and two others, to constitute his section *Amblymeris*, leaving all the other species above mentioned in *Eulycium*; his *Lyciobatos* being confined to the old Linnæan species *L. Europæum* and three others, that have no relationship with it whatever, the former species being placed by other botanists in *Eulycium*. Kunth and Schlechtendal, again, station *L. Europæum, barbatum*, and *Chinense* in *Eulycium*, and *L. Afrum* in the section corresponding to *Lyciobatos*. This shows what different constructions various authors give to the same characters, and how useless they are for purposes of discrimination.

oblonga acuta calyce paullo longiore.—C. B. S. ad Buffel-bout, Lat. 30° 20′ legit cl. Burchell.—v. s. in herb. Burchell, no. 1596.—*Frutex* subpedalis, *radice* fusiformi, lignoso, 5-pollicari; *folia* 3–5 lin. longa, ¾–1 lin. lata, *pedunculus* 1 lin. longus, *bracteoli* ½ lin. longi, *sepala* linearia, acuta, rigida, erecta, 2 lin. longa; *corolla* 5 lin. longa, 2½ lin. lata, contractione basali calyce breviori, limbi laciniæ subæquales; *stamina* didynama, inclusa, *filamenta* membranacea, compressa, e contractione tubi orta, apice spiraliter voluta, *antheræ* subtriangulares, æquales, pilis longis hispidæ, loculis confluentibus, rima verticali dehiscentes, marginibus valvarum rigide ciliatis: *ovarium* conico-oblongum, calyce tertio brevius, glabrum; *stylus* usque ad medium hirsutulus, superne inflexus, subexsertus, *stigma* minimum, emarginato-bilobum: *capsula* 2-valvis, 2½ lin. longa, 1¼ lin. lata, apice subcompressa, acuta, valvis dissepimento parallelis, semibifidis, sepalis persistentibus amplexa.

In order to prevent a multiplication of these errors, it appears desirable to abolish these sections altogether, and to distribute the species of *Lycium* in three new divisions, founded simply on the relative depth of the incisures of the corolla; viz.—1. *Brachycope,* where the lobes of the border are one-third (or less) of the entire length of the corolla; 2. *Mesocope,* where the segments are yet longer, but do not exceed the length of the tube; and 3. *Macrocope,* where the divisions of the corolla exceed in length that of the tube: in this latter case the stamens are affixed in the throat of the tube, and are far exserted, when the border becomes expanded.

I have repeatedly endeavoured to show that *Lycium* should not be classed among the *Solanaceæ,* because of the very imbricate æstivation of the segments of the corolla. Prof. Schlechtendal more than twenty years ago (Linn. vii. 72) clearly indicated his doubts to this effect. M. Dunal however, in the 'Prodromus,' still follows the example of preceding botanists in arranging *Lycium* in that family, and constitutes it the type of one of his great divisions of the *Solanineæ* (*Lycineæ*), which there comprises a number of genera that have little relation with it, or with each other, as I have shown (*huj. op.* xi. p. 9). Evidence had previously been offered by me demonstrating its position in the family of the *Atropaceæ* and in the tribe *Atropeæ,* as it possesses those essential characters by which that tribe is peculiarized (*huj. op.* iii. 166). Although in its general features it offers some approach to *Atropa,* it comes nearest to *Mandragora* in its floral structure, but not in its habit, agreeing with it in the form of its calyx, its tubular corolla with a border of five equal segments having an imbricated æstivation, one being always exterior; in its stamens inserted in the tube, the filaments often very unequal in length, being generally furnished with tufts of hair a little above the geniculated points of their insertion; in the style being declined away from the external lobe of the border; in the form of its stigma, its bilocular ovarium with large fleshy placentæ adnate to the dissepiment, in its baccate fruit supported by its persistent unchanged calyx, and its spiral terete embryo.

The calyx in *Lycium* is generally small and cupshaped, with five erect teeth; these are mostly equal, but sometimes one, two, or three of the teeth become imperfectly confluent with the others, appearing thus irregularly 3-toothed or bilabiate, a feature originating, as before observed, in the partial splitting of the teeth, a character that often varies in amount with its age, and in the same specimen: it is always persistent, and little changed with the growth of the fruit. The corolla is always contracted below the point of insertion of the stamens, is cylindrical towards the base, the tube being often inflated or more or less funnel-shaped above, with a border sometimes narrow, having five small rounded imbricated lobes, or frequently these divisions are longer, being often continued through the whole infundibuliform portion of the tube to the insertion of the filaments, in which case they become wholly exserted after the expansion of the border: these features are so constant in different individuals as to afford excellent sectional characters. The corolla, although very often symmetrical in its form, is not constantly so, for in many species the tube is more or less inflated upon the side opposite to that of the more exterior lobe of the border, and both stamens and style are somewhat declined towards this gibbous portion: one, two or three of the stamens are often considerably shorter than the others, which do not exceed the total length of the corolla; they are sometimes even still shorter, and wholly included within the tube after the expansion of the border. The filaments are generally geniculated, or suddenly bent at the point of their insertion into the tube of the corolla, and again curve a little above this point into an erect position, and here they are often furnished with a dense globular tuft of white hairs, which form a fornix closing the mouth of the contracted portion of the tube around the base of the style; in several cases the filaments at their base are distinguished by a flat adnate fleshy process, fringed on its margin, bearing some analogy to the tooth of the filaments in *Cestrum*, or the gland-like scale in *Zygophyllaceæ*; they are sometimes altogether smooth. The ovarium is seated upon a short columnar support, to which the base of the corolla is persistently adnate: after impregnation, the corolla breaks away by an irregular circumscissile line, leaving a free persistent cup, which encircles the lower moiety of the ovarium: in the details given of many species of *Lycium* by M. Dunal, he describes this as a dentate cupular proper disk, but that is certainly a mistake; this circumscission of the corolla is a constant feature, and may always be relied upon as a good generic character, but this fact has hitherto escaped attention. The base of the ovary, enclosed within this induvial cup, is at the same time marked by a glandular enlargement of a different colour, which is a true adnate hypogynous disk, although sometimes this is almost obsolete. The ovarium is uniformly 2-locular, with numerous ovules in each cell attached to a thickened placenta adnate to the dissepiment. The berries supported on the small persistent calyx are scarlet, black, or blue: they contain several flattened reniform seeds, surrounded by pulp, and attached to the central placenta: their slender terete embryo, enclosed in solid albumen, is spirally helical, that is to say, it consists of more than a single volution, which is not coiled in a plane, but rises in the middle in a slightly conical form like the whorl of a snail-shell; the radicle, equal in length and diameter to the cotyledons, points to the basal angle of the seed at some distance from the lateral hilum, which is situated in a conspicuous sinus on the ventral margin. The following is offered as a more exact expression of its generic features than that given in the 'Prodromus' referred to.

Lycium, Linn.; DC. Prodr. xiii. 508 (char. emend.).—*Calyx* tubuloso-campanulatus, 5-dentatus, vel sub-5-fidus, dentibus sæpe irregularibus vel aliquantulum confluentibus, persistens. *Corolla* tubulosa vel infundibuliformis, tubo imo constricto et hinc demum circumscisso, limbo 5- rarius 4-fido, laciniis rotundatis vel oblongis, obtusis, tubo brevioribus aut longioribus, reflexis, æstivatione valde imbricatis, lateribus sese ample tegentibus. *Stamina* 5, rarius 4, laciniis alterna, sæpe inæqualia, medio vel supra basin tubi inserta, longitudine corollæ aut breviora; *filamenta* filiformia, glabra, vel supra insertionem semper geniculatam interdum barbata, sæpe longius hirsuta, aut ad basin glandula lineari antice sita, margine ciliata donata; *antheræ* oblongæ, 2-loculares, loculis adnatis, æqualiter 2-valvatis, rima longitudinali margine dehiscentibus. *Pollen* globosum longitudinaliter 3-sulcatum. *Ovarium* breviter stipitatum, oblongum, imo disco carnoso adnato sæpissime fere obsoleto et cupula libera (corollæ reliquo) circumdatum, 2-loculare, placentis dissepimento coadunatis, multiovulatis. *Stylus* simplex, staminibus subæquilongus, apice paullo incrassatus. *Stigma* depresso-capitatum, plus minusve 2-lobum. *Bacca* calyce sæpe irregulariter fisso suffulta, globosa, aut ovata, 2-locularis. *Semina* plurima, compressa, reniformia; *testa* scrobiculata, crustacea; *embryo* intra *albumen* carnosum, helico-spiralis, teres, *radicula* angulo basali spectante, hiloque marginali evitante, cotyledonibus semiteretibus æquilonga.—Arbusculæ vel frutices *sæpius spinosi, præsertim in America et Africa, pauci in Europa australi et Asia crescentes*; folia *alterna, integra, sæpissime e gemmis foliaceis axillaribus fasciculata*; flores *pedunculati, solitarii, gemini, vel aggregati, axillares, vel sæpius e gemmulis foliaceis in spinis sistentes, aut rarius ex axillis approximatis pseudo-terminales*; corollæ *albidæ, flavescentes, roseæ, vel coccineæ.*

1. Brachycope. *Corolla fere cylindrica, interdum paullo ventricosa, limbi laciniis parvulis, tubi dimidio longitudine, vel adhuc sæpius brevioribus.*

A. Gerontogeæ.

* *Filamenta lævia.* Sp. 1 ad 8.

1. *Lycium sævum* (n. sp.);—fruticosum, valide spinosum, spinis patulis, fuscis, nudis, folio brevioribus, aut foliiferis et tunc

longioribus; foliis crebre fasciculatis, spathulato-oblongis, apice rotundatis, a medio in petiolum angustatis, pallidis, crassiusculis, eveniis, utrinque obsolete puberulis; floribus e fasciculis solitariis aut binis, pedunculatis, calyce brevi, tubuloso, submembranaceo, subæqualiter 5-dentato, dentibus pubescentibus, corolla subcylindrica, tubo superne paullo ampliato, utrinque glaberrimo, limbi laciniis 5, rotundato-ovatis, margine subciliatis, staminibus 5 inclusis, 2 faucem attingentibus, reliquis multo brevioribus, filamentis omnino glabris, paullo infra medium tubi insertis; stylo filiformi, tubo æquilongo.—Arabia.—(*v. s. in herb. Hook. " ad Cisternas* Geddæ," *Fischer, no.* 98.)

This plant appears to be identical with that described by M. Dunal in DC. Prodr. xiii. 524. as "*L. Mediterraneum, sectio longiflorum, an species diversa? var. δ. cinereum,*" and found in the same place by Schimper. Its leaves are 6 to 9 lines long, 1½ or 2, rarely 3 lines broad; the peduncle is 1½ line, and the calyx barely 1 line long; the tube of the corolla 5 lines in length, 1½ line diameter; segments 1¼ line long, 1 line broad, the margins being slightly ciliated, while all the rest of the corolla is smooth: the stamens are perfectly glabrous, as well as the tube beneath their insertion, one of the stamens being only two-thirds the length of the two that reach the mouth of the tube*.

2. *Lycium Europæum,* Linn. Syst. i. 228; Mant. 97; Sibthorp, Fl. Græc. i. 155. tab. 236. L. salicifolium, *Mill. Dict.* no. 3. tab. 171. fig. 2. L. Mediterraneum (§ breviflorum), *Dun. in DC. Prodr.* xiii. 524, cum aliis variis synonymis et citationibus auctorum;—ramulis erectis, subteretibus, glabris, vel albido-pruinosis, spinosis, junioribus angulatis, albescentibus, et glanduloso-pilosulis, spinis nudis, vel longioribus et gemmiferis, gemmis sæpe tuberculatis; foliis fasciculatis, spathulato-oblongis, apice acutis vel obtusiusculis, imo in petiolum elongatulum cuneatis, subglabris vel sub lente parce glanduloso-pilosis; floribus e fasciculis solitariis vel binis, pedunculo longiusculo, calyce subpoculiformi, membranaceo, primum æqualiter 5-dentato, demum sub-bilabiato, dentibus obtusiusculis sphacelato-puberulis; corolla tubuloso-infundibuliformi, glabra, tubo intus infra insertionem staminum piloso, limbi laciniis 5, rotundis, glabris, tubo 4to brevioribus, staminibus 5 inclusis, faucem attingentibus, 3 paullulo brevioribus, filamentis medio tubi insertis, et in nervis tot-

* A drawing with analytical details of this species is given in the 'Illustr. South Amer. Plants,' vol. ii. plate 64 A.

idem decurrentibus, hinc tuboque pilosulis, parte libera omnino glabris; stylo capillaceo, vix exserto, cum ovario articulato: bacca pisiformi subglobosa.—Per totam Europam Australem, præsertim in Græcia abundat, unde pro sepibus antiquissime introductum, forsan in Africam Borealem spontaneum, Insulasque Madeira et Canarienses.—*v. s. in herb. Hook.* (Madeira) *Lemann*, no. 552 (*in sepibus* Portûs Sancti *abundans*) *.

M. Dunal rejects the Linnæan name, merely because the plant is not common throughout all Europe; but on the same ground, the name he has substituted is equally inappropriate, since it is acknowledged by himself, that although it occurs in Southern Europe and the Mediterranean Islands, it has originally been introduced there. If we must reject the Linnæan name, for which I can see no reason, it would be infinitely better to adapt a synonym nearly as old, in preference to a new and unsuitable term, in which case Miller's name, by common rule, would claim precedence over that of M. Dunal.

A considerable difference is observable in this and the preceding plant, both in habit and in the structure of its flowers. It is a species well known, and frequently found in gardens in England. The barren spines measure 3 to 5 lines, but the gemmiferous spines are much longer: the leaves are usually from 9 to 15 lines long, $1\frac{1}{2}$ to 3 lines broad, and attenuated into a slender petiole; the pedicel is 2 lines in length, the calyx is $\frac{3}{4}$ line long; the tube of the corolla is a little curved, 5 lines long, $1\frac{1}{2}$ line diameter in the middle, $2\frac{1}{2}$ lines in the mouth, the rounded glabrous segments being $1\frac{1}{2}$ line in diameter. A specimen in Sir Wm. Hooker's herbarium from one of the Canary Islands (Palma, *Bourgeau*, no. 924), affords a good example of what has been before said respecting the variation of habit and difference in the size and shape of the leaves sometimes found in the same individual. One branchlet bears some short, stout, bare, axillary spines, little more than 3 lines in length; but other axils that are without spines, produce a single large fleshy leaf from 2 to $2\frac{1}{2}$ inches long, and $\frac{1}{2}$ an inch broad, somewhat obtuse at the apex, and attenuated into a petiolar base; another straight branch, 18 inches long, is beset with numerous straight bare spines, 1 to $1\frac{1}{2}$ inch long, accompanied by separate alternate leaves, 3 to 6 lines in length, 1 to 3 lines broad, and without flowers; a third, and more fragmentary portion, has a single spine, $2\frac{3}{4}$ inches long, bearing three small bare spines, each 3 lines in length, and a single spineless nodose axil, producing five fasciculated leaves, about an inch long, and 3 lines broad, with

* A drawing with details of this plant is shown (*loc. cit.*), plate 64 B.

four flowers, the peduncles of which are 4 lines in length: in all of these the corolla had fallen off, leaving the ovary encircled by its induvial cup and the persistent calyx.

3. *Lycium Indicum*, R. Wight, Icon. tab. 1403;—glaberrimum, ramis flexuosis, ramulis divaricatis, apice spinescentibus, vel abbreviatis, spinosis, spinis inferioribus nudis; foliis e gemmis fasciculatis, vel alternis, spathulato-oblongis, imo anguste cuneatis, sessilibus; floribus (in specimine) subsolitariis (in icon. cit. fasciculatis), calyce pedicello subæquilongo, tubuloso, 5-costato, dentibus cum costis continuis, sinubus rotundatis demum inæqualiter fissis: corolla (sicca) pallide flava, infundibuliformi, tubo calyce 4-plo longiore, glabro, limbi laciniis rotundis, ciliatis, tubo 4to brevioribus: staminibus glabris, valde inæqualibus, paullo supra basin tubi insertis, quorum 2 inclusis, 3 subexsertis; stylo exserto: bacca globosa, pisi magnitudine, apiculata, seminibus paucis.—Penins. Indiæ Orientalis.—*v. s. in herb. Hook.* Guzzerat et Scinde (*Stocks*, n. 112; *Dr. Thomson*, n. 57).

In this very distinct species the leaves vary considerably in form; Dr. Wight received his specimens from Dr. Stocks, and from the notes accompanying it, this distinguished botanist was led to infer that it might be only a variety of *L. Europæum*: in those notes Dr. Stocks talks of its bearded stamens, evidently confounding his own specimens with another species growing in Scinde. In Dr. Thomson's plant the leaves are fasciculated, obovate-lanceolate, 4 to 6 lines long, 1 to $1\frac{1}{4}$ line broad; the peduncle is 1 line long; the calyx, $1\frac{1}{2}$ line in length, is tubular, with long obtuse teeth; the corolla is contracted below, its tube being smooth and 4 lines long, its border having five rounded ciliated segments 1 line in diameter; the membranaceous filaments are quite smooth and included, two of them measuring 2 lines, the other three 3 lines; the style is 4 lines in length; the ovary, supported by a closely adnate gland, is surrounded at its base by the induvial cup of the corolla. The specimens from Guzzerat have leaves 12 lines in length and 4 lines in breadth; those from Scinde are obovate or oblong, 8 lines long, 3 to 4 lines broad: the pedicels, one or two in each axil, are 2 lines in length*.

4. *Lycium oxycarpum*, Dun. in DC. Prodr. xiii. 518. Lycium Afrum, *Drège*.—C. B. S.—*v. s. in herb. Hook.* (*Drège*).

The specimen above quoted is certainly distinct from *L. Afrum*; it is entirely smooth, with large knotted glands in the axils, out

* This species with analytical details is seen (*loc. cit.*), plate 64 C.

of which the spines grow; the leaves are 9 to 14 lines long, 2 to $2\frac{1}{2}$ lines broad; the pedicels are 5 lines long, the smooth cup-shaped calyx is $1\frac{1}{4}$ line long, the points of the angular teeth being tomentose; the corolla is tubular and smooth, the tube being $3\frac{1}{2}$ lines long, $1\frac{1}{2}$ line diameter, with small round segments $\frac{3}{4}$ line diameter: the stamens are included, the filaments being dilated at the base, and inserted near the bottom of the tube, and are almost its length, subequal, slender and smooth: the style is exserted*.

The variety *α. grandiflorum* of M. Dunal appears to be *Lycium austrinum*, nob.; var. *β. parviflorum* and *γ. angustifolium* may probably be small-leaved varieties of *L. oxycarpum*, but it is impossible to judge of this without examination.

5. *Lycium intricatum*, Boiss. Elench. Pl. Nov. Hisp. 143; Voy. Bot. Esp. n. 1215; Dunal in DC. Prodr. xiii. 525.—Hispania et Africa Boreali.—*v. s. in herb. Hook.* Oran. *Balansa*, n. 659.

In this specimen the spines are approximate, thick, horizontally spreading, 1 to $1\frac{1}{4}$ inch long, bearing numerous fascicles of leaves larger than those described by M. Dunal; they are from 4 to 6 lines long, 1 line broad: the peduncles are 2 lines long; the calyx, slightly pubescent, is 1 line; the tube of the corolla, quite glabrous, is 6 or 7 lines long; the lobes of the border are nearly orbicular, smooth, and 1 line long; the filaments are quite smooth, and fixed in the middle of the tube; two of the anthers reach the mouth, one is shorter, and the two others are a little exserted: the style attains the length of the lower anther†.

6. *Lycium halophyllum*, Welw. MSS. n. sp.;—fruticosum, nunc 2-pedale, nunc vix 2-unciale, glaberrimum, ramulis virgatis, costato-angulatis, inermibus vel spinosis: foliis subfasciculatis, valde polymorphis, oblongis, utrinque acutiusculis, vel obtusis et spathulatis, crassissimis, glabris, vix petiolatis; floribus solitariis, calyce tubulari, 5-dentato, pedicello subæquilongo, corollæ glabræ laciniis rotundatis, tubo infundibuliformi 6to brevioribus.—Lusitania.—*v. s. in herb. Hook.; ad rupes maritimas prope* Lagos et Cabo S. Vicente (*Welwich. herb. Algarv.* n. 717).

A very distinct species, varying greatly in its height, form, and aspect, and in the size and shape of its fleshy leaves: those of the shorter plants are more fleshy and spathulate, 3 or 4 lines long and 1 line broad; the larger plants have straight branches, with spines $\frac{3}{4}$ to $1\frac{1}{2}$ inch long, with leaves 5 or 6 lines in length and 2 or 3 lines in breadth; the peduncles are 1 line long; the

* For a drawing and detail of this species see (*loc. cit.*) plate 64 D.

† A drawing with details of this species is shown (*loc. cit.*), plate 64 E.

calyx, of the same length, is narrow, tubular, with five short equal ciliate teeth; the corolla is narrow, slightly funnel-shaped, a little curved, smooth, 5 lines long, with five nearly orbicular segments, $\frac{3}{4}$ line long, with ciliate margins; the filaments are smooth, inserted below the middle of the tube, two of them reaching the mouth, two somewhat shorter, with the fifth intermediate*.

7. *Lycium orientale* (n. sp.);—ramulis griseis, substriatis, virgatis, spinosis, spinis longis, gemmiferis; foliis fasciculatis, aut alternis, lineari-spathulatis, in petiolum gracilem attenuatis, glaberrimis, aut pubescentibus; floribus solitariis, pedicello calyce tubuloso subæqualiter 4–5-dentato ciliato 2plo longiore; corollæ glabræ laciniis brevibus 4–5 oblongis, margine subciliatis, tubo anguste cylindrico superne paullo latiore 4to brevioribus, staminibus inclusis, 4-5, subæqualibus, filamentis glabris, tubo 4to brevioribus, antheris oblongis, basi cordatis, apice connectivo excurrente mucronatis, faucem attingentibus; stylo elongato, capillari, apice incurvo, exserto.—Asia Minor et Arabia.—*v. s. in herb. Hook.* Smyrna. Arabia Petræa (*E. Boissier*).

This species is probably common throughout the Levant, but has been confounded with *L. Europæum* and *L. Barbarum*, from both of which it is quite distinct. The two specimens above cited differ much in appearance, the Smyrna plant having much larger, linear, subulate, veinless leaves, generally alternate, somewhat thinner in texture and quite smooth: that from Arabia has shorter, spathulate, crisp, fasciculate, pubescent leaves, and sometimes tetramerous flowers, but in the form of the calyx, the length of the tube of the corolla, the shape and size of the segments of its border, the very short similar glabrous stamens, with singularly mucronate anthers, the two specimens quite agree. The latter plant has quite the habit and appearance of *L. Barbarum*, but it differs in the greater length of the tube of the corolla, its shorter and entirely smooth stamens and mucronate anthers. The Smyrna specimen greatly resembles *L. Europæum* in appearance; its leaves are 12 to 15 lines long, 2 lines broad; the pedicel is 2 lines long, the calyx 1 line, the tube of the corolla $5\frac{1}{2}$ lines, its segments $1\frac{1}{4}$ line. In the Arabian plant the leaves are 3 to 5 lines long, 1 line broad, obtuse, slightly pubescent; the peduncle is 2 lines long, the narrow tubular calyx often $1\frac{1}{2}$ line long, the tube of the corolla $4\frac{1}{2}$ lines, the segments 1 line, and the filaments are barely a line in length†.

8. *Lycium Persicum* (n. sp.);—glaberrimum, ramulis valde no-

* This species with analytical details is shown (*loc. cit.*) plate 64 F.

† A drawing with details of this species is shown (*loc. cit.*) in plate 65 A.

dosis, breviter spinosis; foliis spathulato-obovatis vel oblongis, in nodis glomerosis fasciculatis; floribus solitariis, calyce parvulo, tubuloso, subæqualiter 5-dentato, margine ciliato; corolla violacea, glabra, longe et anguste tubulosa, superne paullo ampliata, limbi laciniis 5, ovatis, margine subciliatis, tubo sexto brevioribus, staminibus 5, medio insertis, glabris, 2 brevissimis, 2 fauce vix exsertis, 1 intermedio incluso; stylo tenui, stigmate exserto.—Arabia.—*v. s. in herb. Hook.* (Aden, *in maritimis,* Dr. Hooker); (*idem, Dr. T. Thomson*).

Near *L. orientale,* but much more gnarled and stunted in its growth; its corolla more slender, its stamens very unequal in length, and its anthers not furnished with the same long mucronate point. Its branches are somewhat flexuose, with rather close internodes, and a spine grows out of each salient node: the leaves are 3 to 9 lines long, ½ to 2 lines broad; the peduncle is 2 lines, the calyx 1 line, the tube of the corolla 5 lines, its segments ¾ to 1 line long: the shorter stamens are 1 line, the intermediate 2 lines, the longer ones 2½ lines in length: the flowers are "blue purple*."

** *Filamenta basi hirsuta.* Sp. 9 ad 14.

9. *Lycium Austrinum* (n. sp.); (an *L. oxycarpum, var. α. grandiflorum,* Dun. in DC. xiii. 518 ?)—ramosum, inerme, vel rarius breviter spinosum; ramulis tortuosis, subnitidis, grosse nodosis, nodis approximatis, creberrime foliosis; foliis 5–20 e nodis fasciculatis, glaberrimis, longe lanceolatis, obtusis, vel acutiusculis, in petiolum tenuem spathulatis; floribus e fasciculis 2–5, pedunculis folio brevioribus, calyceque tubuloso 4–5-dentato 3plo longioribus; corolla majuscula, tubulosa, subincurva, imo crassa, coarctata, glabra, intus paullo infra insertionem staminum pubescente, limbi laciniis 5 rotundatis, nervosis, glabris, tubo 6–8vo brevioribus, staminibus valde inæqualibus, filamentis e quarta parte tubi orientibus, imo geniculatis et glabris, mox longiuscule hirsutis, dein glabris, filiformibus, 2 longioribus longe exsertis, 2 intermediis faucem attingentibus, 1 multo breviori inserto; stylo filiformi, apice crassiusculo, incurvo, exserto.—In Africa Australi.—*v. s. in herb. Hook.* Gamka River (*Burke*).

A plant with large conspicuous flowers like those of *L. Afrum,* but narrower and paler; the leaves are much larger and more crowded; it differs moreover, essentially, in the structure of the flowers. The leaves are comparatively thin in texture, veinless, nearly an inch long, including the slender petiole, and 1½ to 2

* This species with analytical details is delineated (*loc. cit.*) in plate 65 B.

lines broad; the peduncles are 6 lines long; the tubular calyx 2 lines, the tube of the corolla 8 or 9 lines, the segments are 1 to 1½ line long*.

10. *Lycium hirsutum*, Dun. in DC. Prodr. xiii. 521.—C. B. S.—*v. s. in herb. Hook.* (*Drège*, 7866 *b*). Graham's Town (*Rutherford*).

This is well distinguished by the rather dense pubescence which clothes the stemlets, the spines and the leaves. In Drège's specimen the leaves are elliptic, oblong, acute, attenuated at the base into a slender petiole of one-third the length of the blade; the total length being 9 to 12 lines, and their breadth 3 or 4 lines. The specimen from Graham's Town is much more branched, the branchlets and spines are nearly at right angles and densely beset with clusters of leaves: here the petiole is nearly obsolete, the leaves are only 3 or 4 lines long and 1½ or 2 lines broad: the flowers, upon an extremely short peduncle, are nearly sessile: the tubular and very pubescent calyx is larger than in the other specimen, its tube being 2 lines, and its nearly equal linear teeth being widely spread and 1 or 1½ line long: the tube of the corolla is 4 lines long, nearly cylindrical, with a border of five rounded oblong segments, ciliated on the margins, nearly a line in length: the stamens are nearly equal in length, inserted considerably below the middle of the tube, hirsute for about one-fourth their length, and reach the mouth: the flowers in this specimen are in a bad condition †.

11. *Lycium arenicolum* (n. sp.);—spinosum, glaberrimum, ramis costato-angulatis, ramulis superioribus elongatis, subvirgatis, inferioribus in spinis nodosis abbreviatis, nodis osseis, nitidis, cupulatis, utrinque lateraliter in costis decurrentibus; foliis creberrime fasciculatis, sessilibus, linearibus, carnosulis, acutis; floribus 4-meris e fasciculis solitariis, brevissimis, pedunculatis, calyce inæqualiter 4-dentato, dentibus ciliatis; corolla parva, tubulosa, limbi laciniis 4 oblongis, ciliatis, tubo tertio brevioribus; staminibus inæqualibus, paullo supra basin insertis, 1 parum exserto, 2 faucem attingentibus, quarto breviori incluso, filamentis basi hirsutulis; ovario induvio corollæ circumdato, et disco carnoso rubro arcte adnato suffulto; stylo apice incrassato exserto.—C. B. S.—*v. s. in herb. Hook.*; *in arenosis ad* Orange River (*Burke*).

This plant has greatly the habit and appearance of *L. tenue*,

* A figure of this species with sectional details is given (*loc. cit.*), plate 65 C.

† This species with sectional drawings is represented (*loc. cit.*) in plate 65 D.

and is remarkable for the cupular nodes that project from the axils, and that are decurrent on each side with the angles of the stem : five to ten leaves grow out of each node, and are 5 to 7 lines long, ½ line broad : the peduncle is barely longer than half a line, the calyx 1 line, the teeth of the corolla 2½ lines, the segments of the border ½ line long*.

12. *Lycium oxycladum* (n. sp.);—ramosissimum, glaberrimum, ramis patentibus, ramulisque angulatis, longiusculis, apice spinosis, nodis approximatis, osseis, cupulatis; foliis parvulis, 4–7 hinc creberrime fasciculatis, spathulato-linearibus, carnosulis; floribus e fasciculis solitariis, breviter pedunculatis, calyce glabro, poculiformi, subæqualiter 5-dentato, dentibus acutis subciliatis, corollæ tubo infundibuliformi glabro, imo intra calycem piloso, limbi laciniis ovatis, tubo 4–5to brevioribus, margine haud ciliatis, staminibus non longe a basi insertis, filamentis imo glabriusculis, dein longiuscule hirsutulis, superne glabris, 2 longioribus exsertis, 2 medianis faucem attingentibus, quinto breviori incluso.—C. B. S.—*v. s. in herb. Hook.* Uitenhage (*Harvey*, 81). South Africa (*Burke*).

A plant with much the habit of *L. tetrandrum*, but with more fleshy and broader leaves: the leaves are 3 or 4 lines long, ½ line broad; the pedicel is 1½ line, the calyx 1 line in length, the tube of the corolla 3 or 4 lines, the segments of the border roundish or oval, ¾ line long†.

13. *Lycium roridum* (n. sp.);—viscoso-roridum, spinosissimum, intricato-ramosum, ramis fuscis, glaucis, striatulis, nodosis, flexuosis, ramulis spinosis; foliis parvulis, 2–10 creberrime fasciculatis, spathulato-oblongis, vel ovatis, carnosis, pallide glaucis, glandulis minutissimis viscosis utrinque punctatis, pilisque brevissimis sparse scabridis vel interdum glabriusculis; floribus in medio fasciculorum solitariis, pedunculatis, calyce subtubuloso, æqualiter profunde et acute dentato, carnoso, punctis glandulosis pilisque brevissimis munito, corollæ tubo infundibuliformi glabro, limbi laciniis ovatis, tubo 4to brevioribus; staminibus infra medium insertis, imo pilis articulatis longiusculis dense lanatis, hinc superne glabris, inæqualibus, omnibus exsertis, bacca globosa, parva, pallida, mucronulata, calyce cupulato, dentibus recurvis suffulta.—In Africa Australi.—*v. s. in herb. Hook.* (*Burke*).

This plant, from its close external resemblance, would readily

* A drawing of this species with analytical details is shown (*loc. cit.*), plate 65 E.

† An outline of this species with floral details is seen (*loc. cit.*), plate 65 F.

be confounded with *L. oxycladum,* but on careful examination it will be found extremely different. The fleshy leaves are 1 or 2 lines long, ½ line broad, cuneate below, with numerous yellowish immersed shining glands on both surfaces; the peduncle is 1½ line long; the tube of the calyx is equal in length to the five equal erect divisions, which are ¾ line long; the tube of the corolla is 2½ lines; the segments of its border ½ line long; the berry is nearly 2 lines in diameter, 2-celled, containing eight glaucous-brown, oval, compressed, and somewhat cochleate seeds; these are affixed to the lower portion of the dissepiment, which is membranaceous, and slit in the middle of the upper portion, as in the *Duboisieæ**.

14. *Lycium acutifolium,* E. Meyer; Dunal in DC. Prodr. xiii. 519.—Pro char. floral. a cl. Dunalio donato, substit.: calycis dentibus æqualibus, brevibus, acutis, ciliatis, corollæ glabræ laciniis 5 ovatis, tubo superne valde ampliato, basi angustissimo, 4to brevioribus, glabris, staminibus inæqualibus haud procul basin insertis, imo longiuscule hirsutis, superne glabris, 2 longe, 2 paullo exsertis, quinto multo breviori incluso; stylo exserto.—C. B. S.—*v. s. in herb. Hook.* (*Drège sub nomine L. acutifolium b. E. M.*)

A very distinct species, remarkable for its thin, membranaceous, spathulate, oval, fasciculated leaves, and its very long peduncle. The leaves are 3 or 4 lines long, 1¼ to 2 lines broad, attenuated at base into a slender petiole; the very smooth peduncle is 6 lines long; the calyx is 1 line; the tube of the corolla, contracted below, is in its upper portion subcampanulate, 3 lines in length; the segments of the border being 1 line long†.

*** *Filamenta paullo supra basin glabra, mox globula pilorum donata.* Sp. 15 ad 22.

15. *Lycium Afrum,* Linn.; Dun. in DC. Prodr. xiii. 521, cum aliis synonymis et citationibus auctorum.—Pro char. flor. cl. Dunalii substitut. sequent.;—calyce glabro, sæpe margine flosculoso-puberulo, majusculo, campanulato, æqualiter ac breviter 5-dentato, demum 2–3-fido; corolla conspicua, infundibuliformi-campanulata, imo breviter coarctata, glabra, limbi laciniis 5, subrotundis, tubo 5to brevioribus, reflexis; staminibus subæqualibus, inclusis, faucem non attingentibus, filamentis imo geniculatis, nudis, mox fasciculo pilorum donatis, dein superne glaberrimis.—Africa, præsertim in C. B. S.; an in Africam Borealem, Hispaniam, et Lusitaniam introductum?

* This species with full details is shown (*loc. cit.*), plate 66 A.

† A drawing of this species with details is seen (*loc. cit.*), plate 66 B.

—*v. s. in herb. plurimis,* C. B. S.; *inter alia, spec. coll. Drège* (*sub nomine L. rigidum, b. Thunb.*).

This is a well-known species, long cultivated in Europe, conspicuous for its large crimson flowers and copious small foliage. The specimen above quoted from Drège's collection, and described by M. Dunal in the 'Prodromus,' p. 523, as *L. rigidum, var. angustifolium,* Dun., appears to me without doubt a true *L. Afrum.* Specimens from different parts of Southern Africa vary in the length and thickness of their crowded fasciculate leaves, and the species is easily distinguished from all others by its broad calyx and large dark-coloured corolla. The species *L. propinquum* (DC. Prodr. xiii. 526) was founded by G. Don (Dict. iv. 459) simply upon Thunberg's description of *L. Afrum* in 'Linn. Trans.' ix. 153: here, the words "folia unguicularia" are translated, "leaves a nail long," which M. Dunal has reconstrued into "folia 2½ pollicaria:" to me it appears that Thunberg meant to express the essential feature of unguiculate or spathulate leaves: under this more probable construction there is absolutely nothing in Thunberg's character at variance with what we know of *L. Afrum**.

16. *Lycium carnosum,* Poir.; Dunal in DC. Prodr. xiii. 522.—C. B. S.; an *L. Afri* mera varietas?

Not having met with any specimen of this reputed species, I cannot form a decided opinion respecting it, but from the published descriptions, no very essential difference is appreciable between this and the preceding species: the principal distinction, and that derived from cultivated specimens, consists in its somewhat smaller berry being of a deep blue, while the other is of a blackish red colour, a mere difference of shade. M. Dunal, from a specimen cultivated at Montpelier, says it is very close to *L. Afrum,* differing only in its smaller stems, fewer spines, thicker, shorter and paler leaves, and in a more greenish hue in the colour of the corolla: a considerable difference in both these respects is often witnessed in indigenous specimens of *L. Afrum*: it does not therefore appear, that the validity of the species rests upon very satisfactory grounds; and this is confirmed by the fact, that among the numerous collections brought from all parts of the Cape colony during the last few years, no specimen appears that can be referred to this species.

17. *Lycium glaucum* (n. sp.);—spinosum, glaberrimum, intricato-ramosum, ramulis rugoso-rimosis, vel lævigatis, junioribus niveis, spinis sæpius brevibus, nudis, ex axillis strumoso-

* An outline of this species with its floral analysis is shown (*loc. cit.*), plate 66 C.

nodosis; foliis e nodis 5–10, fasciculatis, angustissime linearibus, carnosulis, glauco-pallidis; floribus in fasciculis solitariis, folio paullo longioribus; pedunculo calyce tubuloso glabro membranaceo breviter et inæqualiter 5-dentato demum fisso subduplo longiore; corolla glabra, infundibuliformi, pallide flava, imo coarctata, limbi laciniis oblongis, obtusis, reticulato-pictis, tubo tertio brevioribus; staminibus 5, subæqualibus, exsertis, filamentis gracilibus, imo breviter pilosis, 2 paullulo longioribus, tubo fasciculis totidem pilorum cum insertione istorum alternis intus donato; stylo capillari, apice inflexo, exserto.—In Persia boreali.—*v. s. in herb. Hook.* (*Aucher Eloy, n.* 5035).

This is a plant of very gnarled aspect, with prominent warty nodes, of a pale glaucous hue, and with pale flowers half the size of those of *L. Afrum*. It is very distinct from *L. Barbarum*, with which it has probably been confounded. Its leaves are from 5 to 7 lines long, ¼ or ½ line broad; the peduncle is 3 lines in length; the narrow tubular calyx is 1½ or 2 lines long, 1 line in diameter; the tube of the corolla measures 4 lines, and the segments of its border 1½ line, and, excepting the five tufts of hair placed alternately with the stamens, between their insertion, it is quite glabrous*.

18. *Lycium echinatum*, Dun. in DC. Prodr. xiii. 513.—Ad char. cl. Dunalii post descr. calycis, adde;—corolla infundibuliformi, pallida, 4-mera, imo coarctata, limbi laciniis rotundis, margine ciliatis, tubo 4to brevioribus; staminibus 4, quorum 2 alternatim longioribus, exsertis, alteris faucem attingentibus, filamentis supra coarctationem tubi glabri insertis, hinc nudis et geniculatis, mox fasciculo pilorum donatis.—C. B. S.—*v. s. in herb. Hook.* (*Drège*, 7870).

The specimen above cited is quite fragmentary, and is remarkable for the extreme smallness of its fasciculate leaves: the branchlets appear angular and glaucous, with a few short spines, and out of each nodose axil arises a fascicle of small narrow linear leaves, 1 line, rarely 2 lines long, and ¼ line broad: out of the midst of these a single flower is seen, the peduncle being 1 line in length; the calyx with four small equal teeth is 1 line long; the tube of the corolla is 2 lines, with four orbicular segments ½ to ¾ line long: the insertion of the stamens is at a point one-fourth from the bottom of the tube, which is quite glabrous, excepting a few ciliate hairs on the margin of the segments†.

* This species with analytical details is seen (*loc. cit.*), plate 66 D.

† A representation of this plant with its floral analysis is given (*loc. cit.*), plate 66 E.

19. *Lycium tetrandrum*, Thunb. Linn. Trans. ix. 154. tab. 15; Dunal in DC. Prodr. xiii. 516. Lycium horridum, *Thunb. loc. cit.* 152. tab. 17; *Dunal, loc. cit.* 516;—intricato-ramosissimum, spinosum, ramulis patentibus, nodulosis, foliis e nodis fasciculatis, obovatis, vel elliptico-oblongis, basi in petiolum brevissimum attenuatis, crassiusculis, glabris; floribus 4-meris in fasciculis solitariis, pedunculo brevissimo, calyce poculiformi, glabro, 4-costato, 4-dentato, dentibus brevibus ciliatis, corolla glabra, infundibuliformi, limbi laciniis rotundatis, margine ciliatis, tubo 4to brevioribus; staminibus 2 longioribus exsertis, 2 alternis faucem attingentibus, filamentis longe supra medium insertis, hinc geniculatis, nudis, et cum fasciculis totidem pilorum tubo adnatis alternis, mox globula pilorum donatis, superne glabris.—C.B.S —*v. s. in herb. Hook.* (*Drège*, 7872).—Uitenhage (*Harvey*, no. 865).—*In herb. meo*, Uitenhage (*Harvey*, no. 1034, *sub nomine Lycium horridum*).

Upon the same sheet in Sir Wm. Hooker's herbarium I find four specimens of Drège's collection, all fragments and very bare of leaves; two of these agree with the figure of Thunberg's *L. tetrandrum*, the others, evidently younger branchlets, answer to his *L. horridum*; the structure of the flowers being exactly alike in both. I cannot perceive, in the copious descriptions of these two species by M. Dunal above quoted, anything that can constitute valid differential characters; we may therefore consider them as identical, as Sprengel long ago determined (Syst. i. 700). The older leaves are fleshy, 3 lines long and $\frac{1}{2}$ line broad; the younger leaves are obovate, 2 lines long: in Dr. Harvey's specimen the leaves are obovate, spathulate, 7 lines long, $2\frac{1}{2}$ lines broad; the peduncle is $1\frac{1}{2}$ line, the calyx 1 line, the tube of the corolla 3 lines, the segments of its border $\frac{1}{2}$ or $\frac{3}{4}$ line long*.

20. *Lycium tenue*, Willd.; Dunal in DC. Prodr. xiii. 515.—Pro char. flor. cl. Dunalii substit.;—pedunculo calyce paullo longiore, calyce glabro, tubuloso, reticulato, subæqualiter 5-dentato, dentibus brevibus ciliatis; corollæ tubo infundibuliformi imo coarctato, calyce 3plo longiore, limbi laciniis 5 erectis, tubo 3plo brevioribus, lævibus, staminibus valde inæqualibus, infra medium tubi insertis, 2 longioribus multo exsertis, 1 mediano faucem attingente, 2 brevioribus inclusis; filamentis imo glabris et geniculatis, mox fasciculo globoso pilorum barbatis, inde glabris.—C. B. S.—*v. s. in herb. Hook.* (*Drège, sub nomine L. tenue.*)

* An outline of this species and section of its flower is shown (*loc. cit.*), plate 66 F.

This is a mere fragmentary specimen, agreeing sufficiently with Willdenow's description, but whether it be identical with the original, or it be the same as that described by M. Dunal, I have no means of judging. The foregoing diagnosis is therefore only founded upon Drège's plant above mentioned: it consists of a branchlet 5 inches long, with spinous axils $\frac{1}{4}$ inch apart; the spines are slender, bare, 3 or 4 lines long, each springing out of a crowded fascicle of leaves, which are spathulately linear, 3 to 5 lines in length and $\frac{1}{3}$ line broad; a single flower arises out of each fascicle, the peduncle being 2 lines long; the smooth calyx is $1\frac{1}{2}$ line long, with five short rather equal teeth; the tube of the corolla is 3 lines long, and the oblong segments of its border 1 line*.

21. *Lycium cinereum,* Thunb. Trans. Linn. Soc. ix. 152. tab. 16; Dunal in DC. Prodr. xiii. 516. Lycium apiculatum, *Dun. loc. cit.* 517. Acocanthera Lycioides, *G. Don.* Cestrum Lycioides, *Licht.*—C. B. S.

With these plants I am wholly unacquainted, but from the descriptions quoted, no specific difference is perceptible between them, as was suggested by M. Dunal himself.

22. *Lycium pendulinum* (n. sp.);—ramosum, ramulis gracilibus, pendulinis, annotinis strumoso-nodosis, subnudis, apice spinosis, junioribus foliosis, foliis e cupula ossea axillari fasciculatis, linearibus, acutis, in petiolum tenuem imo angustatis, eveniis, glaberrimis; flore e fasciculo solitario, pedunculo gracili, calyce 4plo longiore, calyce tubuloso, breviter ac subæqualiter 5-dentato, corolla infundibuliformi, imo intra calycem coarctata, et extus pilosa, superne glaberrima, limbi laciniis oblongis, venosis, tubo 4plo longioribus, staminibus inæqualibus, uno longiore exserto, 2 faucem attingentibus, 2 brevioribus inclusis: filamentis supra coarctationem tubi insertis, hinc nudis et geniculatis, mox fasciculo globoso pilorum munitis, superne glabris; stylo filiformi, exserto.—C. B. S.—*v. s. in herb. Hook. sub nom. L. Afrum var. pendulum,* N. ab E.

This plant accords more with *L. tenue,* Dun., than with *L. tenue,* Willd.; its branches are very slender and pendulous: the leaves are 4 or 5 lines long, $\frac{1}{2}$ line broad; the peduncle is 3 lines long; the tubular calyx 2 lines, with five short erect teeth; the corolla is 3 lines long, and the oval segments of its border $\frac{1}{3}$ to $\frac{1}{4}$ of its length†.

* This species with sectional drawings is seen (*loc. cit.*), plate 67 A.
† This plant with floral details is shown (*loc. cit.*), plate 67 B.

[To be continued.]

II.—*Additions and Corrections to the Arrangement of the Families of Bivalve Shells.* By J. E. Gray, Ph.D., F.R.S., V.P.Z.S. &c.

One of the advantages, and not the least, of preparing and publishing a revision of the state of our knowledge on any special subject, such as the animals of Bivalve shells, are the additions to that knowledge which its publication induces. During the time my former paper was in the press and since its publication, I have had an opportunity of looking over more than a thousand molluscous animals, and of examining the animals of more than fifty species of Bivalves belonging to nearly as many genera, some of them not before observed, which has rendered it necessary to make several corrections and important additions to my former communication.

There must be added to the family *Veneridæ* the genus *Cypricardia* of Lamarck and its subdivisions: all these animals have two short separate siphons and a small pedal opening. I have examined the animal of *Trapezium angulatum.*

Mittré has described the animal of what he calls *Coralliophaga dactyla,* but M. Petit informs us that the shell intended is the *Cardita Lithophagella* of Lamarck found in the Mediterranean, and not the *Cypricardia Coralliophaga* of that author, which is only found in the West Indies. This animal greatly resembles that of *Trapezium angulatum,* and should be the type of a new genus which may be called *Lithophagella.* The *Cypricardia vellicata* and *Coralliophaga oblonga* have similar animals, but all these genera require revision.

In the Revision, vol. xiii. p. 410, I placed *Astartidæ* in the order *Veneracea,* because Prof. E. Forbes in the 'British Mollusca,' i. 451, described the animal of the genus as having "the mantle freely open with plain margins; slightly united posteriorly at two points, so as to form *two siphonal* orifices with simple edges," and at pl. M. fig. 5. figures the animal of *Astarte sulcata* with two siphonal apertures; at p. 455, he further observes on this species, "the siphonal openings are quite sessile, and but slightly separated from each other;" and at p. 466, he states that the animal of *A. compressa* has "sessile siphonal orifices."

I was aware that Philippi (Wiegmann's Archiv, 1839, 125, copied Ann. and Mag. Nat. Hist. vol. iv. p. 297) had described the animal as like *Cardita,* with only a single anal opening, but placed more faith in the latter description. I have however had an opportunity of examining the animal of *Astarte striata* from Greenland, which appears to be the same as the *A. compressa* of the 'British Mollusca,' and find the description of Philippi correct, and that it has only a single opening like *Crassatella* and *Cardita.* The family must, therefore, be removed to the order *Unionacea,* between *Carditidæ* and *Crassatelladæ,* differing chiefly from the latter in the external position of the cartilage.

Most probably, when the animal of *Astarte* is alive, the hinder portion of the mantle near the anal aperture forms a siphon-like aperture, as is the case in *Crenella* and in many of the other *Lucinacea.* It has been suggested that perhaps the leaves of the mantle are united together and form a siphonal aperture when the animal is alive, but separate when the specimen has been kept in spirits; however, there is not the slightest appearance of any such union on the surface of the mantle, and it certainly is not the case with *Crenella, Mytilus, Unio, Anodon,* and other animals which are without a branchial siphon, and which have an imperfect siphonal aperture for the entrance of the water to the gills.

CARDITIDÆ. This family may be thus divided:—

A. *The elongate hinder cardinal tooth in left valve single, trigonal, upper lamina of it rudimentary or quite wanting. Shell strongly costate, cordate or ovate.*

1. *Venericardia.* Shell short, cordate, hinder cardinal tooth triangular. *V. australis, V. ajar.*

2. *Cardita.* Shell elongate, ovate, hinder cardinal tooth elongate. *C. antiquata.*

B. *The elongate hinder cardinal tooth in left valve double, both laminæ equally developed, elongate. Shell elongate, oblong.*

3. *Mytilicardia.* Shell oblong, strongly costate; front hinge-tooth triangular, diverging; anterior lateral none. *M. Jeson, M. concamerata.*

4. *Lazaria.* Shell oblong, strongly costate, front hinge-tooth compressed, anterior lateral tooth distinct. *L. Pectineus, L. radiata.*

5. *Azarella.* Shell roundish, compressed, dilated behind, striated; front hinge-tooth elongate, compressed, similar and parallel to hinder; lateral teeth none. *A. semiorbiculata, A. gubernaculum.*

In *Astartidæ* I inserted "*Cypricardia* sp. according to D'Orbigny;" this was a mistake for *Cardita* sp. M. D'Orbigny both describes and figures *Cardita spurca,* t. 82. f. 13, as having two distinct siphonal apertures. I have not been able to see the animal of this shell. M. Quoy describes the animal of *Venericardia australis.* Deshayes figured the animal of *Cardita calyculata* as having only a single anal siphonal opening, and this is the case with the animal of the several species of *Cardita*

I have examined; but if there is not some mistake in M. D'Orbigny's description and figure of *Cardita spurca*, it must be a distinct genus; however, perhaps he has been misled by the hinder part of the mantle being expanded behind during life, so as to represent a second siphon, which is only a false appearance.

Tellinidæ.—The genera *Sanguinolaria* and *Soletellina*, which have been referred to *Solenidæ*; *Fragilia* and *Capsa*, arranged with *Veneridæ*, should be referred to this family; they have, like them, two elongated separate siphons, with large distinct fan-shaped retractile muscles, and the gills not produced into the siphons.

Anatinidæ.—In the May Number of the 'Annals' (p. 413), I referred the genus *Mytilimera* of Conrad to the family *Modiolarcadæ* with doubt. In an examination which I have been enabled to make of typical specimens of *Mytilimera Nuttalli*, I think I have discovered the mark left by the shelly plate over the large subinternal cartilage; and on comparing it with *Anatina cuneata*, I have as little doubt as one can have from the examination of shells alone (especially in an imperfect condition), that they belong to the same genus and the family *Anatinidæ*. As *Mytilimera* was published before the *Byssonia* of Valenciennes, it ought to be retained for these shells. They both have the habit of living imbedded,—*Byssonia cuneata* in Ascidia, and *Mytilimera* in sponges.

Muteladæ.—In *Mutela* the lips are very large, semioval, attached by the straight side without the free point existing in *Unio* and *Anodon.*

Cardiadæ.—The gills are united together behind the body or base of the foot.

Solenidæ. This family may be thus divided :—

A. *Cardinal teeth* 1 · 1. *Siphons produced, united; siphonal muscles moderate; siphonal inflection deep, truncated.*

1. *Solen.* Shell truncated in front; umbo anterior; anterior adductor muscle elongate, horizontal. *S. marginatus.*

2. *Hypogella.* Shell rounded at each end; umbo subanterior; anterior adductor muscle round. *H. ambigua, H. vaginata.*

B. *Cardinal teeth* 2 · 3. *Shell rounded at each end.*

a. *Siphons moderate, separate; siphonal muscles small; siphonal inflection small, truncated.*

3. *Ensis.* Siphons not produced, separate; umbo anterior; anterior adductor muscle elongate, horizontal. *E. Ensis.*

4. *Pharella.* Siphons shortly produced, separate; umbo subanterior; anterior adductor muscle elongate, subtrigonal; shell subcylindrical. *P. javanica, P. Michaudi, P. acutidens.*

5. *Pharus.* Siphons produced, separate; shell compressed; umbo subcentral; anterior adductor muscle elongate, horizontal; umbonal ribs rudimentary. *P. legumen.*

6. *Cultellus.* Siphons ——? anterior adductor muscle rounded, hinder triangular; shell compressed; umbo subanterior. *C. lacteus.*

b. *Siphons much produced, large, united, covered with a thick periostraca; retractor siphonal muscles small; siphonal inflection very small.*

7. *Cyrtodaria.* Anterior adductor muscle elongate; umbo subposterior. *C. glycimeris.*

c. *Siphons elongate, with large fan-shaped retractor muscles; siphonal inflection deep, rounded.*

* *Siphons very large, united, covered with a hard periostraca. Shell compressed. Hinge-teeth* 3 · 3, *compressed.*

8. *Siliqua.*

** *Siphons large, united at the base, covered with a hard periostraca. Shell subcylindrical. Hinder teeth conic.*

9. *Glycimeris.* 10. *Adacna.*

*** *Siphons very large, united at the base, upper part free, ringed.*

11. *Macha.* Shell obliquely sulcated. *M. strigillatus.*
12. *Azor.* Shell smooth. *A. antiquatus.*

**** *Siphons elongated, cylindrical.*

13. *Tagelus.* * Umbo submedial; siphonal inflection very deep, beyond the umbo. *T. viridiæneus. T. Carabæus.*

** *Novaculina.* Umbo subposterior; siphonal inflection deep, not reaching the umbo. *T. Novaculina,* India. *T. Dombei,* Peru. *T. fragilis,* Europe. *T. constrictus,* China.

Elizia.—Animal unknown. Shell suborbicular, oblong, equivalved, compressed, thin, covered with a hard shining periostraca; umbo not prominent, subanterior. Cardinal teeth oblique, in right valve two, hinder bifid elongate, in left valve three, central bifid. Pallial impression submarginal. Siphonal inflection deep, oblong, rather contracted at the outer edge, descending from the upper part of the hinder margin to the centre of the disk.

Elizia orbiculata = *Solen orbiculatus,* Gray in Wood Cat. Supplement, t. 1. f. 4.

Lucinidæ.—As our knowledge of the animals of Univalve shells has increased, we have found that shells which have a great resemblance to each other are formed by very different animals, until it has become almost impossible to pronounce with certainty on the genera of several Gasteropodous Mollusks, unless we are in possession of the animal and operculum as well as the shell. The same fact is every day forcing itself on our notice with respect to the Bivalves. It is nearly impossible to separate the *Muteladæ* from the *Uniones,* the *Modiolarcæ* from the *Modiolæ,* though the animals are very unlike.

All conchologists considered that the *Lucinidæ* were a very natural group, yet we learn that *Ungulinæ* of Daudin, which are scarcely to be separated from them, except by their irregular outline from living in holes in rocks, have four gills and distinct labial palpi, while the *Lucinæ* have only two gills and no labial palpi. This appeared so improbable when I printed my paper in the May Number of the 'Annals,' that I placed a mark of doubt after the description, but I have since had an opportunity of verifying the accuracy of the observations.

One of the most striking instances occurs in the shell referred to the genus *Mysia,* or *Diplodonta.* In the paper above referred to I described the animal of a Philippine species of this genus, which has two siphonal apertures and a lanceolate foot, and referred it to the suborder *Veneracea.* M. Mittré in 'Journ. de Conchyliologie,' 1850, t. 238, described and figured the animal of a Brazilian species, which he calls *Diplodonta Brasiliensis,* having only a single anal siphonal aperture and a cylindrical foot like the *Ungulinæ;* and which, indeed, appears chiefly to differ from that genus in the anal aperture being further from the pedal one, and in the adductor muscle being roundish instead of linear and elongate: the difference in form of this part probably explains the relative position of these two apertures.

The examination of the animal of *Ungulina,* and M. Mittré's description and figure, show the necessity of forming for these genera, as recommended by M. Mittré, a family, which may be called *Ungulinadæ,* characterized by the single anal siphonal aperture, and the presence of two pairs of gills and distinct labial tentacles, which will contain the genera, 1. *Ungulina,* Lamk., 2. *Scacchia* of Philippi, and 3. a new genus which may be called Mittrea, having *Diplodonta Brasiliensis* for its type. One of our English shells, *Tellina rotundata,* Montague, has been referred to the genus *Diplodonta,* but I have not been able to examine its animal, and according to the description of Mr. Clark, quoted by Messrs. Forbes and Hanley, it differs essentially from any of the preceding: "the mantle plain, somewhat closed posteriorly and anteriorly, but with a large opening for the foot in the centre of the ventral range: no siphonal process is to be found, not even an orifice, except the pedal one."—Brit. Moll. ii. 67. Should any of your readers have a specimen of this animal, I should be happy to have the opportunity of examining it; and also of the animals of any of our species of *Lucinæ.*

I may further remark, that the species of the genus *Diplodonta* have been confused with the *Cyrenellæ,* but the latter may be known by a careful examination of the teeth of the hinge, and the animal differs in having two siphons.

If M. Mittré's description of the animal of *Venus diaphana,* on which Recluz has formed his genus *Felania,* is correct, it will also have to be referred to the *Ungulinidæ.*

While on the subject, I may state, that the genus *Myllita* of D'Orbigny and Recluz, 'Journ. de Conch.' 1850, 88. t. 11. f. 12–14, is the same as *Pythina* of Hinds, 1844, Voy. Sulph. 70, and I believe established on the same species.

Etheriadæ.—The lips are very large, semioval, and attached by the straight side without any free point, as in *Mutela.* There is in fact no distinct muscular foot in the adult specimens. The body containing the liver projects into the cavity of the mantle, and has been described by Rang as a foot. The foot may be present in the young state before the shell is attached.

Through the kindness of M. D'Orbigny, who has sent me the original specimen of his genus *Acostea,* I am enabled to state that it is identical with the *Mulleria* of Férussac and Sowerby, and it appears to be the American form of this family.

Mytiladæ.—The pedal opening of *Crenella* is small, forming the hinder half or third of the basal margin.

MALLEACEA should be divided into three families:—

1. *Pinnadæ.* Mislead by Rang (Manual Moll. 292), this family was erroneously referred to *Mytilacea.* Anterior adductor muscle well developed. Gills narrow, very much produced behind, free from each other and the mantle, but fitting against a fold on its inner surface. Rectum with a long tubular process at its base. Vent medial. *Pinna.*

2. *Pteriadæ.* Anterior adductor muscle none. Gills narrow, much produced behind, free from each other and the mantle, but fitting against a fold on its inner surface. Rectum simple. *α. Avicula, Meleagris, Malleus,* and *Perna.* *β. Crenatula.*

In *Avicula* the hinder pedal muscle is separate from and in front of the large adductor muscle, with a separate scar; in *Meleagrina* it is close to and forms part of the large scar. There are some other small scars, two in front and one behind the circular central scar, formed by the ligaments of the muscles which suspend the mantle and gills.

3. *Vulsellidæ*. Anterior adductor muscle none. Gills narrow, much produced behind, united together and to the inner surface of the mantle, dividing the mantle-cavity into two parts. Rectum simple. *Vulsella*.

In all these families the body forms a single mass, the tube of the rectum passes over the back of the adductor muscle, the vent being free and medial.

OSTREINA. Add, *vent medial, free; the body forms a single central mass.*

Ostreidæ. Gills united together and to the inner edge of the mantle. Shell, hinge toothless.

Plicatulidæ. Gills free behind and free from the mantle, suspended from the body by a membrane. Shell, hinge with two diverging cross-grooved cardinal teeth.

The genus *Plicatula*, which has been hitherto placed with *Spondylus*, should be removed to the tribe *Ostreina* and formed into a separate family, as the animal has no appearance of any foot, which is so peculiar in the former genus. The animal is very like *Ostrea*, has four equal suspended gills united together, acute, and produced beyond the lower side of the adductor muscle. Lips four, rather small, united together above the rather large mouth. The shell is attached by the outer surface of the left valve, and the hinge is furnished with two diverging teeth, with the cartilages in a triangular pit between their base.

ANOMIAINA. *Foot distinct, small, truncated at the end; ovaries separated from the mass of the body and attached to the inner surface of the right leaf of the mantle. Vent nearer to or attached to the right leaf of the mantle. Gills united together behind, suspended by membranes to the inner side of the mantle.*

Anomiadæ. Animal attached, rather distorted; foot on the right side of the body, with a very large byssal pore at the base; byssus horny or stony, formed of parallel laminæ, emitted through a notch in the right valve of the shell. Pedal muscles large, leaving two or three large scars on the left valve. The byssus, or plug, is placed in exactly the same situation in the animal as the beard or byssus of *Mytilus*, *Pinna*, &c., and the animal is only rather distorted by being more closely attached to the marine body than in those genera.

It shows that what is called the foot of the Arcs is in fact an enlargement and production of this byssus-forming organ, while the real foot is greatly reduced.

Placentadæ. Animal free. Foot cylindrical, compressed, medial, without any byssal pore. Vent attached to the right leaf of the mantle. Pedal muscle small, leaving a small round scar between the diverging cardinal plates.

This family must be removed to the tribe of *Anomiaina*, having a distinct foot. The mantle leaves free, margin closely bearded. Foot when contracted in spirits compressed, elongate, larger at the end, truncated, and with a deep linear cavity at the end, apparently produced by the withdrawing of the tip, probably cylindrical, and much elongated and produced when alive. Gills suspended, occupying the front and lower edge. Anus tubular, conical, elongate at the hinder basal margin, attached to the inner side of the right mantle leaf. Lips elongate, attached by their hinder edge. Body surrounding the cardinal ribs and cartilages.

Pectenidæ.—The foot of *Pedum* is elongate, cylindrical, clavate, rather enlarged and rounded at the tip, without any appearance of a byssal groove.

III.—*Supplement to a Catalogue of British Spiders, including remarks on their Structure, Functions, Œconomy and Systematic Arrangement.* By John Blackwall, F.L.S.

[Continued from vol. xi. p. 120.]

Tribe OCTONOCULINA.

Family Salticidæ.

Genus *Salticus*, Latr.

After *Salticus notatus* in the supplement to the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. xi. p. 114) add

Salticus promptus.

Salticus promptus, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 173.

In October 1853, an immature female of this species, which is nearly allied to *Salticus frontalis* and *Salticus reticulatus*, was received from the Rev. Hamlet Clark, who took it near Northampton in the autumn of the same year.

After *Salticus reticulatus* in the supplement to the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. xi. p. 114) add

Salticus Jenynsii.

Salticus Jenynsii, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 174.

This addition to our indigenous *Saltici* has been made through the liberality of the Rev. Leonard Jenyns, M.A., F.L.S., from whom it was received in February 1853, together with numerous specimens of spiders which had been captured in Cambridgeshire.

Family Thomisidæ.

Genus *Thomisus,* Walck.

After *Thomisus cristatus* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. vii. p. 448) add

Thomisus audax.

Xysticus audax, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 25; Koch, Die Arachn. B. xii. p. 74. tab. 413. fig. 1005–1008.

Specimens of *Thomisus audax,* supplied by the Rev. Hamlet Clark, were met with near Northampton and at Holme Fen, Huntingdonshire, in the autumn of 1853. They were all females.

M. Walckenaer, regarding the *Xysticus* (*Thomisus*) *audax* of M. Koch as a mere variety of *Thomisus cristatus,* has included it among the synonyma of that species (Hist. Nat. des Insect. Apt. t. i. p. 521), from which, however, it is undoubtedly distinct.

After *Thomisus formosus* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. vii. p. 450) add

Thomisus floricolens.

Thomisus floricolens, Walck. Hist. Nat. des Insect. Apt. t. i. p. 532.
Thomisus dorsatus, Hahn, Die Arachn. B. i. p. 44. tab. 11. fig. 34; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 24; Koch, Die Arachn. B. xii. p. 56. tab. 410. fig. 991, 992; Sund. Vet. Acad. Handl. 1832, p. 221.

For this addition to our indigenous spiders I am indebted to Mr. R. H. Meade, who transmitted to me, in December 1853, adult males and immature females of *Thomisus floricolens* which had been captured by Mr. Francis Walker in that and the preceding year at Piercefield, near Chepstow, in Monmouthshire.

Family Drassidæ.

Genus *Drassus,* Walck.

After *Drassus cupreus* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. viii. p. 41) add

Drassus lapidicolens.

Drassus lapidicola, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 18; Koch, Die Arachn. B. vi. p. 28. tab. 188. (misnumbered 187 in the text) fig. 450, 451.

Clubiona lapidicolens, Walck. Hist. Nat. des Insect. Apt. t. i. p. 598; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 479.

Clubiona lapidicola, Latr. Gen. Crust. et Insect. tom. i. p. 91; Sund. Vet. Acad. Handl. 1831, p. 139; Hahn, Die Arachn. B. ii. p. 9. tab. 40. fig. 100.

An adult male of this species, which was first recorded as British by Dr. Leach (see the Supplement to the 4th, 5th, and 6th editions of the 'Encyclopædia Britannica,' article Annulosa), has been transmitted to me by the Rev. Hamlet Clark. An examination of this specimen, which was found near Northampton in the autumn of 1853, and had recently changed its integument, has served to convince me that M. Koch has assigned to this spider its appropriate situation in a systematic arrangement of the *Araneidea* by transferring it from the genus *Clubiona* to that of *Drassus,* as by the figure and disposition of its eyes and the structure of its oral apparatus it evidently appertains to the latter genus.

After *Drassus nitens* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. viii. p. 42) add

Drassus propinquus.

Drassus propinquus, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 175.

Two adult males of *Drassus propinquus,* which is closely allied to *Drassus nitens,* were captured in the spring of 1853; one running on a public road near Llanrwst, and the other in a window of the sitting-room at Oakland. In the summer of the same year Mr. R. H. Meade took an adult male of this species in Norfolk.

Genus *Clubiona,* Latr.

After *Clubiona comta* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. viii. p. 44) add

Clubiona pallens.

Clubiona pallens, Koch, Die Arachn. B. vi. p. 19. tab. 185. fig. 443, 444.

Three adult females and an adult male of *Clubiona pallens* were received in October 1853 from the Rev. Hamlet Clark, who informs me that they were taken at Holme Fen, in Huntingdonshire, about the middle of September in the same year.

I have not included the *Clubiona pallens* of M. Hahn (Die

Arachn. B. ii. p. 10. tab. 40. fig. 101) among the synonyma of the above species, as there appears to be much uncertainty about its identity. M. Walckenaer has added the *Clubiona pallens* of M. Koch to the synonyma of *Clubiona amarantha* (Hist. Nat. des Insect. Apt. t. ii. p. 478), supposing it to be the latter species in an immature state, for he remarks that "c'est une jeune que M. Koch a décrite;" this, however, is a mistake, as it is a smaller and perfectly distinct species, and M. Koch's figure of the male clearly represents an individual with the palpal organs fully developed.

Genus *Argyroneta*, Latr.

Argyroneta aquatica.

To the remarks on this species given in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. viii. p. 97) the following particulars relative to its œconomy may be added. In May the female deposits from 80 to 100 spherical eggs of a yellow colour, not agglutinated together, in a lenticular cocoon of white silk of a compact texture measuring ⅓rd of an inch in diameter.

Family THERIDIIDÆ.

Genus *Theridion*, Walck.

After *Theridion nervosum* in the catalogue (Annals and Mag. of Nat. Hist, Second Series, vol. viii. p. 442) add

Theridion pictum.

Theridion pictum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 304; Walck. Hist. Nat. des Insect. Apt. t. iv. p. 489; Hahn, Die Arachn. B. i. p. 90. tab. 22. fig. 68.
Steatoda pictum, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 9.
Theridium pictum, Koch, Die Arachn. B. xii. p. 139. tab. 429. fig. 1062, 1063.

Two adult females of this handsome *Theridion* were received from the Rev. Hamlet Clark in October 1853. Both specimens were captured at Richmond in the autumn of the same year by Mr. George Guyon.

Family LINYPHIIDÆ.

Genus *Linyphia*, Latr.

After *Linyphia gracilis* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. ix. p. 19) add the following species.

Linyphia tenella.

Linyphia tenella, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 177.

An adult female of this *Linyphia* was received from Mr. R.

H. Meade in September, and an immature one from the Rev. Hamlet Clark in October 1853.

Linyphia circumspecta.

Linyphia circumspecta, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 177.

In the autumn of 1853, males of this species, having the palpal organs fully developed, were discovered among herbage growing in woods about Oakland.

Linyphia flavipes.

Linyphia flavipes, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 178.

Adult males of *Linyphia flavipes* were found among moss in woods at Oakland in the summer of 1853.

Genus *Nerïene*, Blackw.

After *Nerïene sulcata* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. ix. p. 271) add

Nerïene herbigrada.

Nerïene herbigrada, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. xiii. p. 179.

Early in October 1853 both sexes of *Nerïene herbigrada*, in a mature state, were detected among coarse herbage and moss growing in woods on the northern slope of Gallt y Rhyg. Like *Nerïene sulcata*, this species makes a near approximation to the spiders of the genus *Walckenaëra*.

Nerïene dubia.

The following fact may be added to the remarks on this species in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. ix. p. 272). An adult male was taken by Mr. Francis Walker at Piercefield, in Monmouthshire, in the summer of 1853, and was transmitted to me by Mr. R. H. Meade.

Family Epëiridæ.

Genus *Epëira*, Walck.

After *Epëira umbratica* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. x. p. 182) add

Epëira agalena.

Epëira agalena, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 36.
Epëira Sturmii, Hahn, Die Arachn. B. i. p. 12. tab. 3. fig 8.

Atea agalena, Koch, Die Arachn. B. xi. p. 137. tab. 391. fig. 936–938 (the specific name *hyalina* is incorrectly connected with the numbers 936, 937 in the plate, but this error is rectified in the text).

In the month of June this *Epëira* may be found in a state of maturity on trees and bushes in the woods about Oakland.

After *Epëira ornata* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. x. p. 185) add

Epëira ceropegia.

Epëira ceropegia, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 51.
Epëira sclopetaria, Hahn, Die Arachn. B. ii. p. 46. tab. 57. fig. 131.
Miranda ceropegia, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 4; Koch, Die Arachn. B. v. p. 51. tab. 158. fig. 370.

Mr. Francis Walker captured an adult male of this species at Piercefield in the autumn of 1853, and forwarded it to Mr. R. H. Meade, from whom I received it in December in the same year.

After *Epëira inclinata* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. x. p. 187) add

Epëira albimacula.

Zilla albimacula, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 5; Koch, Die Arachn. B. vi. p. 144. tab. 215. fig. 534, 535.

In December 1853 an adult male of this species was received from Mr. R. H. Meade, which had been taken by Mr. F. Walker at Piercefield in the summer of the same year.

M. Walckenaer has placed the *Zilla* (*Epëira*) *albimacula* of M. Koch among the synonyma of *Epëira agalena* (Hist. Nat. des Insect. Apt. t. ii. p. 37); but the males of these species differ in the design formed by the distribution of their colours, in the armature of their anterior legs, and in the structure of their palpal organs.

After *Epëira tubulosa* in the catalogue (Annals and Mag. of Nat. Hist. Second Series, vol. x. p. 249) add

Epëira calva.

Epëira calva, Blackw. Annals and Mag. of Nat. Hist. Second Series, vol. x. p. 99.

An immature female of this interesting *Epëira* was received in October 1853 from the Rev. Hamlet Clark, who states that it was taken in Leicestershire.

IV.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.*

By Thomas Williams, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[With two Plates.]

[Continued from vol. xiii. p. 312.]

Mollusca.

The Annulose and Arthropodal series conduct by a separate path across that wide space which divides the Echinodermal from the Vertebrate animal. The Molluscan subkingdom traverses the same distance by a divergent route which begins at the Bryozoon and terminates at the Cephalopod. These grand invertebrate chains of beings unite mutually below at the Echinoderm and Bryozoon, and superiorly at the basilar link of the vertebrated series. The zootomist, having studied serially the articulate families, is constrained to return to the base of the invertebrate cone, in order to seize the point of departure of that independent road along which the molluscan families attain the summit. Between these groups there exist few points of intercommunication. Reciprocal affinities nowhere attract attention. The Mollusca constitute a separate study: in varieties of form they are equalled by no other division of invertebrate animals; in number of species they exceed almost the limit of arithmetic; in diversities of structure they bewilder the anatomist; in modes of life discordantly diverse, they perplex the student of their habits. And yet a deeper insight into the plan of the molluscan organism enables the earnest thinker to seize the clue of natural union which obtains between the countless members of this variegated group.

Provided with a heart to circulate the blood, a distinct alimentary system, a nervous system, and its satellitic organs of sense, a muscle-apparatus, viscera of complex organization, and a blood-fluid fibrinized and corpusculated, they offer to the physiologist a problem by no means easy of solution.

Of this composite machinery the respiratory function is the primary moving power. Without it nothing can go on. It is momentarily important. What provisions are made to insure its full and adequate performance? The terrestrial Gasteropods excluded, all mollusks respire on the aquatic principle. They are tenants of the water. The organs of breathing in bulk and complexity of structure far surpass those dedicated to other offices. The bulk of blood, which at any given time is included within the limits of the branchial organ, is relatively considerable. Measured by the complex magnitude of the branchiæ, the inert oyster is a physiological paradox. It is hard thence to believe that muscularity and respiration are directly proportional. The force generated by the act of breathing is expended in other directions. Cephalopods and air-breathing Gasteropods apart, the branchial structures of every known mollusk are abundantly ciliated. In this anatomical particular they contrast strikingly with those of the Crustacea. Both are breathers of water. In one only are cilia provided. The question implicating the *reason* of natural things lies far too deep to be fathomed by a mechanical explanation. In both the purpose to be accomplished is the same; in both the means employed are intimately similar, and yet in one instance vibratile cilia are constituently admitted into the mechanism, in the other they are rejected. Biochemistry at a future æra will elucidate these mysteries.

The peripheric circulation in the Mollusca is lacunar rather than capillary. This capital fact was first established by Milne-Edwards* and Valenciennes †: these authors describe the blood as effused into the parenchyma of the body. It returns into the veins without the intervention of capillaries. The details upon which rest these general postulates will be afterwards stated. In the anatomical character of the peripheric passages, in the small proportion of fibrine in the blood, the circulating system and the blood of the Mollusca resemble obviously the chylaqueous fluid and its containing system.

In all mollusks, separate, specially constructed organs are consecrated to the function of breathing. Even the Brachiopoda are not exceptional to this rule; they are pallio-branchiate. The universal presence of complexly formed and profusely multiplied respiratory organs attests the extreme value of the office which they are designed to fulfill.

The ultimate vessels of the branchiæ in all mollusks, those of Brachiopods and Tunicates ‡ excepted, occur in the form of straight

* Obsérv. et Expér. sur la Circul. chez les Mollusques.—Comptes Rendus, 1845, xx. p. 261.

† Nouv. Obsérv. sur la constit. des appareils de la Circul. chez les Mollusques.—*Ibid.* p. 750. See also Ann. des Sc. Nat. 1845, iii. p. 289.

‡ I regret that no recent opportunity has occurred to me to test the validity of the anatomical principle expressed in the text. For the present I assume that the ultimate blood-channels in the branchiæ of the Tunicate mollusks *reticulate* (Pl. I. fig. 2 & fig. 4); that is, that the blood which moves at one moment in one direction courses at the next in another at right angles with the former, the whole being on the same plane, and the circumscribed stigmata being water-passages. This assumption conforms with the description of all observers from the time of Savigny.

parallel non-communicating tubes, of regular outline and uniform diameter in the Lamellibranchiata, of irregular contour and variable diameter in the Cephalophora. In *all*, the ultimate blood-channel constitutes one, single, independent tube from one end of its course to the other. Returning upon itself it does not lose its individuality: it nowhere inosculates: it reticulates in no single instance. *One* foundational law of structure is thus proved to preside over the disposition of the ultimate elements of the branchial organs in all the mollusks above the Tunicata. Already the thoughtful eye descries the bright, continuous thread of 'principle' linking remotely separated and disjointed varieties into the golden chain of consistent unity. Another generality no less remarkable remains to be propounded. The branchiæ of *all* Tunicate and *all* Lamellibranchiate, and a considerable majority of the Gasteropod mollusks are *penetrated* by the aërating water. The branchia is a sieve through which the water filters. This act of branchial filtration is a fundamental fact in the history of all the inferior mollusks. The area which is circumscribed by the mantle, at least in all Tunicate and Lamellibranchiate mollusks, is divided more or less completely into two distinct compartments, the one pallial and external, the other internal and visceral (Pl. I. fig. 7, *c* & *d*; Pl. II. figs. 9 & 13). The branchiæ constitute *cribriform* plicæ developed on the divisional membrane (fig. 7, *e, e, e, e*) by which these two compartments (*c, d*) are separated.

These leading propositions outlined in brief, will suffice to prepare the mind for the right conception of those interesting details which it is now proposed to consider.

The limits of these papers render it impossible to refer *in extenso* to those anatomic specialties by which the branchial organs of every species are more or less differentially characterized. Those only can be selected for study which involve a typical principle. Rules, not exceptions, it must be the aim of these investigations to define.

Tunicata.

Tunicate mollusks stand immediately above the Bryozoon. From the latter they are distinguished in the possession of a heart. The movement of the blood is due exclusively to the contractions of this central organ. The heart is systemic and tubular. In many genera it is valveless, as indicated by alternations of direction in the blood's course. No definitely parieted vessels occur on any segment of the peripheric arc of the circulatory system. To this rule the branchial forms an exception. The branchial "bars" are, however, not ordinary vessels. They are peculiarly formed. They are not analogous to those of the vertebrated animals. They are bounded by skilfully configurated cartilages, as will be afterwards explained. In the Tunicata, as in other Acephala, the blood leaving the open ends of the arteries passes into the interstices—*lacunæ*—of the parenchyma of the body; thence it is taken up by the open mouths of the venous radicles. The solids are thus literally soaked in the fluids. The former are everywhere bathed by the latter. It may be affirmed in a general sense, that the higher the serial position of the animal, the smaller the breadth of the ultimate blood-currents, and conversely. The degree of subdivision which occurs in the blood-streams represents a numeric measure of the nutritive actions. The area comprehended by the mantle is divisible in the Tunicata, as in Acephala, into two sub-areas. The one is either bounded, lined, or traversed by the branchiæ, and contains the mouth; the other embraces the viscera and includes the anal outlet. This fact is absolute. That space into which the *mouth* opens is homologous with the pallial extra-branchial or general cavity of the mantle in the Acephala. That in which the intestine terminates coincides with the intra-branchial or visceral enclosure in all bivalves. An exact conception of these primary divisions of the body in the inferior mollusk is really indispensable to the perfect understanding of those respiratory and alimentary currents of the water, the direction and relative bearing of which have perplexed anatomists from the epoch of Cuvier to the æra of Messrs. Hancock and Clark.

In the œconomy of the Tunicate and Acephalan mollusks this principle is inviolable—that nothing, neither water nor alimentary particles, is conducted to the mouth, which has passed *through the gills*. Water charged with carbonic acid is never swallowed.

The feculent pellets are never and cannot be mixed with the alimentary. The current which conveys fresh water to the branchiæ is convective also of food to the mouth. The stream which carries away the effete product of respiration bears off the feculent rejectamenta.

There are then, in truth, but *two* chief œconomic water movements in these animals—that which enters the pallial or extra-branchial space, and that which leaves the visceral and intra-branchial inclosure. This is simple and intelligible. It resembles a ray of light shining amidst a darkness which for half a century has brooded over a vexed and perplexing controversy.

It is impossible to perform one step in advance towards a more satisfactory knowledge of this subject, unless the meaning of the "siphons" (Pl. I. fig. 1, *a*, *h*) be first brought into the light of clear definition. They are commonly distinguished into the branchial and the anal. The terms in the ordinary signification would indicate the first as the orifice of ingress, and the last as that of egress. This, however, is not the acceptation in which they are used by authors of great celebrity. Mr. Rupert Jones* observes: "The position of the animal is such, that of the two orifices the branchial is always the highest; the entrance into the branchial sac being generally placed at or near the superior extremity of the body, and the œsophageal opening at the base of the branchial sac having an upward direction." This is directly opposed to the definition of M. G. P. Deshayes†, who says—"Whether connected or not, the superior siphon is always characterized as the *anal*, the inferior as the *branchial* siphon." Of course the comparative "superior" must mean that which is nearest to the hinge or dorsum; "inferior," that which is next to the venter, the antipodal point to the hinge. The branchial siphon of Mr. R. Jones is therefore correspondent with the anal of M. Deshayes.

The expression of Cuvier—"deux ouvertures séparées, l'une pour la respiration, l'autre pour les excrémens," &c.—suggests the idea that one tube, the branchial, is devoted exclusively to respiration; that is, that through the *same* tube the inspiratory and expiratory currents concerned in breathing take place.

Dr. George Johnston observes: "The water is imbibed through a branchial siphon. The effete fluid is expelled again through another or anal siphon ‡." The branchial siphon of other authors is the longest or superior, and is distinguished as that which *emits* the refuse water which has traversed the branchiæ. The branchial siphon in the sense in which it is used by Mr. Garner § is synonymous with the inhalent tube, and the anal with the exhalent. In this acceptation the terms are also used by Forbes and Hanley ||, by Alder and Hancock ¶, and by Mr. Clark in his excellent controversial papers against Mr. Hancock in the 'Annals.' Dr. J. E. Gray attaches to these words a similar meaning, calling the inhalent 'the lower' siphon, and the exhalent 'the upper'**.

The "branchial" siphon of the most esteemed authors then is that tubular extension (Pl. I. fig. 7, *a*, *a'*) of the mantle by which the surrounding element is admitted into the "bran-

* See article Tunicata.—Cyclop. Anat. Phys.

† See the article Conchifera.—Cyclop. Anat. Phys.

‡ See his recent excellent work, entitled 'Introduction to Conchology,' p. 275. Van Voorst, 1850.

§ Transactions of Zoological Society, vol. ii. p. 91.

|| British Mollusca, vol. i.

¶ See their valuable papers on the Branchial Currents in *Pholas* and *Mya*, Annals and Magazine of Natural History, Oct. and Nov. 1851.

** See his original and instructive papers in recent Numbers of the 'Annals,' on "A Revision of the Arrangement of the Families of Bivalve Shells," &c.

chial vault" (Clark), "branchial chamber" (Hancock), or "pallial cavity" (Forbes and Hanley) (*d*). It is indifferently described as the "lower," "shorter," "inferior" or "ventral." It is the further of the two siphons from the hinge. Its office is "inspiratory," "inhalent," "branchial" or "prehensile."

The "anal" siphon (fig. 7, *b*, *b'*) is variously defined as the "upper," "superior," "dorsal," "exhalent," "excrementitial," "expiratory," "longer," &c.

That is called "inhalent" which the most conscientious and truth-loving observers declare does not inhale: that the "exhalent" to which an emissive office is strenuously denied! There are but two cavities (fig. 7, *c*, *d*) and only two siphons (fig. 6, *a*, *b*). Of the latter one communicates with one cavity, the other with the other. The boundaries of these cavities severally are conspicuously and unequivocally marked. They are as distinctly defined as the siphons with which they respectively communicate. But though clearly bounded they are not independent. Fluid introduced into the one will unquestionably pass into the other*. Neither the process by which food is brought to the mouth, nor that of respiration, could be understood before the fact was discovered of the *permeability* of the branchial lamellæ. To Dr. Sharpey should be ascribed the merit which belongs to the first discovery of this point†; to Mr. Hancock that of its full and com-

* At a subsequent stage of these inquiries, this general statement will be supported by abundant evidence.—See Acephala.

† Dr. Sharpey's description cannot be misconstrued. "On removing one of the valves, turning down the cloak, and putting moistened charcoal powder on the surface of the gills, the finer part of the powder soon disappears, having *penetrated through the interstices of the bars or vessels* into the space between the two layers of the gills. On arriving there, a part is often forced out again from under the border of the unattached layer at the base of the gill, but most of it is conveyed rapidly backwards between the two layers, and is carried out at the excretory orifice with the general current . . . The coarser particles remain outside the gill and are slowly carried to its edge, following the direction of the bars: they then advance along the edge of the gill towards the fore part of the animal. It thus appears that the water first passes in between the lobes of the mantle to the external surface of the gills; it is then *forced* into the space enclosed between their layers, from whence it is driven out at the excretory orifice, *to which the enclosed spaces of all the gills lead.* As this process continues to go on after the shell and lobe of one side are removed, it is evident that the motion of the water must be *mainly produced by the cilia of the gills.* . . . By their agency the fluid is forced into the space within the gills, and this operation taking place over the whole extent of the gills, must by its concentrated effect give rise to a powerful issuing stream at the excretory orifice, of which the entering stream seems to be a necessary result."—Art. CILIA: Cyclop. Anat. & Phys. In this most able summary, three *principles* are lucidly affirmed:—1st. That the water concerned in breathing *permeates the branchial lamellæ,* and thus traverses the partition which divides

plete demonstration. Mr. Clark*, however, embraces still the doctrine which contends for the non-communicating independence of the siphons and of the cavities of which they are the external continuations. In this respect, his conclusions are directly opposed to the results of the author's observations. That the cavities recently so clearly defined by Mr. Hancock are by structure and office distinct, will be afterwards irrefragably proved. This division of the pallial enclosure into two leading sub-areas constitutes a fundamental feature in the œconomy of the Tunicate and Lamellibranchiate mollusks. It suggests a natural process of thought by which the siphonic actions are interpreted infallibly. It will be subsequently proved, that that siphon which is said by Messrs. Alder and Hancock to give ingress to the water, is really no more branchial than that by which the fluid makes its egress. Both bear to the branchiæ the same anatomical relation. It were as correct to designate the opercular orifice in the fish as the "anal," and the mouth as the "branchial," as to apply such terms to the siphons of the Tunicata and Acephala. Such designations misinform. They express either what is not true, or what is only partially true. The "branchial" siphon is as much oral or prehensile as branchial. The "exhalent" as much anal as expiratory.

It is quite established that two distinct offices devolve upon each siphon. The one is designed to take in water for the purpose of breathing, and alimentary particles for the purposes of food; the other emits at once the products of the respiratory and digestive processes. One name as applied to either will not express the double function. Let the name therefore be drawn

the pallial from the anal chamber. 2ndly. That by this act of sieving the food, the aliment is separated from the water and impelled by ciliary action towards the free margins of the gills and along the groove formed expressly for this purpose on this margin, and finally borne in the direction of the mouth. And 3rdly. The distinctness of the inhalent from the exhalent current; while Dr. Sharpey speaks plainly upon the point that the *excurrent* is set in motion *exclusively* by the *branchial* cilia. It is extraordinary that, in asserting claims to originality upon these very points, in papers published ten years afterwards, so careful and honest a student as Mr. Hancock should have permitted this accessible and celebrated article of Dr. Sharpey to elude his literary search! I rejoice rather than lament over Mr. Hancock's "sin of omission." Confirmation, enriched by numerous valuable original details, proceeding from so truthful an observer, must prove of immense service to the cause of science; but, *palmam qui meruit*. To widen the bounds of knowledge is the highest gratification which belongs to the true man of science. This is his most valued title of nobility. To withhold from the labourer his just reward, is to perpetrate a criminal offence against science.

* On the Pholadidæ.—Ann. and Mag. Nat. Hist. Nov. 1850.

from structure rather than from office. In these papers accordingly that siphon which opens into the pallial or ventral chamber will be distinguished as the *extra-branchial* siphon; that leading from the dorsal, visceral or anal cavity, as the *intra-branchial siphon.* These distinctives express only the anatomical position of these tubes relatively to the branchial partition by which they are separated. They involve no hypotheses. They attribute no function. They cannot misguide.

In the Tunicata the *extra-branchial* siphon (Pl. I. fig. 1, *a*; 2, *a*; 3, *a*) leads into the pharyngeal cavity (*b*), which is homologous with the ventral or pallial chamber of the Acephala. It is the longer and higher of the two. All fluid which reaches the mouth (fig. 3, *b*), seated at the lower boundary of this cavity, must gain the pharyngeal chamber through the extra-branchial siphon. All alimentary substances *rejected* by the mouth, that is, those material particles *not swallowed*, are sent out again by a convulsive jerk of the cavity through the *same* siphon. It is essential to distinguish the substances thus *refused* by the mouth from the true excrementitious pellets which are *always* ejected by the *intra-branchial* siphon.

The *mode* in which the surrounding element enters the pallial space has distracted controvertists, and divided them in belief. By Mr. Hancock, representing one class of observers, it is maintained that the inhalent current is set in motion exclusively by the action of vibratile cilia seated on the lining membrane of the siphon itself. By Mr. Clark this explanation is denied. The former naturalist rests his theory upon the alleged demonstration of cilia on the *internal* surface of the inhalent siphon, the latter upon observation of the currents. The inquiries of Mr. Hancock were confined to the Lamellibranchiate mollusks. But it may be stated with confidence, that what is true of this class will apply to the case of the Tunicata. The dispute is really easy of adjustment. The adjustment here, however, fails in this sense, that the demonstration which is negative is less persuasive than that which is positive. To prove a denial is less easy than to substantiate an affirmation. The microscope leaves it beyond doubt, that the internal lining membrane of the *extra*-branchial siphon of the Tunicate is *not* provided with a vibratile epithelium. They sometimes exist on the tentacles at the base of the siphon, but most certainly not on the walls of the latter. The water which enters this siphon is assuredly therefore not drawn in by the agency of cilia within the siphon.

Further observations are required to determine the exact course of the currents excited by the cilia distributed over the branchial bars. It is not proved that the water enters the siphon in virtue of the cilia situated at the latter point. It enters at the moment of the diastole of the pharyngeal chamber. Such a movement operates suctorially upon the fluid within the sphere of its influence. Having entered the cavity, the water is whirled in a thousand *definite* directions by the branchial cilia. Every particle of material substance contained is rolled into minute pellets and borne in the direction of the mouth. If it be palatable, it is swallowed; if not, it is emitted forcibly again by the same siphon. The water which falls under the influence of the proper branchial cilia is impelled in such manner and direction, and in myriad invisible currents, that it permeates the branchial membrane (fig. 1, *b*; fig. 2, *b*) by means of the meshes circumscribed by the vascular bars. The passage of the water through these meshes does not occur in direct currents, but in streams which pass up and down the sides of the meshes several times before they finally reach the *intra-branchial* or visceral cavity—therefrom to be rejected by the intra-branchial or anal siphon, so that the aërating element by this contrivance is detained for some time in contact with the blood-channel. The egressing current saturated with carbonic acid escapes from this latter siphon in a *continuous* stream,—such a stream as an uninterruptedly acting force alone could determine. The microscope was accordingly applied to the examination of the lining of this siphon, anticipating the immediate detection of vigorous ciliary action. Ascidians, Cynthians, and Clavellinans, submitted to careful inspection, disproved the anticipation. In none, by any device, could cilia be demonstrated on the inner wall of this anal or *intra-branchial* siphon. The current, therefore, which escapes at its orifice is not set in motion by any force within the limit of the siphon itself, but rather by that which is placed at a distance—the *branchial* ciliary action. The space interposed between the branchial membrane and the mantle in Tunicates forms a part of the intra-branchial or visceral cavity. It is filled with refuse water, rendered poisonous by carbonic acid. This effete fluid enacts no further part in the organism. It is finally rejected.

In the Tunicata then the two siphons are *continuous* through the branchial stigmata. The mass of water which always more or less fully distends the body of the animal, observes only one normal or regular movement, viz. that tending from the extra-branchial siphon (fig. 1, *a*) in the direction of the intra-branchial (*h*). The *irregular* and *occasional* currents are propelled in the reverse directions. The pharyngeal cavity may muscularly contract, and now and then emit pure unrespired water, and unused alimentary substances held by this water in suspension. If such discretionary power did not exist, the indiscriminating mouth would swallow every solid substance borne mechanically into the pharyngeal chamber by the water drawn in by the extra-branchial siphon. Nature's machinery would then, indeed, wear the disgraceful impress of faultiness.

In the Ascidians the branchiæ completely line the walls of the pallial chamber. In figure the chamber varies; it is oblong in some species, oval and rectangular in others. The branchial membrane in *Ascidia, Phallusia,* &c. forms a plane unfolded sheet, adapting itself to the cavity of the mantle; in *Cynthia, Boltenia,* &c. it is longitudinally plicated (fig. 5) and disposed in deep and regular folds. The ultimate vessels (*d*) are arranged rectangularly. The circumscribed 'stigmata' (*c*) are parallelogrammic in figure. These perforations lead from the pharyngeal into the "thoracic" chamber of Milne-Edwards. Why it should be called 'thoracic' is difficult to understand. As already defined, it is really the visceral, intra-branchial or cloacal cavity. The branchial vessels in the Ascidians are arranged in two planes (fig. 4). In *Cynthia ampulla* the meshes are very irregular and almost inextricable, some of the minute vessels having apparently a spiral arrangement. In *Chelyosoma,* Eschricht figures a similar vermicular disposition of the branchial vessels. The branchial membrane of *Cynthia* presents large longitudinal vessels. They are crossed by others of equal size. Large meshes (*d*) are thus formed. Smaller vessels (*b*) lying on a different plane form by crossing smaller stigmata. In *Ascidia* and *Chelyosoma,* the angles of the meshes of the branchial membrane bear *papillæ* (*c*) more or less prominent. In *Cynthia* they do not exist. These papillose processes are hollow recesses. They are by-receptacles for the nutritive fluid. In size the branchial vessels vary in different genera. In *Cynthia* they are large, in *Ascidia* they are minute, in *Cystingia* they are indistinct. The branchial plicæ converge at the mouth whenever they exist.

By Carus and Van Beneden a *lateral* opening in the respiratory cavity has been indicated, by which the water passes directly from the branchial sac into the cloaca (fig. 1, *o*; fig. 3, *e*). This aperture corresponds with the open fissure which in many species of Acephalans exists between the attached border of the branchiæ and the base of the foot. It is a safety-valve, as will be hereafter explained.

In Clavellinidæ, Botryllidæ, in the genera *Pyrosoma, Pelonaia* and *Salpa,* such is the structure of the branchiæ, that the water readily traverses the respiratory stigmata, and passes from the extra-branchial into the intra-branchial chambers.

In all genera the branchial membrane is attached by means of threads and vessels externally to the mantle.

The branchiæ in the Clavellinidæ exist in form of a band stretching across the cavity of the mantle, and dividing the pharyngeal from the cloacal chamber. In ultimate structure the branchiæ of this genus differ from those of the Ascidians: in place of presenting on each side simple striæ furnished with vibratile cilia, as in the Salpians, they bear right and left a series of filiform appendages directed horizontally towards the ventral side of the respiratory cavity, where they are fixed on each side of the middle sulcus, and during their passage across are united together by a number of other slender vertical filaments. From this disposition of parts there results a kind of trellis-work, which fills up all the pharyngeal portion of the branchial chamber, permitting no communication between the latter and the cloaca except through the meshes of its network, which are bordered all around with vibratile cilia*.

The branchial sac of the Botryllidæ is like that of the Clavellinidæ: it is similarly organized. The branchial spiracles are variable in number. It is in general only slightly folded. The respiratory sac in *Botryllus* lies horizontally, and has only nine rows of stigmata, grouped into threes by the longitudinal folds. The angles of the branchial network are marked with *papillæ* in *Distoma* and *Diazona*.

The *branchiæ* in *Pyrosoma* line the internal tunic of the mantle. They are orally disposed. They consist of numerous vessels or channels anastomosing with each other at right angles. "Nothing is more curious," says Milne-Edwards, "than the respiratory apparatus of these animals, when the vibratile cilia with which each of the stigmata is furnished are simultaneously effecting their vorticiform movements with rapidity and perfect harmony†."

In *Salpæ* the gill is constructed of a flattened tube, stretched on a vertical plane obliquely across the central or branchial cavity of the body. It is composed of a double membrane formed by a fold of the internal tunic or mantle. It partitions the branchial chamber into two portions—the pharyngeal and cloacal.

The circulatory systems of the Ascidians resemble that of the Bryozoa. If the heart were removed, it would be a chylaqueous system. It is transitional between the Polypes and the Mollusks. Van Beneden compares the Ascidian to a digestive canal suspended in the midst of an external envelope surrounded by a fluid moving in the open spacious perintestinal space. It is only in the branchial network and tentacles that it can be said to be contained in vessels.

Mr. Gosse gives an exact description of the living circulation in *Perophora Listeri* (fig. 3). Speaking of the blood-globules, he

* See article TUNICATA.—Cyclop. of Anat. and Phys.

† Annales des Sciences Naturelles, 2nd ser. tom. xii. p. 375 (1835).

observes, "They do not appear to pass into a defined system of vessels, . . . but find their way through the interstices of the various organs in the various cavities of the body. . . . They proceed by jerks; some find their way into the space between the breathing surfaces, and slip in between the rows of oral rings (*stigmata*), and wind along down between the rings in irregular courses*."

In the Ascidiadæ and Clavellinidæ the centres of this system consist of two trunks, a dorsal and a ventral, the capillary system of the branchiæ being intermediate. Lister's famed observations on this subject should be consulted†. The descriptive details afterwards to be presented on the subject of the respiratory and circulatory systems of the Acephalans, will illustrate many points of interest in the structure of the corresponding systems of the Tunicata. The peripheric channels of the blood are analogous in the two classes. The ultimate structure, though not the *arrangement* of the vessels of the branchiæ, is also similar. The nutritive fluids, morphotically distinctive, are chemically identical in the two classes.

Acephala.

In the Terebratulidæ there exists no express apparatus for breathing. With the Craniadæ they are therefore placed at the inferior limit of the Lamellibranchiate series. Prof. Owen has shown that the mantle in the Brachiopods is more vascular than in those orders of bivalves in which gills exist. Dr. Carpenter‡ has lately shown that the external layer of the mantle in *Terebratula* and certain other Brachiopoda, sends out *cæcal* tubes *through* the shell. They are respiratory in office, and the exact counterpart of those membranous processes which the author of these papers has described in the Echinodermata as projecting up above the external surface of the body. The *cæcal* character of these parts establishes a community of type between the fluid system of the Brachiopods and the chylaqueous system as defined by the author. The arms are long, richly ciliated tubes. In these tubes the blood moves in a *single* channel by flux and reflux. This incident also in the history of the fluids allies these inferior mollusks with those animals in which a chylaqueous system only exists. This latter fluid never undergoes an orbital movement: it fluctuates to and fro. The ultimate respects in which the vessels in the mantle of the Brachiopods differ from

* See his interesting work, 'A Naturalist's Rambles on the Devonshire Coast,' p. 245.

† Phil. Trans. 1834.

‡ Proceedings of the Royal Society, April 6, 1854.

those of the mantle of the higher Acephala; and what differentiation of these parts was required to enable an ordinary structure to discharge a special office, has been shown by Dr. Carpenter.

The organs of breathing are well developed in all the Lamellibranchiate Acephalans. Their vascular system is elaborately multiplied. They are capable of containing a considerable amount of blood. If aquatic were not less intense than atmospheric respiration, the aggregate area of the surface exposed by the gills of mollusks in general would insure a measure of effect sufficient to raise these animals high in the scale of physiological activity. *Surface* is not the only factor to be counted in determining the dynamic value of the respiratory office. The composition of the blood demands a numeric place in the calculation. If the fluid occupying the vessels were identical in density with the exterior element, no interchange of gases could proceed. A difference in the specific densities of the gases held in solution by fluids of identical gravities would constitute a condition in virtue of which the gases would reciprocally move independently of the fluids. The less the proportion of fibrine in the blood, other things being equal, the lower is its absorptive capacity for gases. The blood of mollusks is less charged with fibrine than that of the higher Articulata. In the former the floating corpuscles are less highly organized. They are strikingly less filled with solid contents. They are smaller and yet not more numerous. The physical conditions as regards the fluids then are not favourable in the Mollusca to a high rate of respiration.

Cuvier first defined the bivalve mollusks under the title of *Acephala testacea*. By Lamarck they were constituted into a separate class under the name of *Conchifera*. M. de Blainville marshalled them under the order *Acephalophora lamellibranchiata*. The anatomical definition of Cuvier presents clearly the chief points of structure:—"Leur corps qui renferme le foie et les viscères est placé entre les deux lames du manteau; en avant, toujours entre ces lames, sont les quatre feuillets branchiaux striés regulièrement en travers par les vaisseaux; la bouche est à une extremité, l'anus à l'autre, le cœur du côté du dos; le pied, lorsqu'il existe, est attaché entre les quatre branchies*."

The *mantle* of the mollusk is a grand feature of the organism. Its horizontal lobes embrace, its *vertical* process, on which the branchiæ are evolved structurally and functionally, bisects, the whole body. The mantle at once invests and secretes the shell, and forms the very basis of the body of the animal. It is composed of muscles, nerves, fibres, and vessels. It is lined internally in all cases with vibratile epithelium. A straight line,

* Règne Animal, vol. sur les Mollusques, p. 182.

carried from the anterior to the posterior extremity of the shell in any Acephalan, divides the mantle and the body into two very distinct and dissimilar halves. On one side lie the branchiæ and extra-branchial, ventral, or oral chamber (Pl. II. fig. 13); on the other are disposed the viscera, the intra-branchial or dorsal cavity; with the latter the exhalent or intra-branchial siphon is *necessarily* and *invariably* connected; in this dorsal compartment, also, the anal orifice terminates. That cavity (*b*) which lies on the ventral (the side opposed to the hinge) or right side of the hypothetical line, whether the ventral borders of the mantle be open or closed, siphonal or asiphonal, is always and *necessarily* filled with *pure water*. In this chamber the branchiæ (Pl. I. fig. 7^2, *a*, *b*) whatever be their number or position, figure or size, freely float; it is here always that the oral orifice (fig. 13, *a*) opens; it is at once a reservoir of pure water for breathing and pure material for food. All varieties centre in the unity of this idea—all specific aberrations are reducible to this basilar type. Specific diversities arise more frequently from variations in the number, size, siphonal or non-siphonal character of the openings communicating with this (oral or extra-branchial) chamber (Pl. I. fig. 6, *b*, *b*; fig. 7, *c*, *d*), than from those which occur in the siphonal processes of the intra-branchial or anal cavity (fig. 13, *e*). Mr. Clark * and Dr. J. E. Gray † are the most recent and distinguished conchologists who have attempted intelligently to found a classification of the Conchifera on the basis of the varieties which occur in the pallial orifices. Dr. Gray groups the whole class under two primary designations—the *Siphonophora* and *Asiphonophora*—which are again subclassified into orders, genera, and species. In the Pholadidæ, Myadæ, Gastrochænidæ, and Solenidæ, the ventral borders of the mantle are united, and the siphonal tubes are long and more or less distinct. The mantle is also closed in the Corbulidæ and Anatinidæ, but the siphons are short. In the Tellinidæ the mantle is open, while the tubes are prolonged. An open mantle coexists with short siphons in Cardiadæ, Veneridæ, Mactridæ, and Donacidæ. An open mantle is co-present with sessile tubes in Cycladidæ, Kelliadæ, Lucinidæ, Cyprinidæ, Unionidæ, and Arcadæ. In Mytilidæ, Ostreadæ, Pectinidæ, and Anomiadæ, the whole gape of the mantle is one undistinguished capacious orifice. Guided by the rule that pure water must in some manner or other, with adequate freedom, be admitted into the oral or extra-branchial cavity, it is quite obvious that the

* Ann. and Mag. Nat. Hist., June 1851. "On the Classification of the Marine and Testaceous Mollusca."

† Ann. and Mag. Nat. Hist., May 1854.

larger the ventral or common opening of the mantle, the *less* is the necessity for the lower or extra-branchial siphon. If, on the contrary, the leaves of the mantle be fused at their borders all round, a well-developed siphon is absolutely required. This cavity must have a free and ready communication with the exterior. If this communication is not established in one mode, it must in another. A siphon is a *necessary* provision if the mantle be closed; if open, it is only supplementary. In the former case, everything fluid and solid which enters the pallial cavity must pass through the extra-branchial siphon. It can gain the chamber through no other source. In the latter, the siphon is only incidentally and occasionally used. The great bulk of water drawn into the cavity rushes in through the ventral and pedal openings. That which, alike solid and fluid, is returned *unused* from this cavity, is indiscriminately jerked out by muscular action through any of the mantual openings. If the pellet of sand be situated near the opening of the siphon of this cavity, at the moment when it receives the impulse of ejectment, it escapes through the *inhalent* or extra-branchial siphon (Pl. I. fig. 6, *b*). If, on the contrary, it be placed at the other end of the chamber, it will be driven out either through the ventral or pedal gape. The orifice and direction in which *refused jets* of water take place from this cavity are contingent upon the position which the rejected portion may have previously occupied in the cavity. Upon this important point neither Mr. Clark nor Mr. Hancock are clearly informed. Mr. Clark is correct in stating that the ingress of the water into the great mantual or extra-branchial cavity is due, not to the invisible agency of vibratile epithelium on the lining membrane of the siphon, but to the diastolic separation of the valves. Mr. Hancock is undoubtedly in error in stating that the water entering this cavity is drawn in by cilia of the *siphon*. The microscope disproves completely the assertion that the internal lining membrane of the inhalent or extra-branchial siphon is the scene of ciliated epithelium. In no single instance of the numerous siphonal species examined by the author, could cilia be discovered in this situation. If at this place cilia do *not* exist, it admits of no dispute, that the occasional inward-tending current which reaches the cavity through this siphon cannot be due to the instrumentality of cilia, at this point at least. Mr. Clark is unquestionably wrong in supposing that, because now and then the inhalent or extra-branchial siphon, and the ventral and pedal openings of the mantle *emit* a jet of water and solid pellets, this cavity is therefore independent, that the "siphons therefore do *not* communicate," and that therefore the ingress and egress of the water designed for respiration take place through the same orifices. Every one of these inferences are *non-sequiturs*. Mr. Hancock is inaccurate in affirming that *all* the water which enters this cavity from without travels *exclusively* along the inhalent or extra-branchial siphon, and never, under any circumstance, through either the ventral or pedal openings *. *All* the water which is admitted into the extra-branchial cavity is not respired; in other language, does not pass through the branchiæ into the dorsal or intra-branchial chamber (fig. 6, *f*); nor is *all* the solid substance, which it may perchance contain, seized by the mouth and swallowed. The act of the passage of the true respiratory water from one chamber into the other is an *involuntary* act. The volume of the fluid and the rate of its motion are definite, and proportional to the organic wants of the animal. The movement by which water is drawn from without into the extra-branchial reservoir is *voluntary* †, and dependent in frequency of recurrence upon the quantity of food which it may bear in suspension, and upon the degree of its purity. The body of water which at any given moment the extra-branchial cavity may contain, is *sieved* by the cilia, which are distributed over the *external* surfaces of the branchiæ. These cilia, as will be subsequently explained, raise a broad current (see arrows on the branchiæ in figs. 6, 8, & 9), very visible to the naked eye, which always and systematically sets in the direction of the free or unattached borders of the branchial lamellæ. These currents *begin* at the attached or proximal edges of all the lamellæ.

They observe the same directions on the under as on the upper surface of each lamella (see arrows on the branchiæ in fig. 7²). They are true food-searching currents. The pellets formed by their agency, having attained the free margin,

* In correcting what earnest and faithful observation and research have convinced me to be "errors," I deal in no flattery or hypocritical circumlocution. I do not honour great men the less because a repetition of their procedures has assured me that in some special particulars they may have approved themselves false. It is because *their* genius has first indicated a main highway through a tangled wilderness, that faithful observers amongst their successors are enabled to mark the points whereat the sin of minor deviations from the straight course may have been committed. It is in this spirit that I have ventured to criticise the acute labours of Mr. Hancock and Mr. Clark. It is in this spirit, I trust, that my criticism will be received. The brief limits of these papers, in which *results* rather than processes are embodied, preclude all reference to details, dissections, experiments, observations on the living animals, injections, &c. Once for all, I affirm, that no assertion has been rashly projected in these papers which has not been conscientiously submitted to the test of *fact*, and weighed in the balance of practical trial.

† The influence of the cilia of the *branchial lamellæ* upon this ingressing current has never yet been clearly perceived. Such influence is undoubtedly exerted.

are carried in the direction of the mouth and tried and tasted by the *palpi* (fig. 6, *i, i*). Those which are acceptable are swallowed; those which are unpalatable are carried completely out of the cavity indifferently by any one of its openings, lest they should again pass over the branchiæ. So incomparably adjusted are the cilia which render the gills a wondrous spectacle of infinitesimal currents, so precise and fore-ordained are the directions in which they move, that the act which sieves the food from the water drives also that water from the recipient into the refuse chamber (fig. 6, *f*; Pl. II. fig. 12, *h*), *through the meshes* circumscribed by the branchial vessels. *This* stage of the respiratory process is strictly involuntary. It is governed by inviolable organic laws, not volitional caprice. It is to the mollusk what the insensible involuntary physical exos- and endosmose of gases in the ultimate air-cells of the lungs are to the mammal. It differs physically and physiologically from the act in which water is drawn into the cavity of the mantle, as strikingly as the thoracic movements of respiration in Man differ from the ultimate process. Thus, whatever may be the number, size, or prominence of the openings* of the mantle, the functions of the great ventral chamber remain unchanged. They are and must be in every instance, under all general mutations of character, those of a reservoir from which food is drawn to the mouth and the aërating element to the branchiæ.

The *second* great cavity (Pl. I. fig. 6, *f*; fig. 7, *c*. Pl. II. fig. 8, *d*; fig. 9, *e*; fig. 10, *c*, *c'*; fig. 12, *h*), lying to the left, dorsal, or "the hinge" side of the imaginary line formerly defined, remains now to be described. It is limited ventradly by the branchiæ, dorsadly by the hinge, and posteriorly by the ex-current siphon.

The anal chamber does not in all genera communicate openly and directly with the interlamellar passages. The former really arises in the latter, when only one of the proximal borders of the branchial lamellæ is attached to the side of the visceral mass; the grooves, running antero-posteriorly and parallel with the length of the gill, and situated between its proximal borders and

* I would beg here to refer the student to the interesting papers of Mr. Hancock, in the 'Annals and Magazine of Natural History' during the years 1852 and 1853, for an account of the collateral openings which in some genera occur in the mantle. In *Chamostrea albida*, in addition to the normal siphonal orifices and pedal and ventral gapes, he describes another of minute size, which is situated under the lower siphon. A similar aperture exists in other Lamellibranchiates. Mr. Hancock has observed it in *Lutraria*, *Cochlodesma*, *Panopæa* and *Myochama* and Prof. Owen in *Pholadomya*. It is clear from the explanation given in the text, that these secondary apertures are really secondary in meaning. They do not in the least affect the physiological character of the cavity.

the visceral mass, although open, form really the commencement of the anal chamber.

Mytilus and *Pecten* exemplify the type of this condition (Pl. I. fig. 7^2). The outer plate (c, c') of each lamella is free or unattached at its proximal margin. This latter is thick and strong. It is composed of the large afferent and efferent trunks. In *Mytilus* and *Pecten* it is not fringed by a slender membrane as in *Cardium* and *Pholas* (fig. 6, *e, f*) and *Mya*, &c. The gutter or channel (fig. 7^2, *f, f*) formed by the attached or *lower* lamella of the superior gill and the free or unattached or upper plate, opens consequently into the extra-branchial or pallial cavity in a direct manner. The water flowing along this groove (fig. 10, *c*) does not however return into this latter cavity, except under extraordinary circumstances. It is conducted in a rapid course, impelled by the branchial cilia, in the direction of the cloaca (fig. 10, *e*). The groove formed at the proximal margins of the inferior, or as it is falsely called, the supplemental gill (fig. 7^2, c'), opens in like manner into the pallial cavity, but on the under surface. It receives the expiratory currents of the lower gill, and conveys them in form of a strong single current towards the exhalent siphon. In *Cardium* (Pl. II. fig. 9), *Pholas* (fig. 7), *Mya, Solen, Cochlodesma,* and *Pholadomya,* the two plates of each branchial lamella on both sides are attached, the upper to the side of the body and foot, the lower to the mantle. The groove bounded by the plates of the branchial lamellæ is divided off, therefore, in these genera by a continuous membrane (fig. 9 *f*) from the pallial chamber. Mr. Hancock says, that in the siphonal families this membrane forms a complete partition between the pallial and anal cavities, since it extends continuously from the anterior to the posterior extremity of the upper plate. The author's observations have convinced him, that, while in *Cardium, Pholas, Solen,* and *Mya* this membrane stretches posteriorly over the cloaca in a hood- or tongue-like form, it leaves between its edge and the side of the foot a fissural opening through which the two cavities freely communicate. The difference, then, between the siphonal and non-siphonal families as respects the parts concerned in respiration, may be defined as consisting in *the degree* in which the intra-branchial grooves are anatomically isolated from the open space of the pallial cavity.

Such points are non-essential distinctions: while they denote the existence of trifling structural varieties, they involve no diversities in the methods of action. Whether partially open or completely closed, the grooves (fig. 6, *f*) running horizontally at the proximal borders of the gills and between their component plates, convey the exhalent current received from the gills in the direction of the cloaca. When there exist two separate branchial lamellæ on either side, there exist two grooves; when one, only one.

The *anal chamber*, then, should be defined as beginning in these intra-branchial grooves, but remotely or primarily in the *inter*-lamellar water-passages of Mr. Hancock. The mode in which this chamber communicates with the water-tubes between the branchial lamellæ is thus described by Mr. Hancock:—"... the anal chamber (in *Pholas crispata*) was laid open, and its ventral wall was seen to exhibit four longitudinal rows of large orifices. These four rows of orifices, already well known to anatomists, correspond to the attached margins of the four gill-plates, which hang from the roof or dorsal membrane of the branchial chamber; this membrane being the ventral wall of the anal chamber, the membrane, in fact, which divides the chambers. These orifices lead into wide tubes, which pass between the two laminæ forming each gill-plate. These inter-branchial tubes lie contiguous and parallel to each other, and extend the full width of the gill, being bifid within its free margin. Thus it is evident that the tubes within the gill-plates *communicate freely* with the *anal chamber* *." This description is exact, but it should be thus qualified: In those siphonal families in which the gills are united posteriorly (this is the case in *Unio*, *Anodonta*, *Mactra*, *Cardium*, *Isocardia*, *Lutraria*) and prolonged into the inhalent siphon, the anal chamber is considerably more capacious than in those in which the branchial plates of opposite sides are distinct and ununited posteriorly (this condition is observed in *Pecten*, *Avicula*, *Arca*, *Pectunculus*, and *Pinna*), or in those in which the siphons are suppressed. In *all* cases, the anal chamber commences anteriorly (fig. 10, *c*) in grooves more or less extended, formed, as already defined, between the plates of the branchial lamellæ and the side of the visceral mass and foot.

These grooves terminate and pour their contents in a continuous stream into the anal chamber—a cloacal cavity common to the branchiæ and intestine. In all cases then the interlamellar water-passages open throughout the *anterior* half or third of the gills into the water-grooves at their bases, posteriorly *directly* into the cloaca or anal chamber. This definition, so positive, precludes all misconception. It leaves the cavities functionally distinct in all genera, though in some structurally continuous. It solves the problem of the Molluscan organism. The ingress and egress of the alimentary and respiratory elements are so ordered, that the œconomy of the conchiferous animal, hidden in a coat of mail, is rendered unequivocally clear to the understanding.

* Ann. & Mag. Nat. Hist., Nov. 1851.

All the *interlaminar* tubes, lately so fully described by Mr. Hancock, pour a *constant* current into this cavity, with which *all* the intra-branchial spaces openly communicate. Into this chamber, at different points in different genera, the intestine terminates (Pl. II. fig. 12, *b*). It receives the excrementitious products at once of the intestinal and branchial systems.

This simple definition was first established in all its details by the researches of Mr. Hancock. It is essentially founded upon the permeability of the branchial laminæ, first proved by Dr. Sharpey. The correctness of this description is denied in the most strenuous manner by Mr. Clark. It is impossible not to admire the ardent eloquence, and sagacious inventiveness of argument with which Mr. Clark defends his own views. The duty of the critic, however, is sacred. The solemn sentence of "error" must be pronounced alike over many of his "facts" and not a few of his "inferences."

Mr. Clark is indeed right in asserting, that frequently a *momentary in*-current occurs through the *ex*-current siphon. This accidental incident is utterly unimportant. The normal, systematic, and necessary direction of the current in this (the dorsal, upper, anal ex-current, ex-halent or *intra*-branchial) siphon is centrifugal. In all Acephalans, whether siphonal or non-siphonal, everything that passes through this siphon has an *outward* tendency. The centripetal movement is irregular and accidental. The stream bears far more strikingly a continuous character than that ingressing at the ventral or extra-branchial orifices. The uninterruptedness of this current was supposed by Mr. Hancock to be due to the action of *cilia* lining the interior of the siphon. The statement of this distinguished naturalist in this particular is indisputably erroneous. This siphon, like the in-current one, is *not* lined with vibratile epithelium. The stream by which it is traversed is not excited by any force within its own limits.

In denying the existence of cilia within this siphon, Mr. Clark is on the side of truth. But the current emanating from the excurrent-siphon is *continuous* in character. It always goes on except when the orifice is closed by voluntary muscular action.

The continuousness of this ex-current is due, not to cilia within the interior of the siphon, but to those at a distance, on the branchial bars. *All* the cilia distributed over the internal surfaces of the branchial laminæ (those facing the interlaminar tubes) excite currents tending in the direction of the dorsal or intra-branchial cavity and that of the ex-current siphon. The *proofs* of this interesting fact will be afterwards given*.

* See a subsequent paper "On the Minute Structure of the Branchiæ."

The character of this exhalent current is not the same in all genera. In *Cardium* it is much more regular than in *Pholas*, &c. It occurs quite as distinctly in the Asiphonophora as in the Siphonal classes. It is with this current that the rejectamenta escape.

The *evidence* upon which the doctrine of the independence of this cavity from the ventral is maintained, will be adduced when speaking of the *minute* structure of the branchiæ.

If the view supported by Mr. Hancock be true, that the dorsal or intra-branchial cavity is separated from the ventral or extra-branchial by a partitional membrane which is permeable nowhere but at the branchial stigmata, it follows that everything which passes from one chamber into the other, either in a progressive or regressive direction, must percolate through these minute foramina. The author's dissections, however, render it probable that a *fissural* opening (fig. 6, *e*) at either base of the foot exists in some of the siphonal genera, if not in others. It is seated at the base of the branchial lamellæ and the junction of the vertical partition of the mantle with each superior gill, and opens directly from the *intra*- into the *extra*-branchial chambers. The office of this fissure is that of a safety-valve.

When the outlet of the ex-current siphon is closed by sphincteric contraction, the intra-branchial cavity being rapidly more and more filled in virtue of the *continuousness* of the branchial ciliary action, the surplus fluid escapes through the lateral fissures back again into the ventral or extra-branchial chamber, again to pass through the branchial foramina, propelled by cilia. It is by thus repeatedly filtering the same water through the branchiæ that those bivalves, such as the Mussels, sustain life, though abstracted for a considerable time from their native element. The fissure in question is detectable only from the inside of either chamber, not from the outside view of the whole mantle, even after the separation of the animal by spirits of wine from its shell. If the exit of the water from this intra-branchial enclosure be due to the force exerted by the lamellar cilia, it follows that the egressing current should be equally as vigorous and marked in the non-siphonal as in the siphonal genera. The presence of the ex-current siphon does not affect the real branchial action of respiration. As a tubular extension of the cavity, it enables the contents of the latter to be delivered at a greater distance away from the body. This is its real office. Thus the sphere in which the animal lives is maintained in purity. The *in-current* which occasionally occurs through this dorsal or intra-branchial siphon should be regarded really as a momentary accident, as an irregular reversal of a normal current. Water thus drawn into the cavity of the ex-current siphon can

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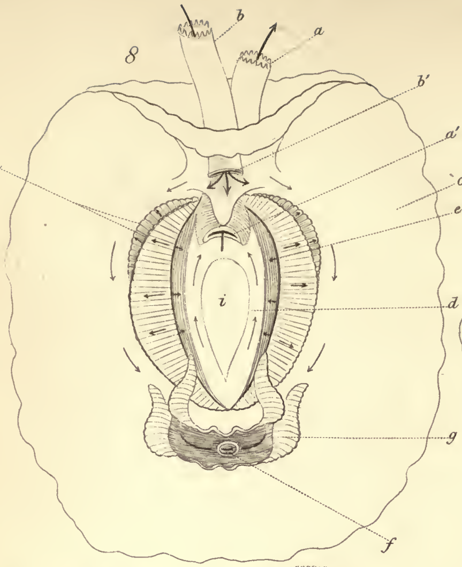

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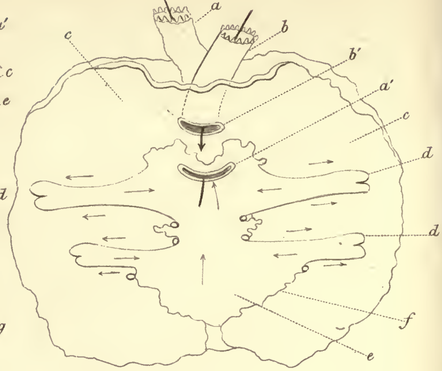

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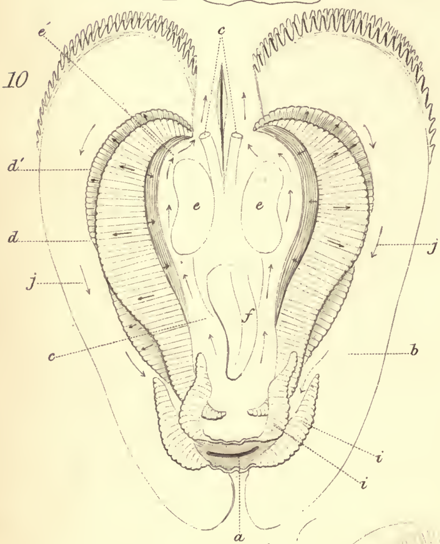

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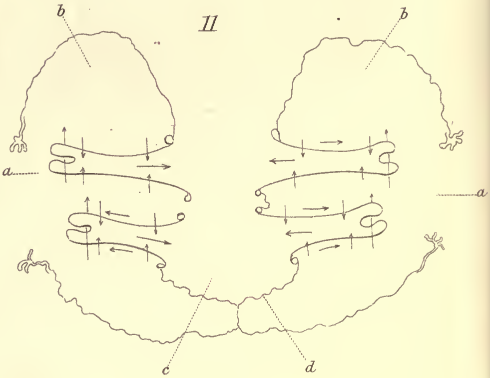

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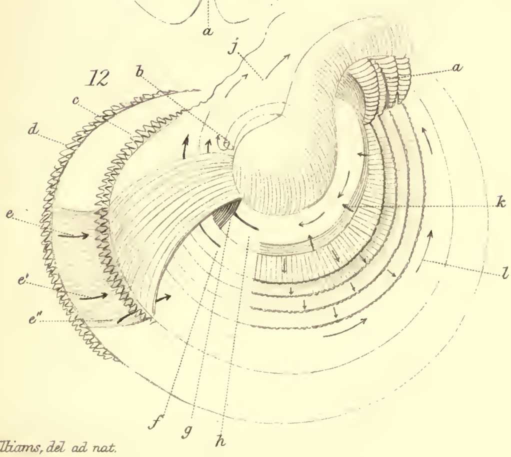

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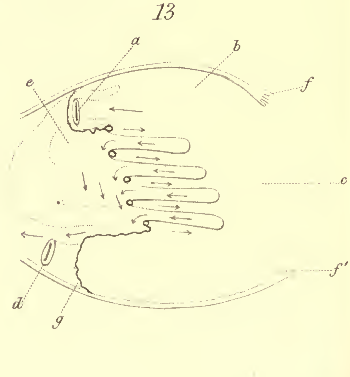

T. Williams, del ad nat.

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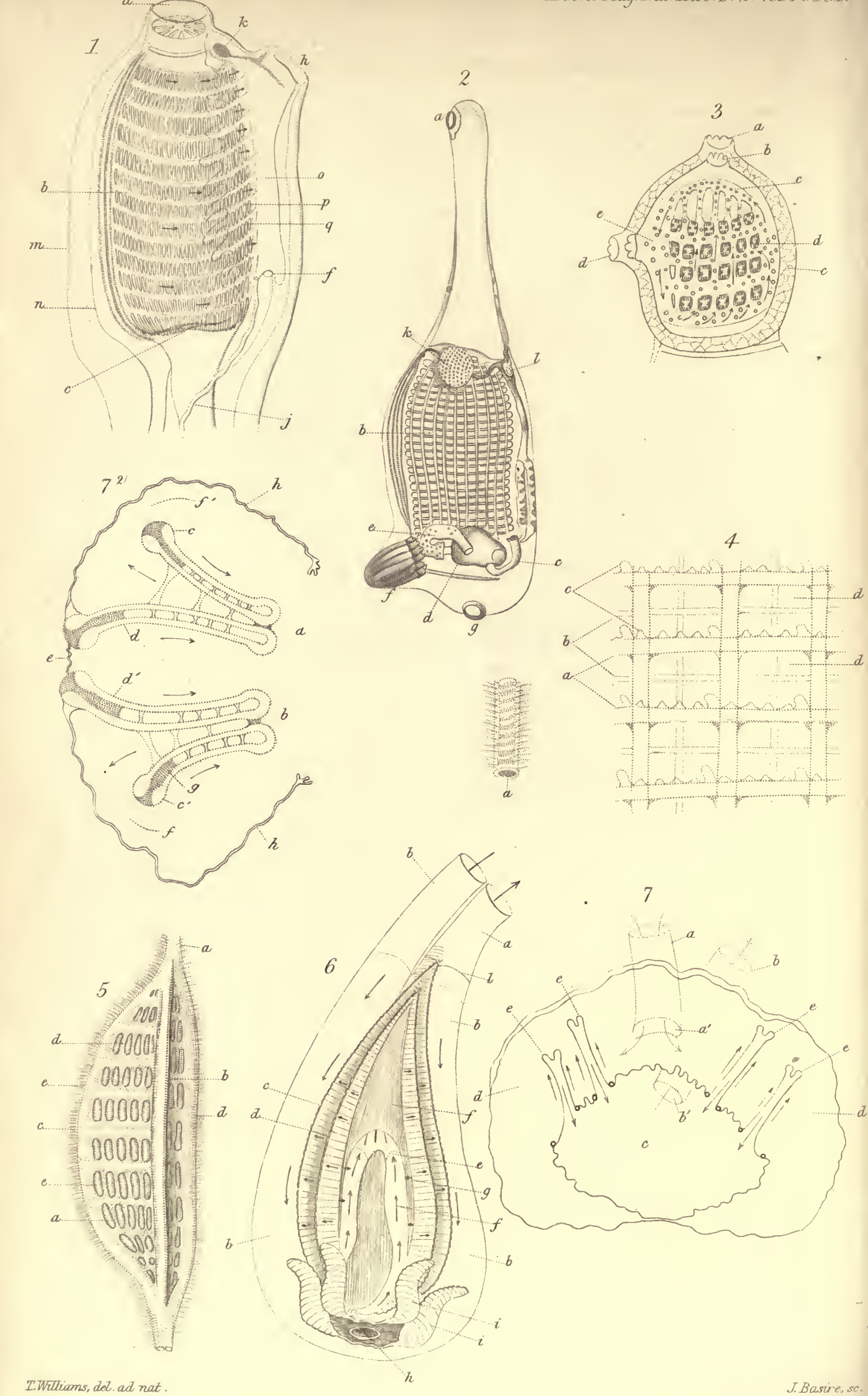

T. Williams, del. ad nat. *J. Basire, sc.*

act no part either in the alimentary or respiratory process. It cannot reach the mouth without permeating the branchial foramina. It can do this only by overcoming the opposing force exerted by the branchial cilia. If the water which occasionally *enters* at the exhalent siphon were normally designed for respiration, like that flowing in at the inhalent siphon, as supposed by Mr. Clark, the former could not reach the branchial lamellæ without meeting and mingling with the counter impure current driven by cilia, coming from the branchiæ. The principle is absolute in the mechanism of the respiratory process in all Tunicate and Lamellibranchiate mollusks, that the aërating element *must pass through the gill.* The function of breathing cannot be accomplished if the water merely passes in a stream whose direction is parallel with the planes of the gill-laminæ. The ultimate and true respiratory currents are those which permeate the laminæ at right angles to their planes. It results of logical necessity, therefore, that if the water did *not* traverse the branchial partition (Pl. II. fig. 12, *g*) which divides the extra- from the intra-branchial chambers, the great and imperious function of respiration could not be accomplished.

The preceding postulates, supported only by theoretical reasoning, will on a future occasion be rendered incontrovertible by the demonstrations of minute anatomy.

EXPLANATION OF PLATES I. and II.

Plate I.

Fig. 1. *Clavellina lepadiformis* (after Milne-Edwards): *a*, mouth and inhalent funnel; *b*, large horizontal blood-channels, running regularly between the vertical ones *q*; *p*, the intervascular stigmata through which the water passes from the branchial chamber into the cloacal cavity (*o*), whose outlet is at (*h*) the exhalent or anal siphon; *f*, rectum terminating in the cloaca; *n*, mantle; *m*, test, the intermediate space being filled with blood.

Fig. 2. *Pyrosoma giganteum* (after Milne-Edwards): *a*, mouth; *b*, branchial sac; *c*, œsophagus; *d*, stomach; *e*, intestine; *f*, liver; *g*, anus; *k*, ovary; *l*, ganglion.

Fig. 3. *Perophora Listeri*: *a*, branchial siphon; *b*, tentacles at its base; *c*, large blood-channels in which the blood-corpuscles are seen; *d*, branchial, *e*, cloacal chamber; *d*, exhalent siphon; *e*, space, tunnelled with spacious blood-channels, between the test and mantle.

Fig. 4. Plan of vessels in the branchial band of *Salpa maxima*: *a*, large vessels constituting a separate layer; *b*, smaller; *c*, cæcal processes from the vessels and filled with blood, and communicating with their internal channel; *d*, *d*, water meshes: fig. 4 *a*, a separate bar, showing cilia, and bore.

Fig. 5. One of the branchial folds of *Cynthia microcosmus*: *a*, *c*, water meshes between the blood-channel; *b*, *d*, the attached borders; *e*, free border; *d*, transverse blood-channels.

Fig. 6. Branchial system of *Pholas dactylus*: *a*, intra-branchial or exhalent siphon; *b, b*, extra-branchial or inhalent siphon; *b, b, b*, pallial or extra-branchial cavity; *c*, external or inferior branchial lamella; *d*, internal or superior lamella; *e*, membrane tying the attached border of the superior branchial lamella to the side of the foot and visceral mass, roofing the *intra*-branchial or anal chamber (*f*); the arrows (*g*) show the currents descending from the branchiæ into the anal chamber, and thence out through the excurrent siphon, under the membranous roof (*f*) connecting the branchiæ of the two sides; *h*, mouth; *i, i*, palpi. The arrows indicate the direction of the currents.

Fig. 7. is a transverse ideal section of the preceding figure. It exhibits the relation of the water-currents and cavities: *a*, incurrent siphon, leading (at *a'*) into the extra-branchial or pallial chamber *d, d*; *b*, excurrent siphon leading out of (at *b'*) the intra-branchial or anal chamber *c*; *e, e, e, e*, branchial lamellæ.

Fig. 7². One-half of *Mytilus* (fig. 10) in transverse section, showing the mode in which the branchial lamellæ are attached to the mantle *h, h*; *a, b*, branchial lamellæ of one side; *c, c'*, *free* proximal border of respectively the upper lamella of the internal gill-plate, and the lower of the external. The *attached lamellæ* (*d, d'*) of each gill-plate are joined by a membrane at *e*; *g*, shows the *continuous* membrane which at the proximal borders connects the branchial bars, so that at this point no water can permeate the lamella; *f, f'*, denote the spacious grooves which receive the water from the interlamellar tubes and convey it to the cloaca. The arrows mark the direction of the currents.

PLATE II.

Fig. 8. Vertical view of the common Cockle, showing the relation of the branchial system to the siphons and cavities: *a*, excurrent siphon leading out of the anal cavity (*a'*) surrounding the visceral mass (*i*); *b*, incurrent siphon conducting (at *b'*) into the extra-branchial cavity (*c*); *e*, arrows marking the excurrent currents coming from the branchiæ; *g*, palpi; *f*, mouth.

Fig, 9. Ideal transverse section of the former figure: *a*, excurrent siphon leading out of the anal cavity (*e*) at *a'*; *b*, incurrent ditto opening at *b'* into the general cavity of the mantle (*c, c*) at *b'*; *d, d*, branchiæ; *f*, the line of the mantle uniting the branchial lamellæ together. The arrows show the order and tendencies of the water-currents.

Fig. 10. Vertical view of *Mytilus*, exhibiting the systems of respiratory and alimentary water-currents: *a*, mouth; *i, i*, palps; *b*, extra-branchial or pallial cavity; *c*, two longitudinal halves of the rectum, terminating in the excurrent channel in the mantle; *e, e* & *f*, surrounded by the grooves (*c*) indicated by the arrows which convey the expiratory water from the branchiæ in the direction of the cloaca; *d, d'*, branchial lamellæ; *j, j*, arrows showing the direction of the currents along the distal or *free* border of the gills which convey food to the mouth.

Fig. 11. Ideal transverse section of the former—compare with fig. 7². Pl. I. It is designed only in outline plan to display the relative anatomy of the extra-branchial (*b*), the branchiæ and pallial membrane (*d*), and the intra-branchial or anal chamber (*c*); *a*, openings of the mantle.

Fig. 12. Oyster: *a*, mouth between the palpi; *b*, anus, emerging out of the visceral mass; *c*, upper half of the mantle arching over the branchiæ; *d*, lower mantle; *e*, *e'*, *e''*, arrows showing currents entering the cavity of the mantle (*l*); the arrow (*l*) also marks the food-bearing currents tending towards the mouth; *h*, intra-branchial or anal cavity; *g* is that portion of the pallial membrane which stretches from the proximal border of the upper branchial lamella to the side of the visceral mass, thus shutting in completely the intra-branchial cavity; *j*, the excurrent.

Fig. 13. Ideal transverse section of the preceding figure: *a*, mouth; *b*, general cavity of the mantle; *c*, openings between the valves (*f*, *f'*) of the mantle; *g*, membrane uniting the branchiæ with the mantle, and dividing the pallial chamber (*c*) from the intra-branchial cavity (*e*); *d*, the anus.

[To be continued.]

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

[Continued from vol. xiii. p. 453.]

205. Treron bicincta, Jerd. *Bata-goya*, Cing. *Patchy-prāā*, Mal., and *Groëne-duyven* of the Dutch descendants; lit. Green Dove.

Very abundant in the south of the island and in the mountain zone, where it is mingled with *T. Malabarica* vel *T. Pompadoura*, Gmel. Towards the extreme north it is seldom met with, though I have killed a few specimens in the Patchellepally. In the neighbourhood of Pt. Pedro I never saw it, its place being filled by the larger *T. chlorigaster*, Blyth.

This Pigeon never alights on the ground, but seeks its food, which consists of berries and small fruits, on the highest trees; it always feeds in flocks, and vast numbers are killed in the southern and western provinces by noticing what trees are in fruit, and watching at their foot for the birds which are continually going and coming. It however feeds so silently and moves so seldom, that it requires much skill to detect a single bird out of a flock of fifty or sixty, and on the least alarm, which is communicated from one to another by a plaintive whistle, they all dart off the tree as if by magic; frequently, on firing at a bird which has exposed itself, I have brought down seven or eight others which I could not see.

It forms a nest in the month of May, of sticks, with a very slight lining of roots, &c. in the fork of a tree, and deposits two shining white eggs. Axis 14 lines; diam. 10 lines.

206. Treron chlorigaster, Blyth.

Confined to the extreme north of the island, where it is very abundant, feeding on the fruit of the banian tree. It is migratory, only appearing in the fruit season, and returning again to the coast of India.

The Tamuls and Cingalese apply the name of "*patchy-praa*" (Green Dove) and "*bata-goya*" indiscriminately to all our Trerons. The words *prāā* and *goya* are synonymous and used for all pigeons.

207. Treron Malabarica ? Jerdon.

Var. *Pompadoura,* Gmel. (Brown's Ill. Pl. 19, 20.)

I procured this species in abundance in the mountain zone, at the top of the Balcaddua Pass, and at Ratnapoora. It feeds on berries, and flies in large flocks. Our Ceylon race is slightly different from the true *T. Malabarica,* and I believe it to be the origin of Brown's wretched figures (plates 19 & 20). My lamented friend Mr. Strickland was satisfied with this view of the case, and intended offering some remarks on these plates and several others which represent Ceylonese birds, but which have hitherto not been satisfactorily identified. I regret that I have not a copy of the work to refer to, and detail as fully as my memory serves me, the conclusions to which we came upon most of them.

208. Carpophaga pusilla, Blyth, J. A. S. xviii. *Mahavillagoya,* Cing. *Matabatagoya* of the Cingalese to the north of Kandy. *Berg Duyven,* Dutch; lit. Hill Dove.

Mr. Blyth separates this species and those from the Nilgiris from Tickell's *Columba sylvatica,* under the name of *C. pusilla.* Mr. Strickland was inclined to agree with him, but wished for a larger series of specimens than those I had by me for comparison.

Our birds extend northward and southward into the low country, but their great haunt is certainly the mountain zone, though, from Dr. Kelaart's observations, it does not appear to have been seen "in very high lands," and the *Mahavillagoya* of Nuwera Elia is another species, *C. Torringtonii,* Kelaart.

They are very migratory, only appearing with the ripe fruit of the banian, teak, and other trees, on which they feed: at this time they congregate in hundreds in places where previously not a specimen could be procured.

209. Alsocomus puniceus, Tickell. *Neeyang cobeya,* Cing.; lit. Season Pigeon, from its being essentially migratorial.

This bird is but rarely a visitant of our island; I believe it appears during the fruiting of the cinnamon trees; the natives all assure me of this; but there is another bird called *Kurrundoo cobeya,* i. e. *Cinnamon Dove,* which is confused with it, or else this has two names. A relative of mine, however, who was formerly in charge of the Government Cinnamon Department, informs me that many years ago, when the south of the island was not so much cultivated as at present, there used to arrive at the fruiting season, flocks of a small pigeon which fed on the cinnamon, and which he could not identify with any I showed him; he called them *Kurrundoo cobeya,* and said he had not seen any of late years. I have sometimes thought this might prove to be *Treron aromatica,* Gmel.

210. Carpophaga Torringtonii, Kelaart. *Mahavillagoya* of the Ceylonese Mountaineers, apud Kelaart.

Mr. Blyth is disposed to consider this as only a variety of *C. Elphinstonei,* Sykes, of the Nilgiris, but Mr. Strickland at once pronounced it to be distinct; if so, Dr. Kelaart's name will stand.

Not having seen it alive, I must refer to his 'Prodromus Faunæ Zeylanicæ' for particulars of its habits; he says (page 108)—"It is an arboreal species seen only in pairs; flies high and in long sweeps: their nests are formed on lofty trees."

211. Columba intermedia, Strickland.

This species is extremely local, being confined to two places, "Pigeon Island," off Trincomalie, and a rock off the southern coast near Barberryn. From these it, of course, makes incursions into the interior, and I have heard of specimens being shot at Vavonia-Vlancolom, on the great central road, about fifty miles from Trincomalie.

212. Turtur risorius, Linn. *Cally-prāā,* Mal.; from their frequenting the Euphorbia hedges called "*Cally*" by the Malabars. *Ringel Duyven* of the Dutch descendants.

Extremely abundant in the northern province, and indeed wherever the country is favourable to the growth of the *Euphorbia antiquorum.* It breeds in the spring, fabricating a loose, careless nest, of small twigs, in the Euphorbia trees, in which it deposits two oval and shining white eggs. Axis 14 lines; diam. 11 lines. While residing in the north, or in my jungle trips, I found them a wholesome and pleasing addition to my table, frequently killing from twenty to thirty of them and of *T. Suratensis* in two or three hours.

213. Turtur Suratensis, Lath. *Mani-prāā*, Mal.; lit. Bead-Dove, from the bead-like spots on the neck. *Cobeya* and *Alloo cobeya*, Cing.

Equally abundant with the preceding in the same localities, but found also in the central province and wooded portions of the southern districts. In its nidification it is similar, and the eggs are only distinguishable by their size, having an axis of 12 lines and a diam. of 9 lines.

The flight of both these pigeons during the love season is most elegant and graceful; the male bird will at such times soar away from the branch on which his "meek-eyed" partner is reposing to a considerable altitude, rising almost perpendicularly and clapping his wings together over his back, then opening them and spreading his tail he sails downward in decreasing circles and graceful curves to the object of his affections, who greets him with the tenderest and blandest cooings, and while he struts and pouts before her caresses his head and wings with her bill. The fervour of their love being assuaged, away they both soar in the fulness of their joy, to descend again in undulating curves, crossing and recrossing each other with the most easy and graceful flight, to the more sober and matter-of-fact work of collecting building materials for the nest.

214. Turtur humilis, Temm.

The fertile portion of the Pt. Pedro district is separated from the neighbouring divisions of Malagam, Jaffna, and Chavagacherry, by a plain of several miles in breadth, in the centre of which, during most parts of the year, is an expanse of shallow brackish water; in the hot season this mostly dries up, in some places leaving a rich deposit of native salt (from the sale of which a large portion of the revenues of the northern province is derived); in others not so impregnated with the saline particles and sooner dry, the natives raise crops of paddy and other grain; in others (reclaimed by embanking) topes of palmirahs have been planted. Far away from other cultivation, and in the centre of the plain between Tunale and Warenny, stands one of these topes, numbering perhaps two dozen palms and margosas; a few banian trees, planted doubtless by some vagrant dove, have taken root and circled some of them in their deadly embrace; a well of brackish water, a ruined temple, and a native hut, complete the picture of this "oasis in the desert." Government duty led me one morning to this spot soon after the waters had subsided: part of my walk had been over parched mud sparkling with saline incrustations, which rendered the glare almost insupportable; at one place the people with me had carried me through water up to their arm-pits, and for the last two miles I had trudged along over the remains of paddy-fields, now dry and dusty, under the burning sun, without a tree or a bush to shelter me; my dogs trailed their tails and drooped their heads, with straining eyes and outstretched tongues, and even the ordinarily garrulous natives were silent, oppressed by the intolerable heat; the mirage deluded us with its pictures of limpid water and tall trees, my spirits almost sank, and I thought I never should reach the trees before us in the distance. How willingly would I, had I been a litigant for that miserable tope, have resigned it, rather than have taken the trouble to walk to it! Suddenly—the first living thing I had seen for hours—a pigeon darted past us in full flight towards the tope; I hardly cared to look at it with my half-closed aching eyes, but its pink-coloured back and small size at once roused me—it was something new! O, how eagerly I watched its flight to that now coveted tope, and longed to be there! The natives knew of no other species but the "Cally and Mani-prāās," and stoutly maintained there were none; I was equally positive the bird that flew by was neither of *them*, and hurried forward, thirst and heat were alike forgotten; and when I reached the spot, instead of partaking of the cocoa-nuts which the head-man's forethought had provided there for me, I sprang on the low wall and peered eagerly among the trees. *Turtur Suratensis* and *T. risorius* perched about the branches in abundance, and—could I believe my eyes?—on a dry leafless "matty" projecting from a palmirah tree, and supporting the twigs of a nest, sat a pair of the lovely little *T. humilis*; there they were, "billing and cooing," in sweet but dangerous proximity, for the same shot laid them both dead at my feet, and in another minute a native lad who had followed me brought down two shining, smooth, white eggs from their nest. This was not the only pair in the tope, and I soon procured half a dozen specimens, and might have killed as many more. An old head-man who was with me, and who had the reputation of being the best sportsman in my district, assured me he had neither seen nor heard of this description of pigeon before; and so said all present, some of them old men who had spent their lives in that neighbourhood. I had lived more than a year in the district and killed dozens of doves without finding one, nor did I ever after, though I often shot along the cultivation, at the edge of the plain, meet with them. Had they bred there that year only? where did they come from? why did they select that lonely tope and keep so closely to it? I left the district and never could learn, nor did I ever find any native who had met with them in other parts of the island. Dr. Kelaart knew nothing of it, and only included it in his list on Mr. Blyth's authority, and I furnished the latter with data;

so whether the little colony raised their young and departed, or breed there still, "remains an untold tale."

215. TURTUR ORIENTALIS, Lath.

I shot a young bird of this species from a small flock of pigeons which flew over my head as I was travelling with the late Dr. Gardner in the Pasdoom Corle in the month of December 1848.

216. CHALCOPHAPS INDICUS, Linn. *Nillo-* or *Nil-Cobeya,* Cing.; lit. Blue Dove.

The "Ground Dove" of Europeans seems not to extend northward further than Kodally Kallu on the eastern, and Putlam on the western sides; at least I never met with it beyond, and the Tamuls have no name for it. About Colombo and all through the wooded southern and central provinces it is abundant. It is generally found on the ground, walking hastily about and picking up seeds; being a bold, fearless bird of great power of wing, it will permit approach to within a few paces, when, with a spring into the air, it will dash onwards a few dozen yards, and again settle; a renewed approach drives it further off a second and a third time, till driven beyond the range of its food, the lovely bird will dart back to its old feeding ground with the rapidity of thought, often brushing the intruder's person with its wings, while following the tortuous narrow windings of the native path. It is principally abroad morning and evening, when its plaintive *lowing* "coo" may be heard from almost every thicket. In such situations they breed, laying two oval yellowish drab-coloured eggs. Axis 12 lines; diam. $8\frac{1}{2}$ lines.

217. PAVO CRISTATUS, Linn. *Monara,* Cing. *Miyil,* Tam. *Pavaan,* Port. *Mayal,* Dutch.

Abundant in the mimosa jungles of the maritime districts, but rare in the hills. They feed in flocks during the mornings and evenings, and roost in trees, on which they may be seen at daybreak expanding their tails and wings to dry.

218. GALLUS STANLEYI, Gray. *Kadoo-koly,* Mal. *Welle-kukullo,* Cing.; lit. Jungle Fowl. *Wild-Hoën,* Dutch. *Galienha di Matoe,* Port.

The Jungle fowl is abundant in all the uncultivated portions of Ceylon, but particularly so in the northern and north-western provinces.

It comes out to feed morning and evening, upon the roads, cultivated lands, or other open places. The cocks are generally seen alone, seldom in company with their hens, who, however, are always in the neighbourhood, and keep together, even though their broods may be of very different ages.

The cocks fight most desperately in defence of their seraglios, the combat frequently terminating in the death of one of the engaged parties. As they not unfrequently mingle with the fowls of the lonely villages, they cross with the domestic breed, being more than a match in courage for the plebeian dunghill cocks, and armed with tremendous sharp spurs.

Mr. Mitford, of the Ceylon Civil Service, showed me, while at Ratnapoora, a hybrid hen; her general appearance and call much resembled that of the wild bird; her eggs also partook of the spotted character, but Mr. Mitford never succeeded in rearing any chicks from them, as they were always addled. The bird was very tame to those with whom she was acquainted, but fled precipitately at the approach of strangers.

The hen selects a decaying stump or thick bush for a nesting place, and lays from six to twelve eggs, of a fine rich cream colour, finely mottled with reddish brown specks. Axis 1 in. 9 lines; diam. 1 in. 4 lines. The young when just hatched resemble young chickens, and the old mother leads them to decaying prostrate trees, and scratches for white ants, which they eagerly devour. They are hatched in June.

In wet weather, Jungle fowl keep much to thick trees, sitting disconsolately with drooping head and tails among the branches; they also roost in trees at night, retiring to rest early. It is rarely that a bird can be flushed, but when they do fly, it is very much in the manner of the pheasant; they run with incredible swiftness, and trust to their powers in this respect for safety. Their cry is a short crow, which resembles the words "George Joyce," sharply repeated.

It may not be out of place here, while upon the subject of Jungle fowl, to mention the varieties of domestic breeds which are found in the island.

The usual kind is the common fowl, which is considerably less than the English breed, and lays a much smaller egg; it runs through all the same variations of plumage; but there is one curious variety, which I cannot describe more aptly than by comparing it to a white fowl drawn down a sooty chimney. On preparing one of these fowls for the table, at which, by the way, they excel all others in flavour and tenderness, the skin and periosteum are found nearly black; the roof of the mouth, tongue, wattles, and legs are also of a deep leaden hue. It is a remarkable fact, that a male bird of the pure sooty variety is almost as scarce as a tortoise-shell tom-cat.

The Cingalese call these fowls "*Calloo-mas-kukulo,*" literally *black-flesh-fowl.* *Kukula* means cock (or *fowl* taken as a whole); *kikili,* hen; *kukulo,* plural, fowls.

The ingenious and learned author of 'Ornamental and Domestic Poultry*,' at page 392, second edition, refers to these fowls as having *silky feathers,* but with us in Ceylon this is not the case.

The Frizzled or Friesland Fowl, of the same author (p. 394), is also domesticated in Ceylon, but it is rare; the Cingalese called it *Capri-kukulo,* and say it was originally imported from Batavia. This accords with Temminck's statements.

The Rumpless Fowl, or Rumkin (*ibid.* p. 387), is also plentiful, but only in a domestic state. Temminck's assertion that it is a wild inhabitant of the island is surely a mistake, and the Governor (Loten, I presume) who forwarded him the information must have been deceived by some head-man or other. I am quite confident the bird does not exist wild in Ceylon; the very native name, "*Cochi-kukulo,*" *Cochin-fowl,* implies its foreign character.

The Cochin China Fowl (*ibid.* p. 289) and Malay Fowl (p. 299) are both found in Ceylon; the former is called *Maha-cochi-kukulo,* or "*large Cochin Fowl,*" and is common enough. I have purchased them for $7\frac{1}{2}$*d.* each, while residing at Pt. Pedro; I mention this as a contrast to the absurd prices given in England. The Malay fowl is principally found about the lines of the native regiment of Ceylon Rifles; they belong to the Malays, and are used in fighting, a sport of which that people, as well as the Cingalese and Tamuls, are passionately fond. I, however, never saw the true game cock in Ceylon.

Creepers (p. 384) are frequently met with; their curiously short legs at once distinguish them from the common breed. One variety has feathered legs, but I never met with true Bantams.

The Poland or Polish Fowl (p. 364) was introduced many years ago by a relative of my own, the original birds having been procured from my father.

I am not sufficiently acquainted with all the varieties of domestic fowls to state if other kinds are found in the island; probably some which I have called "*common fowls*" may be more valuable varieties.

* Published at the office of the 'Gardeners' Chronicle,' London.

[To be continued.]

VI.—*On Manufactured Sea-Water for the Aquarium.* By P. H. Gosse, A.L.S.

The inconvenience, delay and expense attendant upon the procuring of sea-water, from the coast or from the ocean, I had long ago felt to be a great difficulty in the way of a general adoption of the Marine Aquarium. Even in London it is an awkward and precarious matter; how much more in inland towns and country places, where it must always prove not only a hindrance, but to the many an insuperable objection. The thought had occurred to me, that, as the constituents of sea-water are known, it might be practicable to manufacture it; since all that seemed necessary was to bring together the salts in proper proportion, and add pure water till the solution was of the proper specific gravity. Several scientific friends to whom I mentioned my thoughts, expressed their doubts of the possibility of the manufacture; and one or two went so far as to say that it had been tried, but that it had been found not to answer; that though it looked like sea-water, tasted, smelt, like the right thing, yet it would not support animal life. Still, I could not help saying, with the lawyers, "If not, why not?"

Experientia docet. I determined to try the matter for myself.

I took Schweitzer's analysis; but as I found that there was some slight difference between his and Laurent's, I concluded that a very minute accuracy was not indispensable. Schweitzer gives the following analysis of 1000 grains of sea-water taken off Brighton:—

Water	964·744
Chloride of sodium	27·059
Chloride of magnesium	3·666
Chloride of potassium	0·765
Bromide of magnesium	0·029
Sulphate of magnesia	2·295
Sulphate of lime	1·407
Carbonate of lime	0·033
	999·998

The bromide of magnesium and the carbonate of lime I thought I might neglect, from the minuteness of their quantities; as also because the former was not found at all by M. Laurent in the water of the Mediterranean; and the latter might be found in sufficient abundance in the fragments of shell, coral, and calcareous algæ, thrown in to make the bottom of the aquarium. The sulphate of lime (plaster of Paris) also I ventured to eliminate, on account of its extreme insolubility, and because

M. Laurent finds it in excessively minute quantity. The component salts were then reduced to four, which I used in the following quantities :—

Common table salt	$3\frac{1}{2}$ ounces.	
Epsom salts	$\frac{1}{4}$,,	
Chloride of magnesium . . .	200 grains	Troy.
Chloride of potassium . . .	40 ,,	Troy.

To these salts, thrown into a jar, a little less than four quarts of water (New River) were added, so that the solution was of that density that a specific gravity bubble 1026 would just sink in it.

The cost of the substances was—sulph. mag. 1*d.*; chloride mag. 3*d.*; chlor. pot. $1\frac{1}{4}$*d.*; salt, nil;—total, $5\frac{1}{4}$*d.* per gallon. Of course if a larger quantity were made the cost of the materials would be diminished, so that we may set down 5*d.* per gallon as the maximum cost of sea-water thus made. The trouble is nothing, and no professional skill is requisite.

My manufacture was made on the 21st of April. The following day I poured off about half of the quantity made (filtering it through a sponge in a glass funnel) into a confectioner's show-glass. I put in a bottom of small shore-pebbles, well washed in fresh water, and one or two fragments of stone with fronds of green sea-weed (*Ulva latissima*) growing thereon. I would not at once venture upon the admission of animals, as I wished the water to be first somewhat impregnated with the scattered spores of the *Ulva*; and I thought that if any subtle elements were thrown off from growing vegetables, the water should have the advantage of it, before the entrance of animal life. This too is the order of nature; plants first; then animals.

A coating of the green spores was soon deposited on the sides of the glass, and bubbles of oxygen were copiously thrown off every day under the excitement of the sun's light. After a week therefore I ventured to put in animals as follows :—

2 *Actinia mesembryanthemum.*	*Coryne ramosa.*
7 *Serpula triquetra.*	*Crisia eburnea.*
3 *Balanus balanoides.*	—— *aculeata.*
2 *Sabella* —— ?	*Cellepora pumicosa.*
2 *Sabellaria* (*alveolata* ?)	*Cellularia ciliata.*
2 *Spio vulgaris.*	*Bowerbankia imbricata.*
1 *Cynthia* (*quadrangularis* ?)	*Pedicellina Belgica.*

These throve and flourished from day to day, manifesting the highest health and vigour; the plants (including one or two Red Weeds that were introduced with the animals) looked well, and the water continued brilliantly crystalline. Within the succeeding month specimens of *Actinia mesembryanthemum, A. angui-*

coma and *A. clavata*, a *Trochus umbilicatus*, and a *Littorina littorea* were at different times added.

Six weeks have now elapsed since the introduction of the animals. I have just carefully searched over the jar, as well as I could do it without disturbing the contents. I find every one of the species and specimens mentioned above, all in high health; with the exception of some of the Polyzoa, viz. *Crisia aculeata*, *Cellepora pumicosa*, *Cellularia ciliata*, and *Pedicellina Belgica*. These I cannot find, and I therefore conclude that they have died out; though if I chose to disturb the stones and weeds, I might possibly detect them. These trifling defalcations do in no wise interfere with the conclusion, that the experiment of manufacturing sea-water for the Aquarium has been perfectly successful.

P. H. Gosse.

58 Huntingdon Street, Barnsbury Park,
June 9, 1854.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 23, 1854.—Colonel Sabine, R.A., Treas. and V.P., in the Chair.

"Note on an indication of depth of Primæval Seas, afforded by the remains of colour in Fossil Testacea." By Edward Forbes, F.R.S., Pres. G.S. &c.

When engaged in the investigation of the bathymetrical distribution of existing mollusks, the author found that not only did the colour of their shells cease to be strongly marked at considerable depths, but also that well-defined patterns were, with very few and slight exceptions, presented only by testacea inhabiting the littoral, circumlittoral and median zones. In the Mediterranean only one in eighteen of the shells taken from below 100 fathoms exhibited any markings of colour, and even the few that did so, were questionable inhabitants of those depths. Between 35 and 55 fathoms, the proportion of marked to plain shells was rather less than one in three, and between the sea-margin and 2 fathoms the striped or mottled species exceeded one-half of the total number.

In our own seas the author observes that testacea taken from below 100 fathoms, even when they were individuals of species vividly striped or banded in shallower zones, are quite white or colourless. Between 60 and 80 fathoms, striping and banding are rarely presented by our shells, especially in the northern provinces; and from 50 fathoms shallow-wards, colours and patterns are well marked.

The relation of these arrangements of colour to the degrees of light penetrating the different zones of depth, is a subject well worthy of minute inquiry, and has not yet been investigated by natural philosophers.

The purpose in this brief notice is not, however, to pursue this kind of research, but to put on record an application of our knowledge of the fact that vivid patterns are not presented by testacea living below certain depths, to the indication of the depth, within certain limits, of palæozoic seas, through an examination of the traces of colour afforded by fossil remains of testacea.

Although their original colour is very rarely exhibited by fossil shells, occasionally we meet with specimens in which, owing probably to organic differences in the minute structure of the coloured and colourless portions of the shell, the pattern of the original painting is clearly distinguished from the ground tint. Not a few examples are found in Mesozoic as well as in Tertiary strata, but in all the instances on record, the association of species, mostly closely allied to existing types, and the habits of the animals of the genera to which they belong, are such as to prevent our having much difficulty about ascertaining the probable bathymetrical zone of the sea in which they lived.

But in palæozoic strata the general assemblage of articulate, molluscan and radiate forms is so different from any now existing with which we can compare it, and so few species of generic types still remaining are presented for our guidance, that in many instances we can scarcely venture to infer with safety the original bathymetrical zone of a deposit from its fossil contents. Consequently any fact that will help us in elucidating this point becomes of considerable importance.

Traces of colouring are rarely presented by palæozoic fossils, and the author knows of few examples in which they have been noticed. Professor Phillips, in his 'Geology of Yorkshire,' represents the carboniferous species, *Pleurotomaria flammigera* (i. e. *carinata*) and *conica*, as marked with colour, and Sowerby has figured such markings in *P. carinata* and *P. rotundata*. In the excellent monograph of the carboniferous fossils of Belgium, by Professor De Koninck of Liège, indications of pattern-colouring are faintly shown in the figures of *Solarium pentangulatum*, and distinctly in those of *Pleurotomaria carinata* and *Patella solaris*.

In the cabinets of the Geological Survey of Great Britain are some finely-preserved fossils from the carboniferous limestone of Parkhill, near Longnor in Derbyshire. Among these are several that present unmistakeable pattern-markings, evidently derived from the original colouring. They are—

Pleurotomaria carinata and *conica*, showing wavy blotches, resembling the colouring of many recent *Trochidæ*.

An undescribed *Trochus*, showing a spiral band of colour.

Metoptoma pileus, and

Patella ? retrorsa, both with radiating stripes, such as are presented by numerous existing *Patellidæ*.

Natica plicistria, with broad mottled bands.

Aviculo-pecten, a large unnamed species, with spotty markings on the ribs in the manner of many existing *Pectines*.

Aviculo-pecten sublobatus, Ph. ? Beautifully marked with radiating, well-defined stripes, varying in each individual, and resembling the patterns presented by those recent *Aviculæ* that inhabit shallows and moderate depths.

Aviculo-pecten intercostatus and *elongatus* also exhibit markings.

Spirifer decorus and *Orthis resupinata,* show fine radiating white lines.

Terebratula hastata, with radiating stripes.

The analogy of any existing forms that can be compared with those enumerated, would lead to the conclusion that the markings in these instances are characteristic of mollusks living in a less depth of water than 50 fathoms. In the case of the *Terebratula,* which belongs to a genus the majority of whose living representatives inhabit deep water, it may be noticed that all the living species exhibiting striped shells are exceptions to the rule, and come from shallow water.

There are many circumstances which warrant us to suspect that the carboniferous mountain limestone of most regions was a deposit in shallow water. The facts now adduced materially strengthen this inference.

In the British Museum there is a beautifully spotted example of a Devonian *Terebratula,* brought by Sir John Richardson from Boreal America.

Specimens of the *Turbo rupestris,* from the Lower Silurian Limestone of the Chair of Kildare near Dublin, exhibit appearances that seem to indicate spiral bands of colour.

ZOOLOGICAL SOCIETY.

November 9, 1852.—J. S. Bowerbank, Esq., F.R.S., in the Chair.

Descriptions of a new genus, and of several new species, of Mollusca, from the Cumingian Collection. By Arthur Adams, F.L.S. etc.

Family Solenellidæ.

Animal oblong. Mantle open in the entire length; margin double, outer edge fimbriated; hind outer edge ending in two callous conical processes immediately below the respiratory orifice. Respiratory orifice continuous with the opening of the mantle, the margin fringed; anal siphon simple-edged, tubular, elongate, muscular, produced beyond the fringed mantle-margin which surrounds its base. Gill single on each side, attached the whole length. Labial palps elongate, fringed at their margins, and surrounded at their base by a thin dilated membrane. Foot large, compressed, geniculate, ending anteriorly in a folded ovate disc with crenate margins.

Shell thin, not pearly within. Hinge-margin with comb-like teeth. Ligament external.

Genus Neilo, A. Adams.

Testa transversa æquivalvis, inæquilateralis, epidermide fusco tenui induta, latere postico hians. Dentibus cardinalibus, nullis, lateribus anticis et posticis plurimis in serie rectiuscula *dispositis; dentibus parvis acutis; impressionibus muscularibus subdistantibus, impressione pallii sinu magno; ligamento externo elongato.*

This genus differs from *Solenella,* not only in its Leda-like form, but in the hinge-margin having as many teeth anteriorly as posteriorly. In *Solenella* the series of teeth is confined to the fulcrum to which the external ligament is attached;—in this genus the teeth extend along the entire hinge-margin.

Neilo Cumingii, A. Adams. *N. testa transversa, æquivalvi, inæquilaterali, epidermide tenui viridi-fusco obtecta, transverse concentrice sulcata; latere antico clauso, rotundato, postico longiore, subangulato, hiante, margine truncato flexuoso, superne auriculato.*

From the circumstance of the hind margin gaping considerably and being divided as if for two siphons, the anal and branchial tubes in this animal are probably distinct and elongated, as in *Leda.* The genus *Neilo,* in fact, will represent *Leda,* of the family *Nuculidæ,* in a distinct family, *Solenellidæ,* characterized by the external ligament of the hinge. It is from the shores of New Zealand.

Concholepas (Coralliobia) fimbriata, A. Adams. *C. testa ovata alba, longitudinaliter radiatim costata, transverse lamellosa, lamellis pulcherrime fimbriatis; spira minuta, anfractu ultimo amplo; apertura ovali, antice attenuata, subcanaliculata; labio excavato incurvato, margine externo dilatato et valde reflexo; labro acuto, margine late dilatato et eleganter fimbriato.*

Hab. Cagayan, province of Misamis, island of Mindanao, Philippines. On the coral reefs at low water (*H. C.*). Mus. Cuming.

Externally this curious shell resembles *Concholepas,* but the absence of the two teeth on the fore part of the outer lip prevents it being strictly referred to that genus. In the character of the inner lip, and in its place of habitation on coral reefs, it approaches *Leptoconchus,* and perhaps it has affinities also with *Pedicularia.* I have thought it best, until the animal is known, to regard it as a subgenus of *Concholepas,* under the name of *Coralliobia.*

Paxillus minor, A. Adams. *P. testa dextrorsa, ovali, tenui, epidermide fusca obtecta; anfractibus septem, convexis, longitudinaliter confertim costellatis vel valde striatis; apertura suborbiculari, ascendente, antice subproducta; peristomate duplici, externo reflexo, dilatato; labio plica dentiformi valida instructo.*

Hab. —— ?

I believe the little shell described above to be a dextral species of the genus *Paxillus,* described by my brother and myself in the 'Annals' for January, 1851. We there considered the genus to belong possibly to *Auriculidæ*; but an examination of this species, and a better knowledge of the locality where the shells have been found, lead us to place them amongst the *Helicidæ.*

Diplommatina Bensoni, A. Adams. *D. testa minima vix ri-*

mata sinistrorsa, cylindrico-ovata, costellata, costulis distantibus obliquis regularibus; anfractibus sex, convexis, apice subobtuso; apertura rotundata; peristomate duplicato, externo expanso reflexo, interno recto, margine flexuoso.

Hab. On the banks of a river, Moreton Bay, E. Australia (*Mr. Strange*).

This very pretty little shell agrees in all its characters with the genus *Diplommatina* of Mr. Benson, after whom I have named it. There is some difficulty in the location of this genus. Mr. Benson says distinctly that the eyes are "*on* the posterior part of the tentacula, at their base," but he says there is no operculum. Mr. Gray, on the other hand, has described the operculum. The true position is probably in *Truncatellidæ*.

Crassatella speciosa, A. Adams. *C. testa transverse ovata, subæquilaterali, pallida, epidermide tenui fusca induta, concentrice plicata; plicis confertis regularibus; latere postico rotundato, antico acuminato subrostrato, angulato, margine ventrali convexo, antice sinuato.*

Hab. Bay of Campeachy. Mus. Cuming.

The beaks in this species are acute and close together, and rather more deeply plicate than the rest of the surface of the valves; there is an obtuse oblique and angular ridge extending from the umbones to the ventral margin.

Crassatella lævis, A. Adams. *C. testa ovato-transversa, crassa, tumida, subæquilaterali, castanea, lævigata, concentrice striata, natibus subsulcatis; latere postico rotundato, antico producto subrostrato, margine oblique truncato, carina obtusa a natibus ad basin decurrente instructo, posteriori sulcato, margine ventrali convexo antice sinuato.*

Hab. La Guayra (*M. Le Marie, French Navy*). Mus. Cuming.

A large smooth pale chestnut shell beaked anteriorly and with a prominent obtuse keel extending from the beaks to the fore part of the ventral margin, and a broad shallow groove behind it; the lunule is ovate lanceolate, and the beaks are transversely sulcate.

Crassatella obscura, A. Adams. *C. testa ovato-trigonali, transversa, subæquilaterali, compressa, nigro-fusca, apicibus transverse corrugata, ad umbonem plicata; latere antico rotundato, postico subtruncato; margine valvarum intus crenulato.*

Hab. China Seas, deep water. Mus. Cuming.

A small brown-black species, with the valves only plicate near the beaks and their inner margins finely crenulated.

Crassatella bellula, A. Adams. *C. testa ovato-trigonali, subæquilaterali, carneo-fulva, immaculata, transverse concentrice plicata; plicis obtusis subconfertis regularibus, antice undulatis, subevanidis (sub lente rugulosis); latere postico rotundato, antico vix truncato; umbonibus acutis parvis approximatis.*

Hab. New Zealand (*Mr. Hart*). Mus. Cuming.

A beautiful pinkish yellow species, without any spots or markings, with the plicæ on the fore part undulated and rugulose under the lens.

Crassatella truncata, A. Adams. *C. testa ovata, compressa, carnea, pallidiori ad partem anticam, radiis angustis inconspicuis ornata, inæquilaterali, latere antico breviori et rotundato, postico dilatato et truncato, linea elevata e umbonibus ad marginem ventralem; transversim valde costata, costis acutis subimbricatis.*

Hab. China Sea, deep water (*A. Adams*).

This is a small pale pink or flesh-coloured species, strongly ribbed, the ribs being sharp, prominent and imbricated; the posterior side is dilated and truncate, and the surface of the valves is marked with faint linear radiating lines.

Crassatella compta, A. Adams. *C. testa ovato-trigonali, subæquilaterali, apicibus antrorsum curvatis, rufescenti, transverse concentrice plicata; plicis validis, regularibus, subdistantibus; latere antico angustiori, postico latiori, rotundato, interne purpurascente.*

Hab. China Sea, deep water (*A. Adams*).

This is a small red species, with prominent curved beaks, strongly plicate transversely, and of a purplish pink colour in the interior of the valves.

Crassatella concinna, A. Adams. *C. testa ovato-transversa, subæquilaterali, epidermide tenui fusca obtecta, utrinque rotundata, concentrice plicata, plicis validis regularibus rufo-fusco articulatis; interstitiis creberrime longitudinaliter striatis; umbonibus acutis confertis.*

Hab. China Sea, deep water (*A. Adams*).

A small fuscous species, of an ovate form, rounded at both ends, with the transverse plicæ strongly produced and prettily articulated with brownish red.

ROYAL INSTITUTION OF GREAT BRITAIN.

May 12, 1854.—Sir Henry Holland, Bart., M.D., F.R.S., Vice-President, in the Chair.

On the common Plan of Animal Forms. By Thomas Huxley, Esq., F.R.S.

The Lecturer commenced by referring to a short essay by Gœthe—the last which proceeded from his pen—containing a critical account of a discussion bearing upon the doctrine of the Unity of Organization of Animals, which had then (1830) just taken place in the French Academy. Gœthe said that, for him, this controversy was of more importance than the Revolution of July which immediately followed it—a declaration which might almost be regarded as a prophecy; for while the *Charte* and those who established it have vanished as though they had never been, the Doctrine of Unity of Organization retains a profound interest and importance for those who study the science of life.

It would be the object of the Lecturer to explain, how the controversy in question arose, and to show what ground of truth was common to the combatants.

The variety of Forms of Animals is best realized, perhaps, by reflecting, that there are certainly 200,000 species, and that each species is, in its zoological dignity, not the equivalent of a family or a nation of men merely, but of the whole Human Race. It would be hopeless to attempt to gain a knowledge of these forms, therefore, if it were not possible to discover points of similarity among large numbers of them, and to classify them into groups,—one member of which might be taken to represent the whole. A rough practical classification, based on obvious resemblances, is as old as language itself; and the whole purpose of Zoology and Comparative Anatomy has consisted chiefly in giving greater exactness to the definition and expression of these intuitive perceptions of resemblance.

The Lecturer proceeded to show how the celebrated Camper illustrated these resemblances of the organs of animals, by drawing the arm of a man, and then by merely altering the proportions of its constituent parts, converting it into a bird's wing, a horse's fore-leg, &c. &c. Organs which can in this way be shown to grade into one another, are said to be the same organs, or in anatomical phraseology are *Homologous*:—and by thus working out the homologies of all the organs of the Vertebrate class, Geoffroy, Oken, and Owen,—to the last of whom we are indebted for by far the most elaborate and logical development of the doctrine,—have demonstrated the homology of all the parts of the Vertebrata, or in other words, that there is a common plan on which all those animals which possess backbones are constructed.

Precisely the same result has been arrived at, by the same methods, in another great division of the Animal Kingdom—the *Annulosa.* As an illustration, the Lecturer showed how the parts of the mouth of all insects were modifications of the same elements, and briefly sketched the common plan of the Annulosa, as it may be deduced from the investigations of Savigny, Audouin, Milne-Edwards, and Newport.

Leaving out of consideration (for want of time merely) the *Radiate* animals, and passing to the remaining great division, the *Mollusca,* it appears that the same great principle holds good even for these apparently unsymmetrical and irregular creatures: and the Lecturer, after referring to the demonstration of the common plan upon which those Mollusks possessing heads are constructed,—which he had already given in the Philosophical Transactions,—stated that he was now able to extend that plan to the remaining orders, and briefly explained in what way the 'Archetypal Mollusk' is modified in the *Lamellibranchs, Brachiopoda, Tunicata,* and *Polyzoa.*

We have, then, a common plan of the *Vertebrata,* of the *Articulata,* of the *Mollusca,* and of the *Radiata,*—and to come to the essence of the controversy in the Académie des Sciences—are all these common plans identical, or are they not?

Now, if we confine ourselves to the sole method which Cuvier admitted—the method of the insensible gradation of forms—there can be no doubt that the Vertebrate, Annulose and Molluscan plans are sharply and distinctly marked off from one another, by very definite characters; and the existence of any common plan, of which they are modifications, is a purely hypothetical assumption, and may or may not be true. But is there any other method of ascertaining a community of plan beside the method of Gradation?

The Lecturer here drew an illustration from Philology—a science which in determining the affinities of words also employs the method of gradation. Thus *unus, uno, un, one, ein*, are said to be modifications of the same word, because they pass gradually into one another. So *Hemp, Hennep, Hanf*, and *Cannabis, Canapa, Chanvre*, are respectively modifications of the same word: but suppose we wish to make out what, if any, affinity exists between *Hemp* and *Cannabis*, the method of gradation fails us. It is only by all sorts of arbitrary suppositions that one can be made to pass into the other.

Nevertheless modern Philology demonstrates that the words are the same, by a reference to the independently ascertained laws of change and substitution for the letters of corresponding words, in the Indo-Germanic tongues: by showing, in fact, that though these words are not the same, yet they are modifications by known developmental laws of the same root.

Now Von Bär has shown that the study of development has a precisely similar bearing upon the question of the unity of organization of animals. He indicated, in his masterly essays published five-and-twenty years ago, that though the common plans of the adult forms of the great classes are not identical, yet they start in the course of their development from the same point. And the whole tendency of modern research is to confirm his conclusion.

If, then, with the advantage of the great lapse of time and progress of knowledge, we may presume to pronounce judgment where Cuvier and Geoffroy St. Hilaire were the litigants—it may be said that Geoffroy's inspiration was true, but his mode of working it out false. An insect is not a vertebrate animal, nor are its legs free ribs. A cuttlefish is not a vertebrate animal doubled up. But there was a period in the development of each, when insect, cuttlefish, and vertebrate were undistinguishable and had a *Common Plan.*

The Lecturer concluded by remarking, that the existence of hotly controverted questions between men of knowledge, ability, and especially of honesty and earnestness of purpose, such as Cuvier and his rival were, is an opprobium to the science which they profess. He would feel deeply rewarded if he had produced in the minds of his hearers the conviction that these two great men—friends as they were to one another—need not be set in scientific opposition; that they were both true knights doing battle for science; but that as the old story runs, each came by his own road to a different side of the shield.

MISCELLANEOUS.

On the Formation of the Stomata in the Epidermis of the Leaves of the Spiderwort (Tradescantia virginica), *and on the Evolution of the Cells in their neighbourhood.* By Dr. Garreau.

When a fragment, taken from the outer axillary portion of a very young leaf of the common Spiderwort, is examined by the microscope, it presents quadrilateral cells, the cavities of which are partially occupied by a smooth nucleus which has not yet become filamentous. Amongst these cells, at tolerably regular distances, others are seen possessing the same transverse diameter, but only half the size in the direction of the axis of the leaf; the proteic matter contained in them is less united, more granular, and of a more amber-like tint than that of the preceding cells. These new cells give origin to the two semilunar cells of the stomate, and this metamorphosis commences by the separation into two little masses of the azotized matter which they contain. Between these masses the outline of a double diaphragm is first observed; this separates the cell into two chambers, and soon splits and separates to form the stomatic orifice, a change which takes place concurrently with a partial resorption exercised by the new cells upon the parent cell.

Before this metamorphosis takes place, the parent cell corresponds at its two extremities with two cells, of which the nuclei are supported upon the portion of the cell-wall which touches these extremities. These nuclei, which are at first simple, soon emit filaments which run to a certain distance, near the centre of the cell, where they form a little mass of their constituent matter, a second nucleus. Scarcely has this change taken place, than the oldest nucleus, which is contiguous to the lateral wall of the parent cell, liquefies the portion of the wall of the cell which encloses it, and appears as if it would penetrate into the parent cell of the stomate, of which it then touches the wall. This liquefaction soon stops, and the semifluid matter is seen to surround itself with a pellucid membrane which constitutes the nascent cell. This cell at this period, is lodged partially in a notch of the wall of that from which it has arisen; but in consequence of the growth of both these cells, this notch becomes effaced, and only appears like a slight curve. The cell which has lost a portion of its wall does not appear to be perforated, but it is probable that at the point where the dissolution was effected, there is nothing but a simple wall belonging to the new cell.

The two cells situated above and below the stomate are originally square; they afterwards become elongated, and the nucleus which occupies the centre of each of them emits proteic processes, which run towards the wall of the cell contiguous to the acute extremities of the stomatic cells, and accumulate their proper substance at this point; this substance soon envelopes itself in a very thin membrane, so as to constitute a distinct cell, but still contained within the former, which appears from that time to be divided into two by a simple septum. This new cell, which at first is much broader than long, soon elongates until it acquires a nearly square form, which it retains.

This mode of multiplication appears interesting, as it seems to show the solvent action exerted by proteic substances upon cellulose membrane and the part which they play in its regeneration, phænomena which, as may be seen, are not without analogy with those observable during the evolution of spores, pollen, &c. Another fact worthy of remark is, that in these formations the generation of the cells extends to all those contiguous to the parent cell of the stomate.—*Comptes Rendus*, 17th April, 1854, p. 744.

Description of a new Genus of Bivalve Mollusca. By H. and A. Adams.

Genus Myrina, H. and A. Adams.

Shell transverse, oblong, subequilateral; valves closed, covered with a horny epidermis, pearly within; beaks subcentral. Hinge edentulous, ligament internal, linear; muscular impressions far apart, pallial impression simple. Byssiferous.

A single species, for which we propose the name *M. Denhami*, was discovered by the Officers of H.M.S. Herald, attached to floating masses of blubber.

On the Dimorphism of the Uredineæ. By M. Tulasne.

Since numerous observations have placed it beyond a doubt that a vast number of *Fungi* possess reproductive bodies of several kinds, there is in the history of the *Uredineæ* a fact, which, I think, admits of a more satisfactory interpretation than it has hitherto received. I refer to the simultaneous presence or succession in the same sori of two sorts of fruits (spores), which are attributed to different species. Some mycologists see in this nothing but a cohabitation, which, although frequent, is by no means necessary; others suppose a compulsory relation between the two Uredines,—that of a parasite with its host. If the latter opinion prevailed, instead of four or five *Phragmidia* and a few *Pucciniæ*, which would be parasitic upon various *Uredines*, as is usually believed, we should have, as I have convinced myself, a multitude of other *Pucciniæ*, the *Uromyces*, the *Pilulariæ*, the *Triphragmia*, the *Coleosporia*, the *Melampsoræ*, the *Cronartia*, and no doubt many other *Uredineæ* which I have not yet been able to study sufficiently. Thus the *Uredineæ* would not only live, as is really the case, as parasites upon the vascular plants, but they would also offer among themselves an example of parasitism quite unknown in the history of organized bodies, as about a third of their species would be charged with the nourishment of another third. This parasitism would also present a very unprecedented character, for it would prevail between plants almost identical with each other, or at all events united by the closest affinities, whilst, even amongst the simplest beings, there are generally well-characterized organic differences between the parasite and its host. The parasitic life attributed to the *Phragmidia*, the *Pucciniæ*, the *Cronartia*, and other *Uredineæ*, in relation to the *Uredines* proper, is therefore *à* *priori* extremely improbable. Direct observation does not appear to me to render it at all more probable, for the productions in question are often met with quite independently of each other. As to those who only see in the *Uredines* and their hosts, associations or cohabitations comparable to those of the various grasses which compose our meadows, they perhaps will not recognize the importance of the phænomenon in question, and may misunderstand its signification. Against them they have the often striking resemblance between the *Uredo* and the Fungus which is united with it, and especially the constant order of their respective appearance, the *Uredo* always preceding its companion. This resemblance and succession evidently indicate relations between the productions which present them, and as these relations cannot be those of parasitism, they may be with more probability regarded as the indications of specific identities, which were suspected by some old observers, but which have been universally neglected by the mycologists of the present day. In truth, there is scarcely room to hope that we shall ever be able to furnish a direct proof of this identity, or one obtained by sowing, in consequence of the almost insurmountable difficulties attending the culture of Fungi, and especially that of the *Entophyta*; but even if the supposed proof were obtained in this manner, it would still be very legitimately open to criticism from the nature of these difficulties, and moreover its place may readily be supplied. At least, I think, that the attentive observation of the successive development of the heterosporous *Uredineæ* gives us sufficient authority for believing that these are not, as is now generally supposed, *Uredines* associated in pairs, but *Uredines* furnished with a double apparatus of reproduction and capable in consequence of assuming two different forms.

Amongst these peculiar *Uredineæ*, the *Phragmidia* and *Pucciniæ* are those which have especially attracted the attention of observers. Many have thought that the spherical or oval spores which are first produced in their sori, and which now constitute various species of *Uredineæ* (*Lecytheæ s. Epiteæ* and *Trichobasis sp. recentior*), were only either the true grains of these *Phragmidia* and *Pucciniæ*, or a still imperfect state of their plurilocular fruit. The former of these opinions wrongly supposes that these pretended grains are engendered in these backward fruits, and the second requires the admission of a transformation which has not actually been proved; but both ascribe to one and the same plant the two sorts of reproductive bodies which succeed each other on the same pulvinulus (*Chirode*, Lév.). In a great number of *Pucciniæ*, fruits intermediate in form between the spherical grains or *Uredo*, and the bilocular fruits or *Puccinia*, indicate evidently that these two kinds of reproductive organs belong to one and the same Fungus. Nevertheless, notwithstanding the numerous examples of dimorphism presented by the *Phragmidia*, *Pucciniæ* and *Uromyces*, these *Uredineæ* do not perhaps prove our opinion in so satisfactory a manner as the *Coleosporia*, *Melampsoræ* and *Cronartia*.

The pulvinuli of the *Coleosporia*, Lév. (*Uredo tremellosa*, Str. *et affines*) have at first apparently all the same organization; but some of them soon become converted into spherical and pulverulent fruits or spores, whilst others remain entire and solid, the obovate and segmented cells of which they are composed each emitting three or four long tubes terminated by large reniform spores. This second mode of fructification, which has hitherto remained unknown, is sometimes coexistent with the former in the same sori; it betrays the close affinity which unites the *Coleosporia* with the *Pucciniæ* and *Phragmidia*, and completely justifies the interpretation which we propose to give for the reproductive apparatus of all these Entophytal Fungi.

The *Melampsoræ*, Cast. (*Xylomatum sp.* Fr. S. M. ii. 261, *Sclerotiorum veterib.*) resemble the *Coleosporia* in their double structure, but differ from them in many respects. Their Uredo-pulvinuli (*Lecytheæ* and *Podosporia*, Lév. *partim*) have also an earlier development than the sori, which do not become pulverulent; the latter are formed of simple cells (unilocular) which only produce a single germ, which is terminal or basilar and usually tetrasporous, like that of the *Pucciniæ* or *Podisomata* (see my note on the germination of the *Uredineæ*, 'Comptes Rendus,' xxxvi. p. 1093). The dissemination of the spores or grains of the so-called *Uredo* takes place in summer and autumn; the spores, properly so called, of the solid pulvinuli are only produced, on the contrary, towards the end of the winter or in the beginning of spring; they are of an orange or yellow colour in *Melampsora betulina*, N., *M. populina*, Fr., *M. Tremulæ*, N., and *M. salicina*, Fr., and of a cinereous tint in *M. areolata*, Fr. The production of these late spores is a phænomenon hitherto unobserved, and proves at once that the *Melampsoræ* are certainly *Fungi*, and *Fungi* belonging to the group *Uredineæ*; two facts which have both been disputed by some mycologists.

As to the *Cronartia*, their delicate ligula is neither fistular, as is generally supposed, nor intended to carry out the propagative corpuscules of the Fungus; it is solid, and formed of cells which become seminiferous in the same manner as the chambers of a *Puccinia*, so that it must be regarded as the analogue of the ligula or columella of the *Podisomata* (see my observations on the *Tremellineæ* in the Annales des Sci. Nat. xix. p. 205). The spores with which it is covered are white and of a globose-ovoid form. Besides this complicated reproductive apparatus, which has been so misunderstood hitherto, the *Cronartia* possess another which makes its appearance earlier. The ligula in fact is usually surrounded at its base with ovoid or globular, pedicled cells, which are also evidently organs of reproduction, constituting an *Uredo* (*U. Vincetoxici*, DeC., *U. Pæoniarum*, Desm.) in the sense usually attached to this word*.

Thus the truth of the question before us will be perhaps less on the side of the philosophers than on that of the cultivators, who maintain that the *black rust* of the harvests is the second age of the *orange rust* which infests the plants in spring. According to our views, in fact, the *Puccinia graminis*, Pers., and the *P. coronata*, Cord., which form the greater part of the black rust of the Cereals, would claim, as belonging to them reciprocally, the *Uredo linearis*, Pers. and *U. Rubigo-vera*, DeC., to which the orange rust of the

* This *Uredo* would be a *Trichobasis* with M. Léveillé.

same plants in spring is also principally due. Persoon, Banks, DeCandolle and other botanists, have more or less partaken of the popular feeling to which we have just referred, but they have all explained it in such a manner as to show that the black fruits of the graminicolous *Pucciniæ* would be orange at the commencement of their development, and in this condition would have been taken for *Uredines*. None of these observers, I believe, have suspected the existence in this case of the phænomenon of dimorphism.

Now that the discoveries recently made in the history of the lower animals have shown what astonishing transformations their specific identity may undergo, these suppositions will be received, I imagine, with less prejudice, especially as they are already supported by a sufficient number of facts to remove a great deal of their apparent temerity. I have moreover great reason to hope that new observations will soon confirm them.—*Comptes Rendus*, 24th April, 1854, p. 761.

METEOROLOGICAL OBSERVATIONS FOR MAY 1854.

Chiswick.—May 1. Rain. 2. Rain: low white clouds. 3. Cloudy. 4. Very fine. 5. Foggy: very fine. 6. Cloudy: uniformly overcast: slight frost at night. 7. Fine: rain. 8. Heavy rain. 9. Showery: thunder, with heavy showers. 10, 11. Cloudy. 12. Foggy: very fine: boisterous at night. 13. Fine. 14, 15. Very fine. 16. White clouds: partially overcast: very clear: frosty. 17. Uniform haze: clear, with very dry air: overcast. 18. Uniformly overcast: clear at night: frosty. 19. Clear and fine. 20. Cloudless: very fine: clear. 21. Cloudy and fine: rain. 22. Densely clouded: rain. 23. Rain: fine: very clear. 24. Heavy showers: clear at night: frosty. 25. Fine: showers, partly hail: clear. 26. Heavy clouds: very fine: heavy rain at night. 27. Heavy rain: hail-storm, with thunder and lightning quarter to five P.M.: clear at night. 28. Fine: cloudy: showery: heavy rain. 29. Rain. 30. Overcast: rain: cloudy. 31. Very fine throughout.

Mean temperature of the month	50°·07
Mean temperature of May 1853	51 ·27
Mean temperature of May for the last twenty-eight years .	53 ·85
Average amount of rain in May	1·77 inch.

Boston.—May 1. Cloudy: rain A.M. 2. Cloudy: rain A.M. and P.M. 3. Cloudy: rain P.M. 4. Fine. 5. Cloudy: rain P.M. 6. Fine. 7. Cloudy: rain, with thunder and lightning A.M. and P.M. 8. Cloudy. 9. Cloudy: rain, with thunder and lightning A.M. and P.M. 10. Cloudy. 11. Cloudy: rain A.M. 12. Fine. 13. Cloudy. 14, 15. Fine. 16. Cloudy. 17. Fine. 18. Cloudy: rain A.M. 19, 20. Fine. 21. Cloudy. 22. Cloudy: rain A.M. 23. Rain A.M. and P.M. 24. Cloudy: rain A.M. 25. Fine. 26. Cloudy: rain A.M. 27. Cloudy: rain A.M. and P.M. 28. Fine. 29. Cloudy: rain A.M. 30. Cloudy: rain A.M. and P.M. 31. Cloudy.

Sandwick Manse, Orkney.—May 1. Clear A.M.: drops P.M. 2. Clear, fine A.M.: clear P.M. 3—5. Clear and fine A.M. and P.M. 6. Clear A.M.: rain P.M. 7. Clear and fine A.M. and P.M. 8. Clear, fine A.M.: cloudy P.M. 9, 10. Bright A.M.: showers P.M. 11. Bright A.M.: cloudy P.M. 12. Cloudy A.M. and P.M. 13. Bright A.M.: showers P.M. 14. Cloudy A.M.: drizzle, showers P.M. 15. Clear A.M. and P.M. 16. Drops A.M.: damp P.M. 17. Showers A.M. and P.M. 18. Clear A.M. and P.M. 19. Cloudy A.M. and P.M. 20, 21. Showers A.M.: cloudy P.M. 22. Cloudy A.M.: drops P.M. 23. Clear A.M. and P.M. 24. Bright A.M.: clear P.M. 25. Cloudy A.M.: rain P.M. 26—30. Cloudy A.M. and P.M. 31. Damp A.M.: drizzle P.M.

Mean temperature of May for twenty-seven previous years .	47°·98
Mean temperature of this month	48 ·39
Mean temperature of May 1853	49 ·07
Average quantity of rain in May for thirteen previous years .	1·68 inch.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1854. May.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·192	29·128	28·80	28·72	28·73	57	42	52·5	46	43	sw.	ssw.	se.	·16	·05	·06
2.	29·467	29·167	28·84	28·89	29·08	60	41	54	47½	44½	sw.	s.	se.	·02	....	·02
3.	29·482	29·437	29·05	29·26	29·41	60	37	54	51	43	sw.	sw.	se.	·01	·18	....
4.	29·663	29·540	29·23	29·51	29·58	65	27	50	51	43	sw.	sw.	se.	....	·15	....
☽ 5.	29·694	29·666	29·34	29·63	29·61	63	28	50·5	51	45	sw.	sw.	ese.	·04	....	....
6.	29·591	29·505	29·25	29·38	29·19	59	42	47·5	49	44½	s.	sw.	wsw.	....	·07	....
7.	29·598	29·512	29·13	29·19	29·24	61	44	55	50	46	s.	sw.	calm	·39	....	·26
8.	29·558	29·448	29·07	29·29	29·45	58	32	41	48	46	sw.	sw.	calm	·62	·09	....
9.	29·861	29·676	29·33	29·65	29·95	60	34	49	45	40	n.	w.	nnw.	·17	·11	....
10.	30·039	29·992	29·70	29·96	29·68	58	41	48·5	50	43½	ne.	n.	s.	....	·22	·02
11.	30·075	29·939	29·55	29·73	29·90	56	30	52	54	50	w.	s.	w.	....	·03	·13
○ 12.	30·186	30·118	29·79	29·84	29·84	67	39	53	55	49	s.	n.	w.	....	....	....
13.	30·110	30·083	29·65	29·83	29·87	67	37	60	49	46	nw.	nw.	w.	....	....	....
14.	30·139	30·112	29·75	29·89	29·97	67	47	56	50	45½	ne.	w.	w.	....	....	·05
15.	30·120	30·097	29·74	30·18	30·24	66	43	53	47	44	n.	n.	se.	....	....	·06
16.	30·136	30·125	29·84	30·12	30·04	61	30	49	52	49	ne.	ne.	wsw.	....	....	·01
17.	30·163	30·032	29·77	29·93	30·00	69	40	49	49	44	ne.	w.	wnw.	....	....	·06
18.	30·140	30·040	29·66	30·11	30·18	56	30	51	46	44	ne.	ne.	nw.	....	·08	·02
☾ 19.	30·229	30·199	29·87	30·14	29·97	64	30	51	50	49	ne.	n.	se.	....	....	....
20.	30·162	29·989	29·75	29·79	29·69	71	41	55	49	48½	s.	n.	wsw.	·07	....	....
21.	29·884	29·706	29·43	29·54	29·53	64	47	62	50	47½	s.	w.	se.	·19	....	·09
22.	29·581	29·492	29·16	29·43	29·29	62	44	60	52	49½	sw.	s.	ese.	·30	·10	....
23.	29·654	29·514	29·15	29·38	29·55	62	38	55	50	46	sw.	s.	ese.	·10	·07	·21
24.	29·760	29·669	29·30	29·67	29·79	62	30	61	53½	48	sw.	s.	ese.	·08	·03	....
25.	29·802	29·760	29·40	29·87	29·75	63	40	53	53½	47	sw.	sw.	wsw.	·12	·04	....
● 26.	29·701	29·658	29·28	29·80	29·79	64	42	55	52½	49	sw.	sse.	e.	·48	·11	·50
27.	29·714	29·639	29·27	29·72	29·66	59	37	55	53	48	sw.	sw.	ne.	·12	·15	·03
28.	29·740	29·634	29·30	29·65	29·72	62	38	56	53	50	s.	ssw.	e.	·42	....	....
29.	29·628	29·576	29·24	29·78	29·86	58	41	54	52	50	s.	w.	e.	·40	·42	....
30.	29·839	29·765	29·35	29·90	29·99	65	36	57	53½	49	sw.	ssw.	ene.	·34	·03	·09
31.	30·128	29·948	29·54	30·02	30·05	71	40	56	48½	48	sw.	sw.	n.	....	·07	....
Mean.	29·839	29·747	29·40	29·670	29·696	62·48	37·67	53·4	50·35	46·43				4·03	2·00	1·61

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VII.—*Researches on the Development of Viviparous Aphides.* By Waldo I. Burnett, M.D., Boston*.

Every naturalist is aware of the remarkable phænomena connected with the viviparous reproduction of Aphides or plant-lice, for their singularity has led them to be recounted in works other than those of natural science, and, from the days of the earlier observers, they have been the theme of a kind of wonder-story in zoology and physiology.

I need not here go over the historical relations of this subject. The queer experiments and the amusing writings of the old entomologists are well known. The brief history of the general conditions of the development of these insects is as follows:—In the early autumn the colonies of plant-lice are composed of both male and female individuals; these pair, the males then die, and the females soon begin to deposit their eggs, after which they die also. Early in the ensuing spring, as soon as the sap begins to flow, these eggs are hatched, and the young lice immediately begin to pump up sap from the tender leaves and shoots, increase rapidly in size, and in a short time come to maturity. In this state it is found that the whole brood, without a single exception, consists solely of females, or rather and more properly, of individuals which are capable of reproducing their kind. This reproduction takes place by a viviparous generation, there being formed in the individuals in question young lice, which, when capable of entering upon individual life, escape from their progenitor and form a new and greatly increased colony. This second generation pursues the same course as the first, the individuals of which it is composed being, like those of the first, sexless, or at least without any trace of the male sex throughout. These same conditions are then repeated, and so on almost indefinitely, experiments having shown that this power of reproduction under such circum-

* From Silliman's American Journal for January 1854.

stances may be exercised, according to Bonnet*, at least through nine generations, while Duvau† obtained thus eleven generations in seven months, his experiments being curtailed at this stage, not by a failure of the reproductive power, but by the approach of winter which killed his specimens; and Kyber‡ even observed that a colony of *Aphis dianthi* which had been brought into a constantly heated room, continued to propagate for four years, in this manner, without the intervention of males, and even in this instance it remains to be proved how much longer these phænomena might have been continued.

The singularity of these results led to much incredulity as to their authenticity, and on this account the experiments were often and carefully repeated; and there can now be no doubt that the virgin *Aphis* reproduces her kind, a phænomenon which may be continued almost indefinitely, ending finally in the appearance of individuals of distinct male and female sex, which lay the foundation of new colonies in the manner just described§.

The question arises, what interpretation is to be put upon these almost anomalous phænomena? Many explanations have been offered by various naturalists and physiologists, but most of them have been as unsatisfactory as they have been forced, and were admissible only by the acceptance in physiology of quite new features.

As the criticism I intend to offer upon some of these opinions will be better understood after the detail of my own researches, I will reserve their future notice until the concluding part of this paper.

My observations were made upon one of the largest species of *Aphis* with which I am acquainted, the *Aphis Caryæ* of Harris‖. While in Georgia, this last spring, it was my good fortune that myriads of these destroyers appeared on a hickory which grew near the house in which I lived. The number of broods on this tree did not exceed three, for with the third series their numbers were so great that their source of subsistence failed and they gradually disappeared from starvation. The individuals of each

* Traité d'Insectologie, ou Observations sur les Pucerons, 1745.

† Mém. du Mus. d'Hist. Nat. xiii. p. 126.

‡ Germar's Magaz. d. Entomol., 1812.

§ For details of experiments by which Bonnet's original results were verified, see Réaumur, Mémoires, iii. Mém. 9 and 11, and vi. Mém. 13. Also, DeGeer, Mémoires, iii. ch. 2, 3. Curtis, Trans. Linn. Soc. vi.; Philos. Trans. 1771. Sauvages, Journ. de Physique, i. Dutrochet, Mémoires, ii. p. 442. See also the more modern writers, and especially Kirby and Spence, Introduction to Entomology, iv. p. 161.

‖ A Treatise on some of the Insects of New England which are injurious to Vegetation, 2nd ed. 1852, p. 208. As Dr. Harris says, it is probably *Lachnus* of Illiger (*Cinara* of Curtis).

brood were, throughout, of the producing kind, no males having been found upon the closest search; they were all, moreover, winged; and those few that were seen without these appendages appear to have lost them by accident. I mention this fact especially, since it has been supposed by naturalists that the females were always wingless, and therefore that the winged individuals, or the males, appeared only in the autumn*.

The first brood, upon their appearance from their winter hiding-places, were of mature size, and I found in them the developing germs of the second brood quite far advanced. On this account it was the embryology of the third series or brood alone that I was able to trace in these observations.

A few days after the appearance of these insects, the individuals of second brood (B), still within their parents (A), had reached two-thirds of their mature size. At this time the arches of the segments of the embryo had begun to close on the back, and the various external appendages of the insect to appear prominently; the alimentary canal had been more or less completely formed, although distinct abdominal organs of any kind belonging to the digestive system were not very prominent. At this period, and while the individuals of generation B are not only in the abdomen of their parent A, but are also enclosed, each, in its primitive egg-like capsule,—at this time, I repeat, appear the first traces of the germs of the third brood (C).

These first traces consist of small egg-like bodies arranged two, three, or four in a row, and attached in the abdomen at the locality where the ovaries are situated in the oviparous forms of these animals.

These egg-like bodies consisted either of single nucleated cells, of $\frac{1}{3000}$th of an inch in diameter, or a small number of such cells enclosed in a simple sac. These are the germs of the third generation; they increase with the development of the embryo in which they have been formed, and this increase of size takes place, not by a segmentation of the primitive cells, but by the endogenous formation of new cells. After this increase has gone on for a certain time, these egg-like bodies appear like little oval bags of cells—all these component cells being of the same size and shape, there being no cell which is larger and more prominent than the rest, and which could be comparable to a germinative vesicle. While these germs are thus constituted, the formation of new ones is continually taking place. This occurs by a kind

* See Westwood, An Introduction to the modern Classification of Insects, &c. London, 1839, ii. p. 438; but especially Owen, Parthenogenesis, &c., p. 23, note, and p. 59, note, where he says, "Many of the virgin viviparous Aphides acquire wings, but never perfect the generative organs!"

of constriction-process of the first germs, one of their ends being pinched off, as it were, and in this way what was a single sac, is changed into two which are attached in a moniliform manner. The new germ thus formed may consist of even a single cell only, as I have often seen, but it (the germ) soon attains a more uniform size by the endogenous formation of new cells within the sac by which it is enclosed. In this way the germs are multiplied to a considerable number, the nutritive material for their growth being apparently a fatty liquid with which they are bathed, contained in the abdomen, and which is thence derived from the abdomen of the first parent.

When these germs have reached the size of $\frac{1}{300}$th of an inch in diameter, there appears on each, near one end, a yellowish vitellus-looking mass or spot, which is composed of large yellowish cells, which in size and general aspect are different from those constituting the germ proper. This yellow mass increases *pari passu* with the germ, and at last lies like a cloud over and concealing one of its poles. I would also insist on the point that it does not extend itself gradually over the whole germ-mass, and is therefore quite unlike a true germinative vesicle or a proligerous disc. When the egg-like germs have attained the size of $\frac{1}{150}$th of an inch, there distinctly appears the sketching or marking out of the future animal. This sketching consists at first of delicately-marked retreatings of the cells here and there, but which soon become more prominent from furrows, and at last the whole form of the embryo stands boldly out. As the whole idea and form of the insect is thus moulded out of a mass of cells, it is evident that the separate parts which then appear, such as the arches of the segments, the extremities and the oval apparatus, consist at first only of rows of simple cells. This point is here beautifully prominent, and nowhere have I observed finer illustrations of the cell-constitution of developing forms.

The development thus proceeding, each part of the dermoskeleton becomes more and more distinct, and the increase of size of the whole is attained by the constant development of new cells. During this time, the yellow vitellus-looking mass, situated at one of the poles of the embryo, has not changed its place; it has increased somewhat in size, but otherwise appears the same. When the development has proceeded somewhat further, and the embryo is pretty well formed, the arches of the segments, which have hitherto remained gapingly open, appear to close together on the back, thereby enclosing this vitellus-looking mass within the abdominal cavity.

It is this same vitelloid mass thus enclosed that furnishes the nutritive material for the development of new germs which would be those of the fourth brood, or D; this development of germs here commences with the closing up of the abdominal cavity, and the same processes which we have just described are again repeated.

The details of the development subsequent to this point are like those of the development of ordinary insects or of the Articulata in general; and although this ovoid germ has at no time the structural peculiarities of a true ovum—such as a real vitellus, a germinative vesicle and germinative dot; yet, if we allow a little latitude in our comparison, and regard the vitellus-looking mass as the *mucous*, and the germ-mass proper as the *serous* fold of the germinating tissue, as in true eggs—if, I repeat, we can admit this comparison of parts, then the analogy of development between these germs and true eggs of insects may be traced in considerable detail.

This comparison I have been inclined to admit at least in part, from the striking resemblance of these developing forms at certain stages, with the embryological forms of spiders as they have been figured by Herold* and as I have myself traced them. When, in spiders, the serous fold of the germinating tissue has extended so as to cover two-thirds of the developing form, leaving the vitelline mass on the dorsal surface near one of the poles, the whole embryo quite resembles that of a developing Aphis just before the arches of the segments close up on the back.

With this view of the relative parts of the germ, the following would be the details of the development of the different systems, and in the noticing of which I shall follow Kölliker†.

1. The germinating tissue consists of two parts; a serous and mucous fold.

2. The abdominal plates arise from the serous fold, sprout out towards the vitelloid mass, pass over it and unite on the dorsal surface of the future animal; on the opposite side are formed plates which do not unite, but are formed into the hind legs.

3. The wings are the lateral limbs.

4. The first traces of the abdominal column appear in the chain of abdominal muscles situated between the nerves and the intestinal canal.

5. The nervous system in all its parts arises from the serous fold, as well also as the organs of sense.

6. The mucous fold, or the vitellus-looking mass, serves no purpose in the formation until the closing in of the visceral plates.

7. Thus enclosed in the abdominal cavity, it is not transformed

* De Generatione Aranearum in ovo. Marbourg, 1824.

† Observationes de prima Insectorum genesi adjecta Articulatorum evolutionis cum Vertebratorum comparatione. Diss. Inaug. Scr. Alb. Kölliker. Turin, 1842. A work replete with facts and interesting suggestions.

directly into the intestinal canal, but simply furnishes the material from which the component cells of the said canal and its hepatic diverticula are formed. It also furnishes the material from which the new germs are formed, as already shown.

8. The heart is formed on the dorsal aspect between the mucous and serous folds. In this way the details of development closely correspond with those of the embryology of the other Articulata which I have studied; and the subject is all the more interesting, as the germ-masses, from which such development occurs, in no way and at no time structurally resemble true eggs.

When the embryo is ready to burst from its developing capsule and make its escape from the abdomen of its parent, it is about $\frac{1}{16}$th of an inch in length, or more than eight times the size of the germ at the time when the first traces of development were seen. From this it is evident that, even admitting that these germ-masses are true eggs, the conditions of development are quite different from those of the truly viviparous animals; such as for instance in *Musca, Anthomyia, Sarcophaga, Tachina, Dexia, Miltogramma,* and others among Dipterous insects*; or in the viviparous reptiles,—for in all these cases of ordinary viviparity, the egg is simply hatched in the body instead of out of it. The egg, moreover, is formed exactly in the same way as though it was to be deposited, and its vitellus contains all the nutritive material required for the development of the egg until the coming forth of the new individual. The abdomen of the mother serves only as a proper nidus or incubatory pouch for its full development. This is true of all the ovo-viviparous animals whatsoever†. With the viviparous Aphides, on the contrary, the developing germ derives its nutritive material from the fatty liquid in which it is bathed, and which fills the abdomen of the parent‡. The conditions of development here therefore are more like those in Mammalia, and the whole animal may, in one sense, be regarded as an individualized uterus filled with germs, for the digestive canal, with its appendages, seems to serve only as a kind of laboratory for the conversion of the succulent fluids which the animal extracts from the tree on which it lives, into this fatty

* See Siebold in Froriep's Neue Notiz. iii. p. 337, and in Wiegmann's Arch. 1838, i. p. 197; also his Observat. quæd. Entom. &c., p. 18.

† It is true that in the Scorpionidæ the eggs are developed in the ovary, but there is no reason to suppose that the conditions are here different from those of the viviparous Diptera. In *Oribates*, also, the eggs are developed in a kind of uterus situated directly above the ovipositor, but this appears to be only an incubatory pouch.

‡ This fatty matter forms beautiful crystals of margarine, and the crystallization may easily be seen to take place. The forms exactly resemble those given by Robin and Verdeil, Traité de Chim. Anat. et Physiol. pl. 38. fig. 2 *h*. Paris, 1853.

liquid from which the increase and development of the germs take place.

When the young animal has reached its full development as an embryo, it bursts from its encasement and appears to escape from the abdomen of its parent through a small opening (*porus genitalis*) situated just above the anus. In the species under consideration it generally remains clinging on the back of the parent until its external parts are dry and it is able to begin life for itself. Each parent here produces from eight to twelve individuals, and if this rapid increase is continued undisturbed, through seven to nine broods, we cannot wonder at the countless numbers which appear from so few original individuals*.

Such are the details of the embryological development of the so-called viviparous Aphides, as far as I have enjoyed opportunities for their study. We will now refer for a moment to the special points which have here been made out. In the first place, it is evident that *the germs which develope these forms are not true eggs*. They have none of the structural characteristics of eggs, such as a vitellus, a germinative vesicle and dot; on the other hand, they are, at first, simple collections, in oval masses, of nucleated cells. Then again, they receive no special fecundating power from the male, as is the necessary preliminary condition of all true eggs; and, furthermore, the appearance of the new individual is not preceded by the phænomena of segmentation, as also is the case with all true eggs. Therefore their primitive formation, their development, and the preparatory changes they undergo for the evolution of the new individual, are all different from those of real ova†.

Another point is, *these viviparous individuals have no proper ovaries and oviducts*. Distinct organs of this kind I have never been able to make out. The germs are situated in moniliform rows, like the successive joints of confervoid plants, and are not enclosed in a special tube. These rows of germs commence, each, by a single germ-mass which sprouts from the inner surface of the animal, and which increases in length and in the number

* Réaumur has shown that in these animals the rate of increase is so great, that in five generations or broods only one Aphis may be the progenitor of five billion nine hundred and four million nine hundred thousand (5,904,900,000) descendants; we may well ask, what would be the number of descendants where the broods were extended to eleven!!—See Kirby and Spence, Introduction to Entomology, i. p. 175.

† Milne-Edwards thinks he has found true *ova* and ovaries in the viviparous forms of these animals. (Quoted by Dr. Carpenter in Brit. and For. Med. Chir. Rev. 1849, iv. p. 443.) I think he must have been deceived, as I was at first, by the general appearances, which, unless carefully examined, closely resemble those of true oviparous individuals.

of its component parts from the successive formation of new germs by a constriction-process as already mentioned. Moreover, these rows of germs, which, at one period, closely resemble in general form the ovaries of some true insects, are not continuous with any uterine or other female organ, and therefore do not at all communicate directly with the external world. On the other hand, they are simply attached to the inner surface of the animal, and their component germs are detached into the abdominal cavity as fast as they are developed, and then escape outwards through a *porus genitalis,* exactly as is the case with the eggs of fishes*. Here, then, comes the important question, What interpretation shall we put upon these reproductive parts—these moniliform rows of germs? Ignoring all existing special theories relating to reproduction, the observing physiologist would be left no alternative but to regard them as *buds,* true gemmæ, which sprout from the inner surface of the Aphis, exactly like the buds from the external skin of a Polype†.

Before proceeding to a discussion of the relations of this important conclusion to which we have just arrived, it may be well to refer to the views of others upon the exact signification of these singular reproductive phænomena.

Those old entomologists, such as Bonnet, Réaumur, DeGeer, &c., who were the first to observe, besides verifying beyond all doubt, these peculiar phænomena, all believed that each brood constitutes a separate generation, and that the reproduction takes place by true ova, as in the common generative act of other insects. This wide deviation from the ordinary course of nature, as it seemed to them, they attempted to explain and reconcile by various theories. Thus Réaumur‡ affirmed that these viviparous individuals were androgynous; and, in later times, Léon Dufour§, who knew too well the anatomical structures of insects to believe with Réaumur that they could be hermaphrodites, referred these phænomena to spontaneous or equivocal generation.

Morrem‖, who made somewhat extended researches on the

* These observations of mine on the special anatomy of the reproductive parts of viviparous Aphides agree with those of Siebold, who studied the subject with much care several years since. See Froriep's Neue Not. xii. p. 308. Siebold, however, regarded them as true ovaries and oviducts, but without any of the usual appendages which are found in the true oviparous Aphides.

† I would insist upon this wide and important distinction between buds and ova. The structure and conditions of all ova are the same, and there is no passage between them and buds. But this point will be enlarged upon hereafter.

‡ *Loc. cit.* Mémoires.

§ Recherches Anat. et Physiol. sur les Hémiptères. Paris, 1833.

‖ Anat. de l'*Aphis persicæ,* in the Ann. d. Sc. Nat. v. 1836, p. 90.

anatomy of *Aphis persicæ*, and especially of its generative organs, advanced the novel theory, that these broods were developed in the body of the virgin parent, by a previously organized tissue becoming individualized and assuming an independent life, exactly, as he believed, to be the case with Entozoa. To each and all of these views, it scarcely need be said that they would be wholly inadmissible according to the present established doctrines of physiological science, even had we no directly controverting observations.

But there are other explanations or views which deserve more attention. The first of these is that advanced by Kirby and Spence*. According to them, "One conjunction of the sexes suffices for the impregnation of all the females that in a succession of generations spring from that union." In support of the reasonableness of this hypothesis, they quote several instances which they regard as of analogous character; thus, they say in regard to the hive-bee, that "a single intercourse with the male fertilizes all the eggs that are laid for the space of two years."

In this connection should be mentioned the similar hypothesis advanced for a like purpose by Jourdan†. According to him many Lepidoptera lay fertile eggs when completely isolated from the males: such are, *Euprepsia casta, Episema cæruleocephala, Gastropacha potatoria, G. quercifolia* and *G. pini, Sphinx ligustri, Smerinthus populi*, and *Bombyx querci*.

But all these cases have really no strict analogy with that of the Aphides in question; for there is not, as with these last, a succession of innately fertile individuals, but only females which are capable of producing several broods from a single coitus, or after having been long removed from the males, which may even then be dead‡. Late researches upon the minute anatomy of the generative organs of insects have furnished results by which these phænomena, seemingly strange at first, can be explained. All these insects which are thus capable of laying fecundated eggs

* Introduction to Entomology, iv. p. 161.

† Manuel de Physiologie, par J. Müller, Trad. de l'Allemand, etc. par A. J. L. Jourdan. Deux. éd. rev. et annot., par E. Littré, ii. p. 599, note.

‡ Siebold has made observations upon allied phænomena occurring in the Psychidæ, which are of no little interest. He has shown that in the genera *Psyche* and *Fumea*, the alleged reproduction, *sine Lucina*, is unfounded—these insects having well-formed internal genital organs, and the male being adapted to impregnate the female while the latter is in her case. But in the genus *Talæporia*, Siebold has shown that there is propagation *sine concubitu*, exactly as occurs with the Aphides. See Ueber die Fortpflanzung der Psyche: Ein Beitrag zur Naturgeschichte der Schmetterlinge, in Siebold and Kölliker's Zeitsch. i. 1849, p. 93: but, for his last researches on *Talæporia*, see his Bericht üb. d. entomol. Arbeiten d. schles. Gesellsch. im J. 1850; or its English transl. in the Trans. of the Ent. Soc. N. S. i. p. 234.

again and again after the first impregnation, have a *receptaculum seminis* connecting with the oviduct, in which the semen is deposited during coition, and where it may be preserved without losing its vitalizing power for several months*. Thus, by this provision, the males, having copulated with the females in the autumn, may immediately die, while these last, hibernating, produce in the spring fertile ova; and in the instance of the *Bombus americana*, such a coition suffices for all the three broods which are produced the ensuing summer.

Another explanation of these curious phænomena, and which has attracted some attention, as well from its singularity as from the eminence of its propounder, is that of Owen, advanced in his Hunterian Lectures in 1843†.

He affirms that the larval Aphides are productive in virtue of the successive continuation from brood to brood of a portion of the primitively fertilized germ, and which material product or leaven is not exhausted until nine to eleven generations. I will quote his own language: "In the Aphides the corresponding vitelline cells retain their share of the fecundating principle (which was diffused through the parent egg by the alternating, fissiparous, liquefactive, and assimilative processes) in so potent a degree, that a certain growth and nutritive vigour in the insect suffice to set on foot in the ovarian, nucleated cells, a repetition of the fissiparous and assimilative process, by which they transform themselves in their turn into productive insects; and the fecundating force is not exhausted by such successive subdivision until a 7th, 9th, or 11th generation." This same doctrine, the successive inheritance of a portion of the primary germ-mass from brood to brood, and by means of which the fertile germs are continued, —this doctrine, I say, is repeated in full in this author's work on Parthenogenesis, and I will here quote one sentence, not only in illustration of this, but to show how different his own observations on the development of these animals are from mine, just described. He says, "One sees such portion of the germ-mass

* For many details on this subject of the *receptaculum seminis*, see Siebold, Müller's Arch. 1837, p. 392; also in Wiegmann's Arch. 1839, i. p. 107 (*Vespa*), and in Germar's Zeitsch. ii. (1840) p. 442 (*Culex*). See also Stein, Vergleich. Anat. &c. 1847, p. 96, 112. I cannot but believe that the anomalous reproductive conditions of the Cynipidæ will, at last, have a solution equally satisfactory. See Hartig, Germar's Zeitsch. ii. p. 178, and iv. p. 395. See also Siebold and Stannius's Comparative Anatomy, transl. i. sect. 348, notes 1 & 4.

† Lectures on the Comparative Anatomy and Physiology of the Invertebrate Animals, &c. London, 1843, p. 233. This explanation is lately insisted upon (strange to relate) in his recent work "On Parthenogenesis, or the successive production of procreating individuals from a single ovum." London, 1849.

taken into the semitransparent body of the embryo Aphis, like the remnant of the yolk in the chick. I at first thought it was about to be enclosed in the alimentary canal, but it was not so. As the embryo grows, it assumes the position of the ovarium, and becomes divided into oval masses and enclosed by the filamentary extremities of the eight oviducts. Individual development is checked and arrested at the apterous larval condition. It is plain, therefore, that the essential condition of the development of another embryo in this larva is the retention of part of the progeny of the primary impregnated germ-cell." (p. 70.)

This view of Owen, so ingeniously advanced, and which he has made subservient for the chief support of his new doctrine of Parthenogenesis, is indeed plausible and seems at first satisfactory; but, as I hope to show, it will not bear analysis.

In the first place, it is evident that Owen does not recognise any physiological difference between a *bud* and an *ovum*; this is clear from what he remarks in the first quotation, but in his work on Parthenogenesis he has said so in as many words. "The growth by cell-multiplication producing a bud, instead of being altogether distinct from the growth by cell-multiplication in an egg, is essentially the same kind of growth or developmental process." (p. 45.)

Here is a fundamental error, which, if not removed, will obscure all our views of the physiology of reproduction. I have already insisted upon the necessity of this broad distinction between these two forms,—a necessity based not only upon differences of anatomical constitution, but also upon physiological signification. An *Ovum* is the exclusive product of an individual of the female sex, and is always formed in a special organ called the ovary. It is the particular potential representative of the female, and has its ulterior development only from its conjunction with a corresponding element of the opposite or male sex; and zoology presents no instance where there is development from eggs, unless these conditions of the two sexes are fully carried out.

A *Bud*, on the other hand, is simply an offshoot from the form on which it rests, a portion of the animal capable of individual development. It sustains, therefore, no relations to sex, and, in truth, is widely separated in its ulterior signification from that cycle of processes conceived in a true oviparous reproduction.

All physiologists who have carefully studied embryological and developmental processes must feel the correctness and importance of this distinction, which lies in realities and not in words.

It is true, that a bud and an ovum are composed each of the same elements,—simple nucleated cells; but in one, these cells are simply in a mass, while in the other, they have, throughout the animal kingdom, high or low, a definite and invariable arrangement. Then again as to the constitution of each and both being, on the whole, of nucleated cells, it may be said, that it could hardly be conceived to be otherwise, for nucleated cells are the elementary components of all functional organized forms; and it may be added, moreover, that he knows little of the highest physiology who has not learned that widely different teleological significations may be concealed beneath isomorphic animal forms.

I have thus dwelt rather lengthily upon this point because I think it is a vital one in our subject, and the possession of clear ideas thereon will be found singularly conducive to our correct appreciation of the whole class of anomalous phænomena under discussion. But we will revert to the subject of Owen's hypothesis.

As to the chief point in this hypothesis, the continuation of the primary germ-mass as a leaven, from brood to brood, it requires but little thought to perceive that it is physically impossible. I would first allude to Owen's statement, quoted above, that a portion of the germ-mass is taken into the abdomen of the embryo Aphis, and, as he thinks, assumes, without any change, the position of the ovarium. By this he refers, undoubtedly, to the vitellus-looking mass I have described in my observations, and according to which, also, it appeared to serve only as the nutritive material out of which the digestive organs and the germs are formed. Moreover, I feel quite sure that the germ-cells are new cells formed in the abdomen, and not those derived from the parent.

But the point I wish to enforce is, that even admitting that individuals B may contain an *actual residue* of individuals A, it is clearly evident that this succession must stop with brood B; for these residual germ-cells which compose B in its earliest condition are lost in the developmental processes, and the germs of individuals C, which are found in B, are each, primarily, nucleated cells formed *de novo*, as I have observed and above described. With these observed conditions of development, it is impossible for the individuals of the successive broods to inherit the original spermatic force in the continuation of the original cells.

The hypothesis of Owen, therefore, plausible and ingenious as it may seem, does not appear to me to accord either with observed facts, or with the soundest physiology of the reproductive processes. I may here remark also, that his doctrine of Parthenogenesis, based as it is upon the conditions of the hypothesis in question, cannot, as such, be sustained, for the same reasons, and all its phænomena would appear to find their solution either in Steenstrup's doctrine of "Alternation of Generations," so-called, or in the conditions of true gemmiparity,—admitting, provisionally, that Steenstrup's doctrine and gemmiparity include really different physiological conditions.

But the most important explanation advanced, and the last which I shall notice, is that offered by Steenstrup* in his doctrine of the "Alternation of Generations," and of which it forms a chief support. The details of this peculiar doctrine of Steenstrup I need not here furnish; they are well known to all physiological anatomists. Its features, however, may be expressed in a formula-like manner. Individuals A produce true fecundated eggs, from which are hatched individuals B, which are unlike their parents in all zoological respects, but in which are developed spontaneously and without any reference to sex, germs which ultimately become individuals like A, and so the cycle of development is completed. These intermediate individuals, B, Steenstrup has termed nurses (*Amnen*), and he regards them as distinct animals subservient for a special end; he therefore considers that B constitutes a real generation.

Instances of such phænomena are found in the lower orders of the animal kingdom—Polyps, Acalephs and Worms; and late research has shown that they are more or less common throughout the whole of the Invertebrata.

The difference between alternation of generation and metamorphosis is too marked to require illustration; in the latter there is the same individual throughout, and the developmental processes, although concealed beneath different exteriors, are regular and normal; with the former, however, this chain of development is broken by one form being developed in another, this intermediate form serving as a stepping-stone for a higher and ulterior development. Another important point in this alternate reproduction, is, that in each new change some real progress is made—the nursing-form being manifestly inferior to the individual to which it gives rise.

Steenstrup regards the Aphides as furnishing the most perfect examples known of nursing individuals, and, on the whole, as constituting typical illustrations of the doctrine he has advanced†.

But if this doctrine implies conditions other than those which belong to true gemmiparity, it does not appear to me that it has any support in the phænomena in question of the Aphides. And although I am inclined to believe, as I shall soon show, that all these phænomena, essentially, may be of the same nature, yet there can be no doubt that the manifestations are here somewhat pecu-

* On the Alternation of Generations, or the Propagation and Development of Animals through Alternate Generations; a peculiar form of fostering the young in the lower classes of Animals. Transl. by the Ray Society. London, 1845, *passim*.

† See Steenstrup, *loc. cit.* p. 112.

liar. With the Aphides there is no real morphological progress made in each brood, for the viviparous individuals are, zoologically, as perfect in every way as those which are oviparous, except in their want of true sexual generative organs. I have shown that, in the one species here described, they had well-developed wings like the true sexual individuals. Moreover, each brood, from the first to the last inclusive, is merely a repetition of the same. But these conditions are external and œconomical, and, instead of offering these prominent examples as evidence against the validity of Steenstrup's doctrine, I would rather present them as broadly indicating that, after all, this doctrine in question involves no conditions excepting those belonging to a modified form of gemmiparity. All the instances of Polyps, Acalephs, Worms, Insects, &c., would then be classed in the same category, and the variations in manifestation would belong rather to the œconomical relations of the animal, than to any intrinsic difference of physiological process. Thus the Distoma-nurses, instead of being developed to a condition resembling at all their parent, remain persistent on a low form, and not only is their whole zoological character undeveloped, but they also experience morphological changes from the developmental process which immediately go on within them. All this is in perfect keeping with their œconomy as animals, for the low order of their conditions of life does not necessitate a higher and more truly zoological form of these nurses from which are to be developed the true animals; were it otherwise, I cannot but believe that both the nurses and the grand-nurse of Distoma would quite resemble the original animals. In the case of the Aphides, the œconomical conditions are different, and finely illustrate this point.

The Aphis-nurse, in virtue of its very typical structure as an insect, must live under higher conditions, and so its development, zoologically, proceeds to a corresponding point; this point is where it, as an insect and as an Aphis, can furnish the nutritive material for the development of its endogenous germs.

Herein, then, would appear to consist the prominent morphological differences observed in this category of phænomena, and I need not labour further to show that they are irrelevant of the primary essential conditions of these curious processes.

Such appears to me to be the highest, both physiological and zoological, interpretation that can be advanced for these phænomena which Steenstrup has so ingeniously collected and collated; and to advance the view that these intermediate individuals or nurses are not intrinsically and zoologically the same as their parents, but furnish examples of how dissimilar animals may arise from a common stock—to put forth this view, I say, is to advocate a doctrine in physiology as mischievous as it is deeply erroneous. I think, therefore, that the doctrine of Steenstrup may prove to be unfounded as far as it would involve, intrinsically, new phænomena in the processes of reproduction; and, as I have said on a preceding page, all its conditions may find their illustration and solution in the various phases of gemmiparity*.

If in this discussion of some of the highest relations of physiology, we have not wandered too far from our subject proper which we have thereby sought to illustrate indirectly, we will revert to the thread of its discourse for a few concluding remarks.

The final question now is, what is the legitimate interpretation to be put upon the reproductive phænomena of the Aphides we have described? My answer to this has been anticipated in the foregoing remarks. I regard the whole as constituting only a rather anomalous form of gemmiparity. As already shown, the viviparous Aphides are sexless; they are not females, for they have no proper female organs, no ovaries and oviducts. These viviparous individuals therefore are simply gemmiparous, and the budding is here internal instead of external as in the Polyps and Acalephs; it moreover takes on some of the morphological peculiarities of oviparity; but all these dissimilar conditions are œconomical and extrinsic, and do not touch the intrinsic nature of the processes concerned therein.

Viewed in this way, the different broods of Aphides cannot be said to constitute as many true generations, any more than the different branches of a tree can be said to constitute as many trees; on the other hand, the whole suite from the first to the last constitute but a single true generation. I would insist upon this point as illustrative of the distinction to be drawn between *sexual* and *gemmiparous* reproduction. Morphologically, they have, it is true, many points of close resemblance; but there is a grand physiological difference, the true perception of which is deeply connected with our highest appreciation of individual animal life†. A true generation must be regarded as resulting only from the conjugation of two opposite sexes—from a sexual pro-

* This statement is made perhaps more strongly and exclusively than the present state of our knowledge would warrant, but I throw it out much in a suggestive way. There is no subject in physiology more interesting and comprehensive than that of *Gemmation*; the important question now is,—does it, as an individual process, embrace all the categories of phænomena treated by Lovén, Steenstrup, &c., these phænomena varying extrinsically, according to œconomical conditions, or do they (the phænomena) imply something beyond and dissimilar from gemmation?

† In this view, as well as in several others herein discussed, I am pleased to say that I have the support of so learned a physiologist as Dr. Carpenter. See his Review "On the Development and Metamorphoses of Zoophytes," in the Brit. and Foreign Med. Chir. Rev. 1848, i. p. 183; and "On Reproduction and Repair," in ibid. 1849, ii. p. 419.

cess in which the potential representations of two individuals are united for the elimination of one germ. This germ-power may be extended by gemmation or by fission, but it can be formed only by the act of generation, and its play of extension and prolongation by *budding*, or by division, must always be within a certain cycle, and this cycle is recommenced by the new act of the conjugation again of the sexes.

In this way, the dignity of the ovum as the primordium of all true individuality is maintained; and the axiom of Harvey, *omne vivum ex ovo*, stands as golden in physiology. The buds may put on the dress and the forms of the ovum, but these resemblances are extrinsic, and in fact only an inheritance from their great predecessor.

These phænomena, thus interpreted, furnish an excellent key to many others which have long been regarded as anomalous, in the history of development.

I refer here to the so-called hibernating eggs (*Wintereier*) which are found in many Invertebrates. These I have not seen, but they have been carefully described by several very trustworthy observers. These so-called eggs consist of oval masses or cells invested with a capsule, but in which no germinative vesicle and dot have ever been seen. Structurally, therefore, they do not resemble eggs, and it is from their form and ulterior development only that they have received this name. Moreover, they sustain none of the usual relations of eggs to the sexual organs, and, as far as I am aware, no one has witnessed their development in the ovaries. These bodies have been observed in *Hydatina** and *Notommata*† among the Infusoria; in *Lacinularia*‡ among the Rotatoria; and in *Daphnia*§ among the Crustacea. In all these instances they hatch without the aid of the male, the existence of which sex was once doubted from its unfrequent appearance.

Now I regard these hibernating eggs as merely egg-like *buds* exactly corresponding to the germs of the viviparous Aphides. In other words, there are in the animals I have just mentioned, certain individuals which reproduce by buds which are developed under rather anomalous conditions; and I will add in conclusion,

* Ehrenberg, Die Infusionsthierchen, p. 413.

† Dalrymple, Philos. Trans. 1849, p. 340.

‡ Huxley, Quarterly Journ. Micr. Sc. 1852, i. p. 13.

§ Müller, Entomostraca, p. 84. tab. 11. fig. 9–11, tab. 12. fig. 5. Also, Ramdohr, Beiträge zur Naturgesch. einiger deutschen Monokulus-Arten, 1805, p. 28; Strauss, Mém. sur les Daphnia, in the Mém. du Mus. d'Hist. Nat. v. p. 413. pl. 29; Jurine, Histoire des Monocles, 1820, p. 120. pl. 11. fig. 1–4. Jurine calls these aggregated eggs "La maladie de la selle." There is, moreover, reason to believe that these anomalous reproductive conditions occur in nearly all the Entomostraca: see Siebold and Stannius's Comparative Anat., my transl. vol. i., my note under sect. 292, note 4.

that I suspect that this gemmiparous mode of reproduction will be found to be far from uncommon among most of the Invertebrata, when our researches into the history of their development shall have been more widely extended*.

P.S.—I regret that I should not have seen until now, when this paper is concluded, the important writings of Leydig on the subject under discussion. In his article "Einige Bemerkungen über die Entwickelung der Blattläuse," in Siebold and Kölliker's Zeitschr. f. wiss. Zool. 1850, ii. p. 62, he speaks of his former observations in the Isis, 1848, iii. p. 184. These I have not seen, neither also a work to which he refers, of J. Victor Carus (Zu näheren Kenntniss des Generationswechsels, Leipzig, 1849). Leydig, in his criticism of Carus's views, expresses the opinion that the development of the viviparous Aphides is, histologically, like that of the Articulata in general. According to him, also, the germ-bodies undergo processes corresponding to those of impregnated eggs. These statements of Leydig, who is an excellent observer, have induced me recently to repeat my observations; but this afforded the same results as before, viz. that the germ-bodies out of which are developed the viviparous Aphides have no true histological identity with eggs.

P.S.† Since the publication of this paper, I have enjoyed the opportunity of making this series of investigations more complete, by an examination of the terminal or last brood which appears at the end of autumn.

This terminal brood has hitherto been considered, as far as I am aware, to be composed exclusively of males and females, or, in other words, of perfect insects of both sexes. I was surprised, therefore, on examining the internal organs of the non-winged individuals, to find that many of these last were not females

* Notice may here be given of some curious observations, which Filippi (Ann. Nat. Hist. ix. June 1852, p. 461) has furnished on the development of the Pteromalidæ. A *Pteromalus* lives in the ova of *Rhynchites betuleti*; in each of these ova there is seen, soon after its deposit, a minute infusorial animal, with a tail by which it moves briskly about among the vitelline cells. It soon ceases to move, however, and in its interior appears a vesicle which increases and changes into a larva which is that of *Pteromalus*; this larva becomes a pupa, and, after eight or ten days, changes to the perfect insect which escapes from the ovum. If these observations are verified, we have here a case exactly like that of the Aphides, excepting that, like the *Distoma*, the intermediate budding form is very low, and takes on none of the zoological peculiarities of the parent. But these statements need corroboration, for they do not agree with the history of other species of *Pteromalus* whose development is well known. See also the wonderful gemmiparous phænomena related by Siebold of *Gyrodactylus*; Siebold and Kölliker's Zeitschr. f. wiss. Zool. i. 1849, p. 347.

† Silliman's Journal for March.

proper, but simply the ordinary gemmiparous form already described. Moreover, so great was the similarity of appearance between these two forms—true females and gemmiparous individuals—that they could be distinguished only by an examination of their internal genitalia. Among the proper females there were, besides those which were filled with eggs or had already deposited them, other individuals in which the ovaries were but feebly developed, or at least, in which no mature eggs had been formed. An opportunity was thereby afforded me to examine the structural differences between the true ovaries and their *quasi* representatives—the bud-like processes. The true ovaries had their usual, well-known structure—multilocular tubes containing nucleated cells which are probably the undeveloped germs; the bud-like processes, on the other hand, consisted of a row of cell-masses, oval and connected by a kind of peduncle, as described in detail in the preceding paper. These wide differences have, more than ever, persuaded me of the morphological dissimilarity of these two kinds of reproducing parts in this animal. It seems to me then that the real intrinsic difference between an ovum and a bud lies as deep as the conditions of sex itself, notwithstanding the latter often has, as in the present case, for instance, some of the morphological characteristics of the former.

The appearance of sexless, gemmiparous individuals in the terminal brood would seem to indicate, moreover, that the conditions which determine the appearance of individuals usually exclusively male and female, are not, perhaps, referable to the fact of this being the last brood, but rather to relations of warmth and nutrition. This view is rendered more probable by the fact of the variation in the number of broods between the first and last, observed in the same species in different years—ranging between seven, nine, eleven or more. Moreover, Kyber, as quoted already in the preceding paper, by nursing continually in a warm room a collection of *Aphis dianthi*, keeping about them a summer temperature, succeeded in continuing uninterruptedly the series of sexless or gemmiparous individuals for four years. There are many other facts in insect life that indicate in like manner some direct relation between temperature and nutriment, and definite sexual development. The subject is as important as it is interesting in physiology, and these very animals will, perhaps, subserve the successful studyof the primary morphological conditions of sex.

VIII.—*On the true position of the Canaliferous Structure in the Shell of Fossil* Alveolina (*D'Orbigny*). By H. J. Carter, Esq., Assistant Surgeon, Bombay Establishment.

[With a Plate.]

In the description of *Alveolina melo*, given at p. 170. vol. xi. of this Journal, I have stated, that the "transverse parallel ridges" seen on the outside of the fossil correspond to the "divisions," or rather partitions, in the interior of the chambers. D'Orbigny also has stated, that the chambers in *Alveolina* are "divided into a great number of capillary cavities by partitions longitudinal to the *enroulement*" (Foss. Foram. du Bassin Tert. de Vienne, p. 143); and so most people would think, judging from the external appearance of the shell; but when the interior is examined by a section made through the longitudinal axis (Pl. III. B. fig. 3), then these divisions and this canaliferous or capillary structure are seen to be confined to the external walls of the chambers, and to be completely excluded from their interior.

The oversight has arisen from the last whorls of the shell being in such close approximation with each other, that there seems in most instances to be no space for the chambers left between them, and hence the appearance of the openings of the capillary canals along the free border of the last-formed segment could hardly be inferred to lead to anything but the chambers themselves; while the intervals between the transverse ridges, too, would also lead to the inference that the latter were so many partitions dividing the chambers into as many cavities arranged longitudinally with respect to the direction or *enroulement* of the shell (figs. 3, 4).

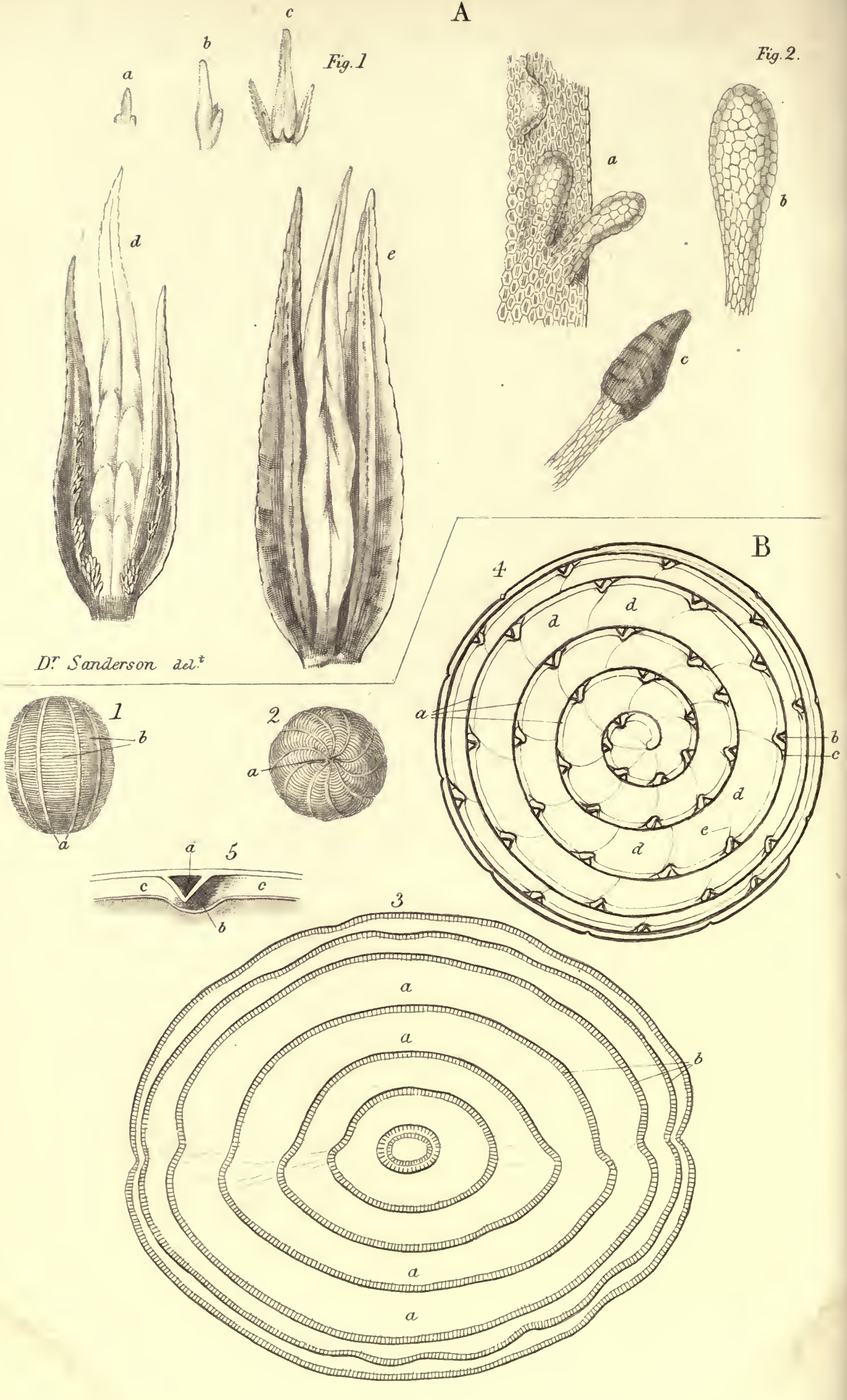
It was only a few weeks since, however (although I had frequently seen and even sketched it), that I recognized the true position of this canaliferous structure, when cursorily examining some specimens of *Alveolina* which had been presented to the Asiatic Society of Bombay by Dr. Leith, and I was instantly struck with its analogy in position and nature to the reticular canaliferous structure in the spicular or marginal cord of *Operculina Arabica* (Pl. IV. vol. x.).

The canals are about 1–400th of an inch square, and the partitions which separate them about a third of this breadth (fig. 3 *b*), sometimes much thinner. They appear to open by a single row of apertures in the free edge of the last-formed segment of the shell, and from thence to be continued into the very centre, following the spire and being confined to the walls of the shell the whole way. On their course they dip inwards as they cross the grooves, which, like those on the surface of a melon, divide the segments and offering a triangular space are filled up by corresponding portions of the shell in the form of ribs (fig. 1 *a*). Through each rib also there is a triangular canal (fig. 4 *b* & 5 *a*), which extends to either extremity of the fossil, where again it may have communicated with the exterior by a foramen or umbilical hole apparently in the latter (fig. 2 *a*). Behind and also internal to the triangular canal there appears to have been another longitudinal channel of communication, formed by a deficiency in the partitions of the canals at this part (fig. 4 *c* & 5 *b*). Although the partitions generally appear to have been continuous under the ribs, yet in many instances they seem to alternate, or nearly so, with the interspaces or canals in the adjoining segments. Whether there was any communication between the canals and the chambers (fig. 3 *b*) future investigation must determine; at present there appears to be no other outlet for them; and if this be the case with *Alveolina*, it may also be the case in many other forms of Foraminifera. Of what use then can the chambers be?

Although I have mentioned holes, channels, canals, and cavities in this fossil, yet in reality there is no such thing; but from their having been filled with transparent calc-spar they are easily recognized, in contradistinction to the white amorphous carbonate of lime which has replaced the shell itself.

The specimens of *Alveolina* in which I first noticed the position of this canaliferous structure were, as before stated, presented to the Asiatic Society by Dr. Leith, who broke off the portions of limestone containing them from rocks in the Bolan Pass, between the towns of Dadur and Quetta.

They are associated, as in Scinde and Arabia, with papyraceous *Orbitolites* (*Cyclolina*, D'Orbig.), and the white compact limestone containing them is that which in this part of the world is generally called "nummulitic;" but in only one or two instances have I seen *Alveolina* mixed with *Nummulites*, and then only very sparsely scattered throughout the mass, though it is quite possible that the opposite may be the case, for they must be close together. The easiness, however, of mistaking *Orbitolites* for *Nummulites*, in the rock, and the occurrence of *Cyclolina* and *Alveolina* together in great abundance in the white compact limestone of the south-east coast of Arabia (which I take to be the same as that of Scinde and the Bolan Pass) far below the position of the *Nummulites*, together with the existence of these two fossils in the Chalk of Europe (D'Orbigny), induces me to think, that much of the white limestone in the East is called "nummulitic," which will hereafter be found to be an equivalent of the Chalk.



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I have also lately been so fortunate as to obtain a view of the cells in the centre of one of these papyraceous *Orbitolites* (*Cyclolina,* D'Orbig.)—the doubly concave species—and I find that they are arranged in concentric circles there, though apparently not more than one deep. The greatest care therefore is necessary in exposing them, for a rub too much or too little may either destroy them altogether or entirely fail to bring them into view. I mention this, because I had inferred, from the subspiral arrangement of the cells in *Orbitoides Prattii* and *Orbitolites Malabarica* (Plates VII. & XVI. vol. xi.), that this might be the case throughout D'Orbigny's order *Cyclostègues*; but on actual examination and subsequent reflection, I find that such cannot be the case in *Cyclolina*; at the same time, the arrangement of the cells being just like that of the divisions on an engine-turned watch-case, to which Dr. Carpenter has so aptly likened them in *Orbitolites complanata*, Lam. (Quart. Journ. Geol. Soc. vol. vi. pt. 1. p. 24), I think this way of describing them much more intelligible than by the use of the term "concentric." The circles on the incrusted surface of *Cyclolina* are evidently concentric; they are in continuous lines; but the arrangement of the cells beneath the crust, though still seen to be concentric under a high microscopic power, fails at first to strike the eye as such from the greater prominence of the semi-gyrating lines, which, flying off from the centre, most faithfully represent the appearance mentioned.

I have measured the cells in the specimen in which I observed this arrangement most satisfactorily, and find that those of the centre are much smaller than those of the circumference; the former are 1–380th of an inch, and the latter 1–633rd of an inch in diameter.

EXPLANATION OF PLATE III. B.

Fig. 1. *Melonites sphæroidea* (Lam.), magnified four diameters: *a*, ribs; *b*, segments.

Fig. 2. Extremity of the same, magnified four diameters: *a*, central foramen or umbilical hole.

Fig. 3. Longitudinal section of the same through the centre, greatly but proportionally magnified: *a*, *a*, chambers; *b*, canals and partitions in the wall of the shell.

Fig. 4. Transverse section of the same through the centre, equally magnified, &c.: *a*, spiral wall of the shell; *b*, triangular canal of the rib; *c*, free space or channel behind and internal to the rib; *d*, *d*, *d*, chambers; *e*, *e*, septa.

Fig. 5. Magnified view of a portion of the wall of the shell, to show—*a*, triangular canal of rib; *b*, free space or channel behind and internal to it; *c*, *c*, partitions of canaliferous structure.

Bombay, 14th April, 1854.

IX.—*Notice of some new species of British Nudibranchiata.* By JOSHUA ALDER and ALBANY HANCOCK.

SEVERAL new species of Nudibranchiate Mollusca have occurred to us during the last two or three years, descriptions of which we had hoped before this to have published elsewhere. Unavoidable circumstances have delayed the publication; and as some of the species are the discoveries of friends, who have kindly placed them in our hands for description, we consider it due to them as well as to ourselves not to delay any longer the announcement of these acquisitions to the British fauna, some of which are of considerable interest.

DORIS ZETLANDICA.

White: cloak with large, soft, conical, pointed, unequal tubercles: dorsal tentacles linear: oral tentacles tubercular: branchial plumes 6, bipinnate, retractile within a cavity. Length $\frac{6}{10}$ths of an inch.

A single specimen of this new *Doris* was found in Shetland by Mr. Barlee in 1849. It differs from all the other British species with retractile tentacles in the form of the tubercles; but the most remarkable difference is in the character of the tongue, which is covered with long, linear, subclavate spines, denticulated on the inner margin.

DORIS MILLEGRANA.

Yellow or orange?: cloak covered with minute granular tubercles: oral tentacles linear: branchial plumes 6, bipinnate, retractile within a cavity. Length $1\frac{1}{4}$ inch.

Two specimens of this *Doris*, which we do not find before described, are preserved in Dr. Leach's collection in the British Museum. They were sent from Torbay by Mrs. Griffiths. The species comes nearest to *D. Johnstoni* in the character of the tubercles, but differs from it in having only six plumes, which do not form a distinct cup. The tongue resembles a good deal that of *D. tuberculata*, having stout, smooth spines; but in this species five or six of the extreme lateral spines are minutely pectinated, which is not the case in *D. tuberculata*, nor in *D. Johnstoni*, though in the latter the spines are also of two kinds. We have been aware of the existence of these specimens in the British Museum for several years, but hoped before this to have met with the species in a living state. Having failed in doing so, Dr. Gray has liberally allowed us to examine and describe it from the spirit specimens. There can be no doubt of its distinctness from *D. tuberculata*, with which it had been confounded by Dr. Leach.

Doris proxima.

Orange-yellow: cloak with stout elliptical tubercles: dorsal tentacles subclavate: head furnished with a broad veil: no oral tentacles: branchial plumes 11, simply pinnate, non-retractile. Length $\frac{1}{2}$ an inch.

This species has been sent us by Mr. Price of Birkenhead, where it occurs not unfrequently within tide-marks, in the spring. It bears great resemblance to *Doris aspera*, of which we at first thought it might be a variety. A careful inspection, however, shows some points of difference; more especially in the shape of the tubercles, which are elliptical and obtusely pointed in this species, while in *D. aspera* they are rounded and flattish. An examination of the tongue has set the matter at rest, as it is decidedly different from that of *D. aspera*.

Thecacera capitata.

White, freckled with greenish brown: tentacles retractile within cavities: veil with two to four orange tubercles on each side, and a row of orange tubercles between the tentacles: branchial plumes 7, pinnate, tipped with orange: a stout branchial lobe on each side also tipped with orange. Length $\frac{1}{4}$ inch.

Dredged at St. Ives, Cornwall, by Mr. Barlee, to whom we are indebted for specimens in spirits.

Idalia elegans, Leuckart.

Rose-coloured, freckled; the processes orange-yellow: anterior filaments 2 (one near the base of each tentacle): lateral filaments numerous, irregular, the posterior ones obtuse, lobular: dorsal filaments 5, three on the median line and two sublateral: branchial plumes 18 (the anterior and posterior ones bifid): foot margined with yellow. Length $1\frac{1}{2}$ inch.

We obtained specimens of this beautiful *Idalia* by dredging off Guernsey last summer. A species described in the Catalogue of the Mollusca of Northumberland and Durham, which we referred with doubt to *I. elegans*, we now propose to call *I. Leachii*. A specimen of the latter is preserved in Dr. Leach's collection in the British Museum.

Idalia pulchella.

Body freckled with pale lilac: tentacles subclavate: anterior filaments 4, set on an expanded pallial ridge: lateral filaments 5 or 6 on each side, the last large and bifid: branchial plumes 11 (the anterior one bifid), rather small, diminishing posteriorly. Length $\frac{4}{10}$ths of an inch.

This pretty species was dredged by Mr. Barlee at St. Ives in the summer of 1853.

Tritonia alba.

Transparent white, with opake-white transverse markings; rather depressed, smooth or very faintly tuberculated: branchiæ imperfectly bipinnate, 4 or 5 on each side, with intermediate smaller ones, set on an expanded and waved pallial margin: veil bilobed, with irregular digitations. Length $\frac{3}{4}$ inch.

The character of the tongue has again come to our aid in distinguishing this species from the young of *T. Hombergii*, to which it bears great resemblance. In this species the lingual spines have slender lateral denticles, while those of *T. Hombergii* are quite smooth. It occurs occasionally along with *T. plebeia*, on masses of *Alcyonium digitatum* brought in on the fishing lines, at Cullercoats, Northumberland.

Eolis carnea.

Flesh-coloured, slender: branchiæ linear-conical, rose-coloured, set in seven clusters: tentacles rather long, of equal length, the dorsal pair dark olive-brown, paler above: oral pair whitish: anterior angles of the foot much produced. Length $\frac{1}{2}$ an inch.

A single specimen was dredged by Mrs. Wyatt of Torquay in Salcombe Bay some years ago. We have not met with it in a living state. The dentition of the tongue, as well as the character and arrangement of the branchial papillæ, show a relationship between this species and *E. alba*.

Eolis glaucoides.

White, depressed: head small: tentacles small, smooth: branchiæ linear, white, with yellowish tips, and a narrow, pale fulvous central gland, set in 11 pedunculated clusters: foot broad, with the anterior angles acute, short. Length $\frac{1}{2}$ an inch.

Under stones near low-water mark on the Isle of Herm near Guernsey. This very curious *Eolis* shows, in most of its characters, an approach to the genus *Glaucus*. One specimen only was found.

Eolis pustulata.

White, pellucid: branchiæ long, linear, obtuse, yellowish orange, granulated with white, set in 9 or 10 rows: tentacles shortish: anterior angles of the foot rounded. Length $\frac{1}{4}$ inch.

We obtained two examples of this new species from the fishing boats at Cullercoats. The granular character of the papillæ distinguishes it from every other British species.

EMBLETONIA PALLIDA.

Yellowish white, with a few black spots on the back: tentacles shortish, approximating: oral lobes indistinct, united into a semicircular veil: branchiæ nearly linear, very pale orange, set in 4 or 5 rows on each side, two papillæ in each row. Length $\frac{1}{10}$th of an inch.

A specimen of this minute species, discovered by Mr. Price on the shore at Birkenhead, was kindly sent us by that gentleman in the spring of this year. It differs from the other British species in having a double series of papillæ at the sides.

ANTIOPA HYALINA.

Pellucid, yellowish, with brown markings down the middle of the back: branchiæ elliptical, tuberculated, hyaline, with the central vessel fulvous: dorsal tentacles obtuse, obscurely laminated, united by a crest: oral tentacles united by a narrow veil. Length $\frac{3}{10}$ths of an inch.

We are indebted for our knowledge of this species to Mr. Byerley of Upton, Birkenhead, who dredged it near Hilbro Island at the mouth of the Dee in 1851. In many of its characters it comes very near to *Proctonotus mucroniferus*, but the laminated crest shows it to belong to the genus *Antiopa*.

X.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By EDGAR LEOPOLD LAYARD, F.Z.S., C.M.E.S. &c.

[Continued from p. 64.]

219. GALLOPERDIX BICALCARATUS. *Aban-cuccula*, Cing.

This species, known to Europeans under the various denominations of "Spur Fowl," "Double-spurred Partridge," and "Kandy Partridge," is an inhabitant of the central, southern, and south-western provinces. It delights in deep-tangled brakes, and thick masses of canes on the sides of gentle declivities; these it finds abundantly in the localities above cited, while in the northern and eastern provinces the sandy soil and open jungles offer no congenial home to a bird of its shy and retiring habits. Even in localities where it does occur, it is more often heard than seen; for so extreme is its wariness, that it rarely falls before the gun even of the native hunter, who creeps about unclad, and noiselessly as the denizens of the forest. It is trapped by means of nooses and other snares placed in its path, for its flesh is highly valued by the natives. I think it decidedly superior in flavour to any other game which I tasted in Ceylon; it ate and looked much like grouse.

It is most active during morning and evening, roaming in small parties amid the open glades, or bare towering trunks of the "Mookalane," but on the least alarm seeking safety in the most impenetrable underwood; after remaining some time concealed, if nothing occurs to excite their fears, a cock-bird, bolder than the rest, will utter a few low notes, not unlike the plaintive cry of a turkey poult; if this is answered from a distance, or the birds are reassured by the total silence, the call is changed to a loud piping whistle, of which the following stave gives the nearest representation I can devise:—

and the birds once more sally out from their concealment. I am convinced that, like the Virginian quail, these birds possess the power of ventriloquism in a great degree. I have often listened to those in my aviary, and could have declared that the calls proceeded from every part of the garden save that in which the performers were located. They do not thrive well in confinement, but exhibit the same wild and suspicious demeanour, always hiding behind their feeding-troughs, or herding in corners. If any object approaches too closely and alarms them, they rise suddenly from the ground with a violent spring, and unless the roof is placed at a considerable altitude, dash their heads against it and fall lifeless to the ground.

They fly with great rapidity, but prefer to take refuge in concealment rather than maintain a lengthened flight. One which escaped from a basket in my house flew up to the roof and through the ventilating holes, but instead of continuing on the wing at the elevation it had attained, it dropped instantly into a small copse, out of which it was hunted with much difficulty, when it darted through an open door into my kitchen and concealed itself behind a box.

The males are very pugilistic, and in their manner of fighting reminded me of the game cock, depressing and elevating the head, imitating each other's actions, &c. &c.

Of its nidification nothing is known.

The wretched figure of a "Rail," in 'Brown's Illustrations,' is, I am certain, meant for a female of this species; Mr. Strickland agreed with me in thus thinking.

220. Francolinus Ponticerianus, Gmel. *Cowdari*, Mal. *Oussa-watua*, Cing.

Not uncommon on sandy soils dotted with jungle, such as extends from Chilaw northward round to Tangalle; in the interior and about Colombo it is not found. In the northern province it is very abundant, and flourishes well on the islands in the Jaffna estuary, on which I have frequently had excellent sport. They frequent the branches of thick trees or bushes, and perch very readily. They breed twice a year, in August and December (at least I have taken fresh eggs in both these months), laying from eight to sixteen eggs. Axis 15 lines, diam. 12 lines. In shape like those of the European bird, but more yellow in colour, in a hollow in the bottom of a bush or tuft of grass, making little or no nest.

221. Perdicula argoondah, Sykes.

I have only seen one pair of these elegant little partridges; they were caught alive at Cotta, near Colombo. I have an egg which can only belong to this bird, also found in the same locality. Axis 12 lines, diam. 9 lines. It precisely resembles a diminutive partridge egg.

222. Coturnix Chinensis, Linn. *Wenella-watua*, Cing.

This small and elegantly coloured Quail is rather common in the grass and paddy fields in the neighbourhood of Galle and Matura; elsewhere I have not met with it, save once in the Pasdoom corle. It flies together in coveys of ten or fourteen, and from its diminutive size and rapid motion is hard to shoot; when once shot at, it is very difficult to flush again, skulking among the tufts of grass, and suffering itself to be caught by the hand. I tried to keep them in confinement, but they appear of untameable nature, and on the least alarm spring upwards with such force as to dash their heads in pieces against the roof of their cage.

223. Turnix ocellatus, Scop., var. Taigoor, Sykes. *Watua*, Cing. *Cādey*, Mal.

Common in the south; the variety which Mr. Blyth designates as *T. Bengalensis* is abundant in the north, to the exclusion of the other. There does not appear to be any difference in the eggs, which are oblong-ovate, of a yellowish green colour, closely mottled with blackish spots, which grow larger towards the obtuse end, in some instances running into each other. Axis 11 lines, diam. 8 lines. The nest, if nest it can be called, is composed of a few bents of grass dropped into a depression in the ground, often only the footprint of a bullock. I have found the eggs from February to August, and equally fresh.

Dr. Kelaart includes *Coturnix Coromandelica*, Gmel., in his list, *sed non vidi*.

224. Esacus recurvirostris, Cuv. *Mosul-Krandi* and *Mosul-Kanati*, Mal.; lit. *Hare-eyed*.

A rarish and wary bird, frequenting the open muddy plains of Mantotte on the western coast, occasionally found about Pt. Pedro, and I saw a specimen or two at Hambantotte. I think it is migratory, appearing in December. I have seen them coming from the seaward in that month. Its eggs, two in number, are deposited on the bare ground in a small hollow; they are of a pale nankeen colour, thickly covered with burnt-umber-coloured blotches, largest and closest at the obtuse end. Axis 2 inches; diam. 1 in. 4 lines.

225. Œdicnemus crepitans, Temm.

Much more frequent and generally distributed than the preceding species. It is found also in flocks of fifteen or twenty, whereas the former is a solitary bird, at most only found in pairs.

226. Cursorius Coromandelicus, Gmel.

Found occasionally on the Wally plains during the month of April. Dr. Kelaart includes *Glareola orientalis*, Leach, *sed non vidi*.

227. Sarciophorus bilobus, Gmel. *Kirella*, Cing. *Alcaty*, Mal. *Verklikker*, Dutch. *Teteue*, Port.

This and the succeeding species are abundant all over the island in the neighbourhood of water, and with their loud untiring cries, which have been likened to the words, "Did he *do* it?" and "It's a pity to *do* it," are the plagues of the sportsman. The tank-shooter in particular, while stealing along in the silence of the night to some secluded pool, where he knows he shall probably find an elk or a bear, is startled by the shrill cry of this ever-vigilant bird, as it springs from almost under his feet and makes the night air ring again, while far and near the cry is re-echoed, till every wild animal within hearing is on the alert, roused by its well-known warning voice.

The nest is merely a hollow stamped in the earth by the old birds, and the eggs, from three to five in number, weigh ʒiiiss. Axis 1 in. 6 lines; diam. 1 in. 3 lines. Their colour is a rich nankeen, plentifully spotted with rather large blotches, some of which are dark brown, others gray, of a deeper or paler shade;

these markings are thickest at the obtuse end. The shape is similar to those of the lapwing.

228. Lobivanellus Goensis, Gmel. *Kibulla,* Cing. *Alcaty,* Mal.

In habits this species so nearly resembles the last, that nothing more need be said upon it. Its eggs are rather larger, having an axis of 1 inch 9 lines, and a diam. of 14 lines; the markings are similar in colour, but smaller and more thickly and generally spread.

229. Charadrius Virginicus, Bech. *Rana-watua,* Cing. *Cotan,* Mal. *Sneppy,* Port. *Chnipe,* Dutch. The Dutch and Portuguese names are applied indiscriminately to all the lesser waders. *Golden Plover* of European sportsmen.

A bird of passage, appearing in September with the rains; it frequents ploughed lands in search of worms and grubs of all kinds, and is not at all rare, particularly in the northern province.

230. Hiaticula Leschenaultii, Less.

Syn. *Charadrius rufinellus,* Blyth, Ann. & Mag. Nat. Hist. 1833.

231. Hiaticula Cantiana, Lath.

and

232. Hiaticula Philippina, Scop. *Ola-watua,* Cing. This name is common to most of the waders.

The mud plains of Mantotte and Bangalle on the western coast, the shores and inlets of the Jaffna estuary, extending as far as Mulletivoe on the eastern coast, and the salt pans of Hambantotte on the south of the island, afford vast feeding-places for myriads of the lesser waders, who fly about in flocks of tens, or tens of hundreds, over the creeks of brackish water which meander through the naked and inhospitable wastes. Nor must the numerous marshy mangrove-covered islands, formed by the silt which accumulates at the mouths of the rivers, be forgotten, nor the reedy margins of the tanks and lakes be overlooked, while enumerating the resorts of the *Charadrinæ, Totaninæ,* and *Tringinæ.* Their piping cries mingle equally with the roar of the surf as it thunders over the coral-reef or sandy beach, with the moaning of the wind among the trees which surround the lonely jungle tank, and with the voice of the husbandman as he urges his toil-worn buffaloes through the teeming mud of his paddy-field. To the true lover of nature I know no sounds more pleasing than the wild cries of the sea birds which blend harmoniously with the rougher voices of her elements; to myself they impart feelings of the most intense pleasure, feelings of exultation, which make me long to raise my voice and shout in concert with those of the busy multitudes.

The commonest of the three species above enumerated is perhaps *H. Philippina*; they are all birds of passage, frequenting different parts of the island at different seasons, but I never heard of any of them breeding with us.

233. Strepsilas interpres, L.

Rare. I procured three specimens at Pt. Pedro in January on the coral-reef, and Mr. Brodie forwarded me one from Putlam which he shot on the Calpentyn lake; I also saw one on the rocks in Colombo harbour in March.

234. Hæmatopus ostralegus, Linn.

Very rare; only one or two specimens seen in the Jaffna estuary in the month of January.

235. Ardea cinerea, Linn. *Kallapua-Karawal-koka* and *Indooroo-koka*, Cing.

Rare: I only procured one specimen, which I killed one morning before daylight while crossing Wally plain. Mr. Gisborne's collector procured one in the island of Valenny near Jaffna.

236. Ardea purpurea, Linn. *Carawal-koka*, Cing.

The "Blue Heron" of European sportsmen is not uncommon. I have shot it at Matura and at Pt. Pedro, and saw it on most of the tanks in the central road. It is rarely seen walking in the flooded fields like the White Herons, but keeps to beds of reeds along the margins of rivers and tanks.

237. Ardea Asha, Sykes.

I procured several specimens of this bird from Valenny, one of the islands of the Jaffna estuary, and from a lake near Chilaw, where they bred in company with others of the same genus. I also shot a young bird pure white, except some dusky gray upon the winglet and coverts of the primaries, and at the base of some of the dorsal feathers. Of this bird Mr. Blyth writes—"This is an exceedingly interesting specimen, and goes far to prove by analogy the identity of the white *Herodias Greyi* with *H. gularis*." I shot this specimen on Colombo lake. The eggs of this species are of a pale blue colour, in shape a rounded oval. Axis 1 in. 10 lines, diam. 1 in. 5 lines. The nest is a huge structure of sticks placed in trees by the water's side. Incubation goes on in May and June in Chilaw lake; eggs said to be from four to six in number.

238. Ardea alba, Linn. *Baddadel koka,* Cing. *Vella-koku,* Mal.; lit. White Heron. *Koku* is the Malabar name for all the Heron family. *Gans,* Dutch. *Garses,* Port.

239. Ardea intermedia, Wagler. *Hotta-kallu-koka,* Cing.; lit. Black-billed Heron.

240. Ardea garzetta, Linn. *Sudu-koka,* Cing.; lit. White Heron.

241. Ardea bubulcus, Savig. *Gehri-koka,* Cing.; lit. Cattle-keeper Heron.

These Egrets are common in nearly all parts of the island, except in the hills; at Nuwera Elia Dr. Kelaart has not met with any; further down I saw them sparingly, but the low country is their stronghold. *A. bubulcus* is sure to be found in attendance on grazing cattle, ridding them of their flies, ticks, &c., and the animals seem well to know their benefactors, and stand quietly, while the birds jump up and peck their tormenters from their flanks and belly. All the species frequent open fields. Half-way between Tangalle and Matura is a large lake, which an official attendance on the Supreme Court of Judicature fortunately enabled me to visit. While the court officers halted for the heat of the day, I set off on horseback from the rest-house and galloped to the village, having sent forward my "fidus Achates," Muttu, over-night, with orders to prepare me a boat. This was in waiting when I arrived; a canoe so narrow that I could not sit in it, or rather *on* it with my knees together. To remedy this defect, Muttu had fastened a bottomless chair over it! and had woven some coir rope across the chasm. The canoe, the only one to be had, was about 12 feet long, worm-eaten throughout, and one end gone entirely, its place being supplied with a piece of fresh turf, to keep out the water!! Into this I and Muttu and a steersman got, the villagers pushed us off, and when fairly afloat I found the top of the gunwale about three inches from the water, and that my frail vessel leaked in fifty places. From my elevated position I counted one, two, three, a *dozen* alligators, and I anxiously inquired of my black, and all but nude crew, if they were of the harmless kind. A shake of the head and the word "*Alliekimboola*" by no means reassured me; it meant they were all man-eaters! I looked at my boat, then at the loathsome reptiles floating around me, then at my boat again; it would not do—I must give it up—the risk was too great; the least sudden, thoughtless move might overset us. I tried the outrigger with my foot, *that* was firm; the nigger knew his safety lay there; "*crack*" went the collecting gun close to my ear, and down came a specimen of *Nycticorax griseus,* a bird until then new to me; this turned the scale, and I ordered the boat forward; thousands of water-birds rose at the report, and soon the guns were busily employed. It was full breeding season. Herons, spoonbills, ibises, pelicans, &c., &c., swarmed in the air and on the trees, while their nests were so crowded as to touch each other. I could only get a few of those nearest the lake; up to them the men climbed from the boat, not daring to venture into the water, which was alive with alligators, watching for the young birds which fell from the nests; several times they snapped up the birds which I shot before I could get them, though they only fell fifteen or twenty yards away; the branches of the trees were white with droppings, and the water below thick and putrid; the stench was intolerable. It was with difficulty I could distinguish one nest from another, so as to be certain of the parentage of the eggs; but by remaining quiet, I marked a bird to its nest, and then rowed up to it, robbed it, and then lay-to again. The nest seemed to be used year after year, if one may judge from the masses of sticks of different ages of which they were composed; my guide also confirmed this idea, and said the birds were not particular as to the nest, one species occupying it one year, another the next perhaps.

The following are the dimensions of the eggs I obtained, taken at random from what appeared the most *usual* form of each species, though much difference exists in this :—

Ardea alba.—Axis 2 inches 3 lines, diam. 1 inch 8 lines.

A. intermedia.—Axis 1 inch 9 lines, diam. 1 inch 4 lines.

A. garzetta.—Axis 1 inch $10\frac{1}{2}$ lines, diam. 1 inch 5 lines.

A. bubulcus.—Axis 1 inch 10 lines, diam. 1 inch 4 lines.

Unfortunately most of my eggs were hard-set. I was there at the beginning of May*. In shape they are equal at both ends, and very rounded; they are also all of the same pure pale blue colour.

242. Ardeola leucoptera, Bodd. *Kanna koka,* Cing.

Very abundant in all marshy ground. It stands motionless on the low embankments of the paddy-fields, and watches for small fish, crabs, &c. When one comes within range, it darts

* I see by an old note, that I found *A. intermedia* breeding in a marsh at Pt. Pedro at the end of July; eggs being then fresh.

out its neck and seizes it with its bill; while thus engaged, their dark-coloured plumes so entirely cover the white ones, that the bird is almost invisible; on taking to flight, however, these become apparent. In allusion to this, the Tamuls have a proverb that, like this Koku, the deceitful man only occasionally shows himself in his true colours.

It breeds in trees in company with other herons; its eggs are the same in colour, but rounder in shape; axis 1 inch 5 lines, diam. 1 inch 2 lines.

243. Ardetta cinnamomea, Gmel. *Nati Korawaka*, Cing.

Common about the south of the island; I have not met with it northward. It frequents beds of rushes, and lights readily on trees. Muttu brought in a white egg, which he stated he thought belonged to the species; he told me he saw a hen bird rise from some sedges, and on going to the place he found a rough nest of reeds and flags raised above the water, in which was the egg. Its axis is 1 inch 3 lines, and diam. 13 lines. In shape it resembles a Heron's egg.

244. Ardetta flavicollis, Lath. *Carawal-koka*, Cing.

Not uncommon in the marshes about Matura; I also shot three specimens on Colombo lake in March. It frequents reeds, and perches readily. It is a fearless bird, permits a near approach and remains motionless, trusting to its sombre colour to escape detection.

245. Ardetta sinensis, Gmel.

This is the smallest of our species, and is abundant on the banks of all the southern rivers; it becomes rare towards the north, where it is replaced by

246. Butorides Javanica, Horsf.,

which is very abundant. I have seen from ten to twenty specimens in the Fort-ditch at Jaffna, in one day. This species, by the way, frequents salt water more than any other, though *A. leucoptera* may often be seen fishing on the mud-banks left by the retreating tide near shore.

Dr. Kelaart includes *A. thalassina*, Swains., in his list, on the authority of some one who forwarded him a specimen many years ago from the Colombo Medical Museum, he being then in England. I am sure he is mistaken in either the identification or locality, the latter most probably, since no dependence can be placed on a museum whose labels have been shifted so often, and on which so little care has been bestowed.

247. Platalea leucorodia, Linn. *Chapy-chundan*, Mal.; lit. Spoon-mouth. *Lapellaar*, Dutch.

The Spoonbill is common enough in certain localities, Mulletivoe, Hambantotte, Tangalle, and Chilaw being the principal. It begins to breed in March in the north, and in the south eggs are hard set in May; some young birds were also about. Its eggs are—axis 2 in. 6 lines, diam. 1 in. 9 lines, rather oval, chalky-white, with irregular blotches of the colour of dried blood about everywhere.

248. Nycticorax griseus, Linn. *Ra-kana-koka*, Cing.

Common on the Tangalle lake and such localities.

249. Tigrisoma melanolopha, Raffles.

I was fortunate enough to procure two or three specimens of this curious bird about Colombo in the month of November 1852. The natives were quite ignorant of it, and while I had one alive in my house came in great numbers to see it. It certainly was a queer-looking creature; its eyes were oblong, pupil surrounded by a light yellow iris darkening into a greenish yellow on the outside. The cere of the bill greenish, legs and bill dark green, claws yellow. On being approached it threw itself back on its tarsi, at first uttering a loud hiss which deepened into a harsh cracking bark; the whole body, head, thighs, wings and neck were inflated with wind and swelled to a great size; its crest was erected and its ruff expanded; in this attitude it waited till the object of its dislike drew near enough to be struck with its sharp pointed bill, which inflicted a severe puncture.

250. Mycteria Australis, Lath. *Peria-koku*, Mal.; lit. Large Heron. *Al-koka*, Cing.; lit. Man-Heron, from its size.

I have only seen a few of these huge waders in the Jaffna estuary at Elephant Pass; they were always in pairs, wading about in the shallow water, but always far out of gun-shot.

251. Leptoptilus Javanica, Lath.

The pouchless Adjutant is occasionally found on the tanks in the Wanny, and about the marshes near Tangalle. I believe it is migratory, as are most of our larger Storks, appearing with the rains.

252. Ciconia leucocephala, Gmel. *Padre-koku*, Cing.; lit. Parson Bird, from its white throat and black plumage ap-

pearing at a distance like a clergyman in his black garments and white neckcloth. *Māāna-koku,* Mal.

Common throughout the island on all the swampy lands. It breeds in trees, in companies, laying several pure white chalky eggs, the surface of which is curiously granulated. Axis 2 inches 9 lines, diam. 1 inch 10 lines.

253. Anastomus oscitans, Bodd. *Gombellu-koka*, Cing.; lit. Snail-eater and Snail-koka;—*Bellu, Gombellu* and *Godabellu* being the Cingalese for snails of all kinds.

Common on all marshes. At Matura I saw them in flocks of several hundreds; they were breeding in lofty trees, but I could not obtain their eggs, though I offered a reward for them; the natives said they defended their nests with such pertinacity that they feared to mount to them.

254. Tantalus leucocephalus, Gmel. *Datudua,* Cing.; lit. Sickle-bill. *Changa vella nary,* Mal. (*Nary* is the general Tamul name for all storks.) *Brand-gaus,* Dutch; lit. Brand or Fire Goose, from the red feather in the tail.

Found in company with the three preceding species: it is not uncommon.

255. Threskiornis melanocephala, Lath. *Tatta-koku,* Cing.; lit. Bald-head Koku.

Common in the northern and north-western provinces; feeding and breeding together in flocks; they lay four or six eggs in a large nest of sticks. The eggs are chalky-white, sparingly blotched here and there with dry blood-coloured marks, thickest at the obtuse end. Axis 2 in. 7 lines, diam. 1 in. 9 lines.

256. Ibis falcinellus, Linn. *Rattu-datudua,* Cing.; lit. Black Sickle-bill. *Karapu cotan,* Mal.; lit. Black Snipe. *Swartz-whelp,* Dutch; lit. Black Curlew. *Prater whelp,* Port. "Black Curlew" of English shooters.

Not uncommon about Tangalle Lake and at Pt. Pedro. It was often brought into the bazaar at the latter place for sale, and I found it delicious eating. They feed just like curlews, inserting their bills into the mud and water in search of worms.

[To be continued.]

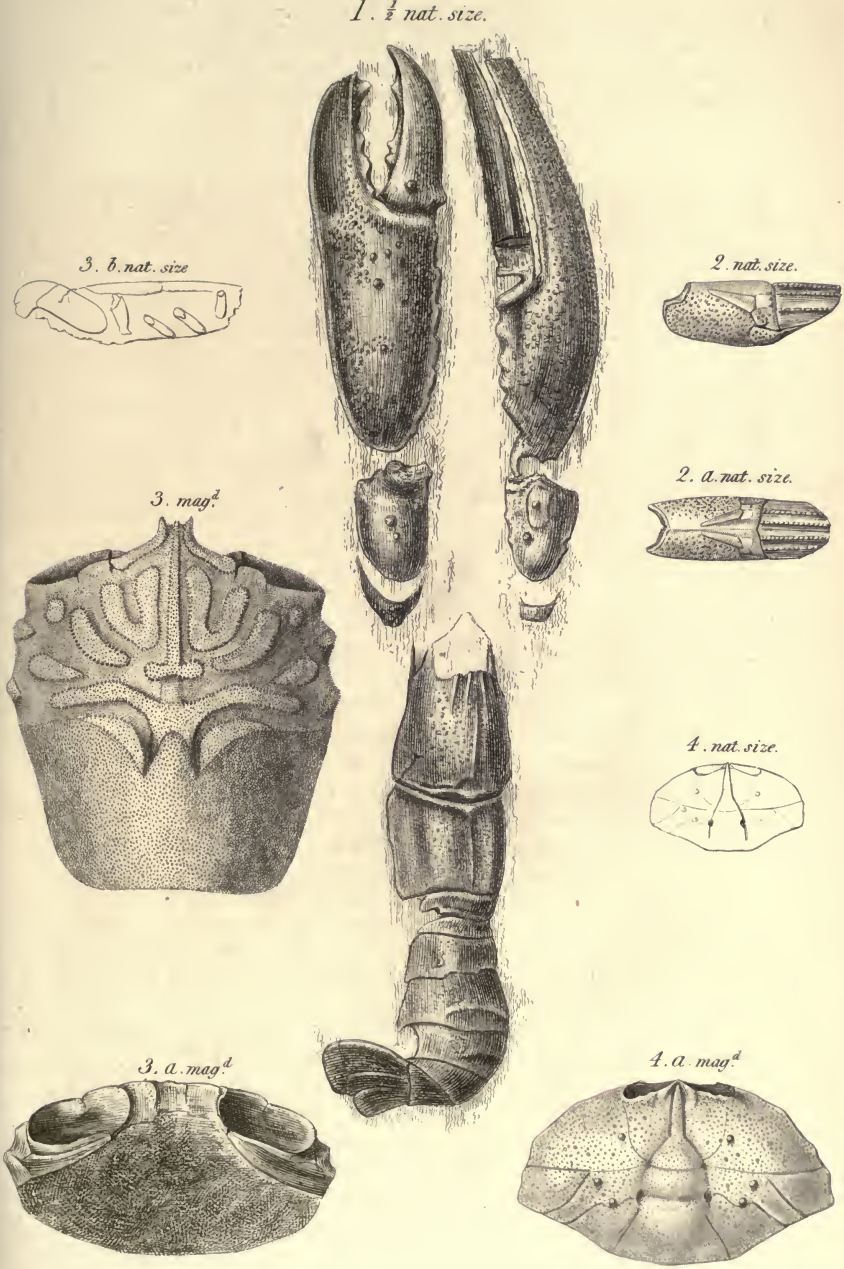
XI.—*On some new Cretaceous Crustacea.* By FREDERICK M'COY, F.G.S., Hon. F.C.P.S., Professor of Natural Science in the University of Melbourne, late Professor of Geology and Mineralogy in the Queen's University of Ireland.

[With a Plate.]

THE line, to the importance of which I first drew attention in a former paper in the 'Annals,' on Crustacea, and to which I there applied the distinctive name of "nuchal furrow," has been also recognized more recently by Professor Milne-Edwards, in his late memoir in the 'Annales des Sciences' on the nomenclature of the hard parts of Crustacea, in which memoir he applies to it the name "cervical furrow," and suggests that it indicates two rings in the carapace of most Decapods, instead of only one, as heretofore supposed. As the nomenclature of Professor Milne-Edwards is much more elaborate than that of his predecessors, I adopt it here, in the description of the *Brachyura* in this paper: the alterations in my former descriptions, necessary to bring them in accordance with the present ones, can be easily made by any interested person studying the French paper referred to.

Hoploparia Saxbyi (M'Coy). Pl. IV. fig. 1.

Desc. *Carapace* nearly cylindrical, averaging from the edge of orbit to posterior side margin 2 inches 4 lines, width about 1 inch 3 lines; nuchal furrow very strong, 1 inch 3 lines from edge of orbit, and therefore nearer to it than to the posterior end of carapace; entire *surface* of carapace closely covered with rough, irregularly unequal, pointed granules (averaging five or six in two lines), rather finer on the posterior half; rostrum broad, depressed in the middle, with a slight elevated mesial line, scarcely reaching the nuchal furrow; rising on the sides into two prominent, longitudinal, coarsely tuberculated ridges, from each of which a row of tubercles extends within half an inch of the nuchal furrow; on the outer side of each of these rostral ridges, and distant about half the width of the rostrum, is a similar row of five or six tubercles from the edge of the orbit; *cheek-ridges* very large, prominent, armed with large projecting compressed spines. *Abdominal segments* covered with a granulation rather finer and more uniform than that of the carapace, but the last segment and middle tail-flap with a much coarser, flattened or squamous tuberculation; transverse suture of outer tail-flap strongly marked, from the great thickness of the basal portion; anterior articular portion of each segment moderately convex,


1. ½ nat. size.
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2. a. nat. size.
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4. nat. size.
4. a. mag^d.

suture dividing it from the posterior portion strong. *Chelæ* very large, extending beyond the rostrum as far as from thence to end of tail-fins, depressed, obtusely carinated at the outer and inner edges, moderately convex in the middle; right hand much narrower than the left, semielliptical, its greatest width (at base of moveable finger) 1 inch, equaling the length of the carpus, or two-thirds the length from the base of moveable finger to the carpal joint; the external margin of the penultimate finger gently arched, nearly smooth, flattened above and below; internal margin of hand and moveable finger straighter than the external one, the former nearly smooth, the latter lobed by five or six very large flattened tubercles; cutting edges of both fingers straight, set with very numerous, small, close, obtuse tubercles; length of the last finger about 2 inches 4 lines; length of penultimate joint or hand, from carapace to tip of penultimate finger, about 4 inches 4 lines: left hand subtrigonal, length of carpus to tip of fingers 1 inch 1 line, width at base of penultimate finger 1 inch 3 lines, but the margins, which are nearly straight from the carpus, continue to diverge at about the middle of the fingers, and are thence strongly arched inwards towards each other; length of moveable finger 1 inch 9 lines, cutting edge of both fingers much arched, the points being incurved, each set with one very large bluntly conical tooth at about one-third its length from the apex, and two large rounded teeth at about one-third the length from the base; the inner margin of the hand is lobed by five or six large compressed tubercles, both hands covered with a coarse granulation (averaging three granules in 2 lines), with eight or ten scattered tubercles nearly a line in diameter; carpus on each side trigonal, about 1 inch 3 lines long, having a granulation like that of the hands, and six or eight irregularly scattered tubercles on the upper surface, a little more or less than a line in diameter. Length of tail-flaps 11 lines, entire length of abdomen $3\frac{1}{2}$ inches.

This species is easily distinguished from the only other cretaceous species (*H. longimana,* Sow. sp.) by the much superior size, and by the great width and flatness of the chelæ. The beautifully perfect specimen which I figure of this species, was collected by S. M. Saxby, Esq. of Caius College, Cambridge, whose extensive collection of Isle of Wight fossils is so well known through the labours of Dr. Fitton and others. I have great pleasure in dedicating it to him.

Very rare in the upper White rag beds of the Upper greensand of Bonchurch, Isle of Wight.

Coll. Mr. Saxby.

Glyphæa cretacea (M'Coy). Pl. IV. fig. 2.

Desc. Carapace narrow; cephalic portion long; from nuchal furrow to anterior end of inner tuberculated cephalic ridge exceeding the greatest depth of the carapace, and exceeding the length of the triangle enclosed between the nuchal furrow and the posterior converging extremities of the oblique branchial ridges; space below the outer cephalic ridge on each side and the branchial regions covered with a rather coarse, equal granulation (averaging eight to nine granules in 2 lines). Length from anterior end of inner cephalic ridges to posterior end of carapace on dorsal mid-line, slightly more than 10 lines; from middle of nuchal furrow to same point slightly more than 9 lines; greatest depth at middle of carapace 4 lines.

I do not know any possible modification of Milne-Edwards's nomenclature of the parts of Crustacea, which would enable us to describe the ridges and sulci of the branchial region of a *Glyphæa* in terms indicating any homology with corresponding parts in other *Decapoda*. This is of little importance, however, in the description of the species, as the ridges are similar in all the examples of the genus. I am not aware of any other true *Glyphæa* in the cretaceous rocks. This very rare species is extremely like the *Glyphæa rostrata* (Phill. sp.) of the coral rag on a small scale, but is easily distinguished, besides its smaller size, by the much greater proportional length of the cephalic part of the carapace, or that in front of the nuchal furrow, when compared with the portion behind it.

Very rare in the Upper greensand of Cambridge.

(*Coll.* University of Cambridge.)

Notopocorystes (M'Coy).

The judicious researches of Mr. Carter of Cambridge have enabled him to add to the characters I originally published of this genus in the 'Annals,' that there is a notch also in the lower edge of the orbit.

I have detected a specimen in his collection of the common *N. Mantelli* (M'Coy) with a pea-like swelling on one of the branchial regions on the back of the carapace, indicating no doubt the existence during the cretaceous period of a representative of the internal parasitic genus *Bophyrus,* which attaches itself to the internal gills of many Crustacea at the present day, manifesting its presence by the like external symptom.

Notopocorystes Carteri (M'Coy). Pl. IV. fig. 3.

Desc. Carapace elongate, trapezoidal; greatest width (a little behind the mesial furrow) at the posterior of the three large antero-lateral tubercles of the margin; gently convex, depressed. *Nuchal furrow* obscured by the map-like marking on the anterior part of the carapace, but it is moderately deep and extends from between the two posterior marginal tubercles, with an irregular curve backwards, rounding at a moderate angle under the posterior gastric lobes. *Gastric region* very large; *meso-gastric lobe* forming a very narrow linear ridge, nearly from the nuchal furrow quite to the extremity of the rostrum, completely dividing the great proto-gastric lobes; it is destitute of the large tubercles on this part of the other species, the granulation being almost invisible to the naked eye, except along its edges; its posterior end is confluent with the two transversely rounded, subtrigonal, small *posterior gastric lobes,* which also form nearly smooth elevations immediately in front of the nuchal furrow; the *anterior gastric lobes* (coinciding with the origin of the anterior gastric muscles) form narrow obliquely elongated elevations, running along the front margin, from the inner notch of the orbit to the rostrum, along which their anterior ends abruptly turn, rendering it trifid, including the point of the meso-gastric lobe, which they resemble in being nearly smooth and being edged with a line of slightly larger granules under the lens; *proto-gastric lobes* very large, ornamented on each side with a trident-shaped group of three elongate elevated lobes, nearly equidistant in front, and converging towards the small posterior gastric lobes behind, the outer lobe of the three usually disconnected at the base from the conjoined inner two; it has also a small round elevation immediately anterior and external to its anterior end; no distinct *orbital regions,* but the outer angle of the very large orbits forms the anterior of the three lateral tubercles; the very small triangular *hepatic regions,* coinciding with the middle lateral tubercle, have also a small elevated subtrigonal lobe close to the margin; *anterior branchial region* (or space between the mesial and meso-branchial sulci) forming a broad oblique band on each side, extending from each side of the posterior lateral tubercle to the uro-gastric region; it has one small smoothed elevation at the lateral tubercle, immediately within and in front of which is a very elongate pear-shaped one, having one side coincident with the nuchal furrow, and a long transverse elongated elevation, extending behind the tapering inner end of the last, angulated in the middle beyond the termination of that lobe, and thence bent abruptly backwards and inwards behind the posterior gastric lobes to the *uro-gastric lobe,* which cannot be distinctly separated from the *cardiac lobe,* but is flanked on each side by the deep lunate hollows, or little fossæ produced by the attachment of the posterior gastric muscles; *posterior cardiac or intestinal region* not distinctly defined from the branchial regions, which latter have a small curved elevated elongation, bordering the inner anterior angle. All these contorted lobe-like elevations on the anterior half of the carapace are very minutely granular, edged by a single row of slightly larger granules, and separated by broad, deep, smooth, concave furrows; the posterior half of the carapace is uniformly minutely granular. Average length 1 inch 2 lines, proportional greatest width $\frac{75}{100}$ (often larger).

This very beautiful and distinct species is larger and flatter than the others of the genus, and destitute of the tubercles with which their carapace is marked, by which character, as well as the very curious, slightly elevated, map-like, contorted, lobular markings of the anterior half of the carapace, it is easily distinguished from its congeners. It is comparatively rare, scarcely a dozen specimens having been found, while nearly a hundred have been found of the *N. Mantelli* (M'Coy).

Upper greensand of Cambridge.
(*Coll.* Mr. Carter, Cambridge.)

Reussia (M'Coy), n. g.

Gen. Char. Small: *carapace* moderately tumid; transversely elliptical, front very strongly rounded; anterior lateral margins obtuse; *orbits* of moderate size, broad, oval, approximate: most of the regions of the carapace sharply defined by narrow sulci; *meso-gastric lobe* triangular behind, abruptly narrowed to a linear tongue-shaped extension in front, reaching to the point of the obtusely angular rostrum, where its apex is flanked by two small oval swellings, indicating the *anterior gastric lobes*; *proto-gastric lobes* large, slightly defined on their outer margin; *posterior gastric lobes* united into one transversely oblong space, slightly wider than the base of the meso-gastric lobe, flanked at its posterior corners by the two lunate fossæ of the posterior gastric muscles; *uro-gastric and cardiac regions* undefined, tumid; *posterior branchial regions* much depressed; *anterior branchial or epibranchial lobe* or region triangular, tumid, corresponding with the lateral angle, and greatest width of the carapace, and defined between the narrow sharply-marked linear nuchal furrow, and an oblique *meso-branchial sulcus*, extending from about its middle to a little below the lateral angle of the carapace; *meso-branchial regions* narrow, strongly depressed in their posterior half; *hepatic regions* very large, evenly tumid; *pterygostomian regions* very tumid; *orbital regions* undefined, two notches in the upper edge of each.

This genus belongs clearly to the true *Brachyura* which are so rare in the fossil state, but is distinct from every living or fossil generic type with which I am acquainted. The types of the genus are the following species, and the *Podophthalmus Buchii* of Reuss (Versteinerungen der Böhmischen Kreideformation, p. 15).

The reference to the genus *Podophthalmus* (Desmarest) by Reuss rested upon very slight foundation, as is shown by his remark, that the rare specimen of this little crab which he found "stets mit ihrer Bauchfläche fest ins Gestein eingewachsen, so dass sich nur der Rückenschild sehen liess. Auch die Augen konnten nicht untersucht werden. Desshalb ziehe ich sie auch nur mit Zweifel zu der obengenannten Gattung, mit der sie sonst ganz gut übereinstimmt." I have now observed the orbits, and find they completely negative the reference of the fossils to *Podophthalmus,* for instead of forming extremely long narrow channels, extending to the lateral angle, or widest points, of the carapace, they are small, broad, oval, and the long diameter about double the short one; the forms of the various regions on the carapace are also quite different, as well as the general outline, from the great curvature of the front in the fossil, and consequent shortness and outward slope of the posterior lateral margin.

Reussia granosa (M'Coy). Pl. IV. fig. 4.

Desc. The general form of the carapace as in the generic character; front and anterior lateral margins very strongly curved, so that the lateral angles are on a line with the gastric fossæ, the tumid, very slightly angulated edge bearing five or six irregularly placed, small, distinct tubercles between the orbit and lateral angle; *hepatic region* much larger than the proto-gastric lobes; *meso-gastric lobe* very sharply defined, by deep narrow impressed outlines; line between the proto-gastric and hepatic lobes very faint; nuchal furrow as a sharp, distinctly impressed narrow line, extending from the base of the meso-gastric lobe to immediately in front of the second tubercle from the lateral angle, having a slight backward curve; *epi-branchial lobe* pyriform, tumid, defined by the meso-branchial sulcus, which extends from the inner third of each side of the nuchal furrow to as far below the cardinal angle on the outer margin as the nuchal furrow is above it; *meta-branchial sulcus* on each side forming a sharply impressed line like the others; all the dorsal surface tumid, except the posterior half of the meso-branchial lobes, and the posterior branchial lobes, which are strongly depressed; *surface* strongly and closely granulated irregularly, the granules being of three or four different sizes; a few small tubercles like those on the anterior margin also occur, one being conspicuous on each side, slightly below the middle of the furrow which separates the proto-gastric from the hepatic lobes, and two on each side on the meso-branchial region a little within the middle. Width of carapace 10 lines, length $5\frac{1}{2}$ lines, transverse length of one orbit $1\frac{1}{2}$ line, depth of middle of hepatic region 3 lines.

The coarsely granular surface easily distinguishes this species from the smooth and glossy *B. Buchii*, Reuss sp. The anterior lateral margins are also strongly curved. There is a third species in the University collection at Cambridge, distinguished from the other two by a very fine uniform granulation of the surface, but it is not sufficiently perfect for description; it might be called *R. granulosa*.

Rare in the Upper greensand of Cambridge.

(*Coll.* Mr. Carter, Cambridge.)

XII.—*On the* Aclis unica, *Auct.* By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Exmouth, 29th June 1854.

I propose, with your permission, to give an account of a very rare mollusk which I discovered this day, and which has hitherto evaded, in a living state, all our researches; I have sought it for thirty years, and may therefore sing "Io Pæans" with the illustrious author of the 'Amorum,' as at last, as with him—

"Decidit in casses præda petita meos."

Let this instance of unexpected success impress on us the value of the "nil desperandum." The discovery of this creature has long been a desideratum, as it will solve several malacological questions: it has from Montagu's time run the gauntlet of nearly all the genera, agreeably to the conchological surmises of naturalists, of whom scarcely two are in accord, and all in error; as my notes require me to place it in a position it has never yet occupied, and which I believe will prove to be its true malacological *status*. Our ignorance of every circumstance attendant on this almost microscopic being has invested it with a strange diversity of position and consequent structure, but the light of discovery that now dawns on us will dissipate, as it does in every case, misapprehensions, and tell us that the Fates have decreed, we all have been at fault about a very simple creature, which though not absolutely a typical *Rissoa*, is all but one, as the shell only wants the callus on the outer lip; but we have many admitted *Rissoæ* without that appendage; indeed, if we were to look for *strict* typical specialties in either the hard or soft parts of any mollusk, every species must become a genus.

RISSOA UNICA, nobis.

Aclis unica, Brit. Moll. vol. iii. p. 222. pl. 90. f. 4, 5.
Chemnitzia unica, Alder et nobis.
Turritella unica, Fleming.
Turbo unicus, Mont. et auct.

Shell.—Of eight yellowish-white, rounded, finely reticulated volutions with oblique well-marked sutural lines. The apex is obtuse and not reflexed, as stated by me in another place: I was deceived by imperfect specimens, which led me into the error of supposing that it would prove a *Chemnitzia*.

This is one of the slenderest British shells, having only an axial admeasurement of $\frac{1}{12}$, and a diameter of $\frac{1}{40}$ unciæ; the outer lip is thin, and the aperture is oblong-oval and almost entire.

Animal.—The general colour is hyaline-white, shot throughout all its organs with a mixture of very minute close-set points, short lines or blotches, of flaky and frosted snow colour. Mantle even with the shell, except that at the apertural upper angle it emits the filament I have so often mentioned as being present in all the *Rissoæ*, and whose particular function is doubtful. The muzzle is slender and rather long, having the first half from the neck, on its upper part, clothed with a very close tunic or tight overlay; the disk is smooth, compressed, bevelled to a fine edge, and almost circular, with a median vertical fissure on the under surface, in which I have often seen the delicate white corneous plates, jaws, and lingual riband: but great powers and much time are required to seize a favourable opportunity of vision in so minute and restless a being. The tentacula are very like those of *Rissoa striata*, moderately long, flat, rounded or obtuse at the tips, quite smooth even under high powers, divergent, with large black eyes, not on pedicles or prominences, but fixed on the centre of their bases with very little external inclination, and widely apart; there is no connecting tentacular veil, nor the least triangularity, foldings, or the presence of apical inflations, as in the *Chemnitziæ*; on the march the eyes are usually carried within the margin of the shell. The foot is slender, greatly hollowed out in front and deeply labiated, with distinct, long, arcuated linear auricles which play on the march, or, as M. Lovèn would term it, "*læte vibrantes*," beneath which it is slightly constricted, and a little beyond the middle, posteally, is fixed on a simple lobe without lateral expansions or terminal cirrhal filament; the light yellow suboval operculum with distinct grossly spiral turns, exactly as in the paucispiral *Littorinidæ*; below the operculum the foot is visibly contracted on each side, and terminates in a rounded rather broad point; no median line is apparent in any part of the sole.

This creature is not at all shy; it remained lively for thirty-six hours, and gave every facility for good examination; it readily creeps up the deepest glasses, and however often brushed down, starts again with unabated vigour. The specimen described was detected in Littleham Cove, between Exmouth and Budleigh Salterton, in the littoral level, in a debris of minute decayed shells mixed with sand and mud that has an offensive odour, the mass being deposited on the margins of deep quiet pools affording nutriment to certain long narrow grassy sea-weeds. I have been thus particular to obviate difficulty to future naturalists, and I wish them success in obtaining a live specimen with less trouble than I have had.

The habitat of this species is, I believe, strictly littoral; its associates are the *Rissoa parva, R. striata, R. planorbis*, nobis (*Skenea planorbis*, auct.), as these are found in the same mass of spoil.

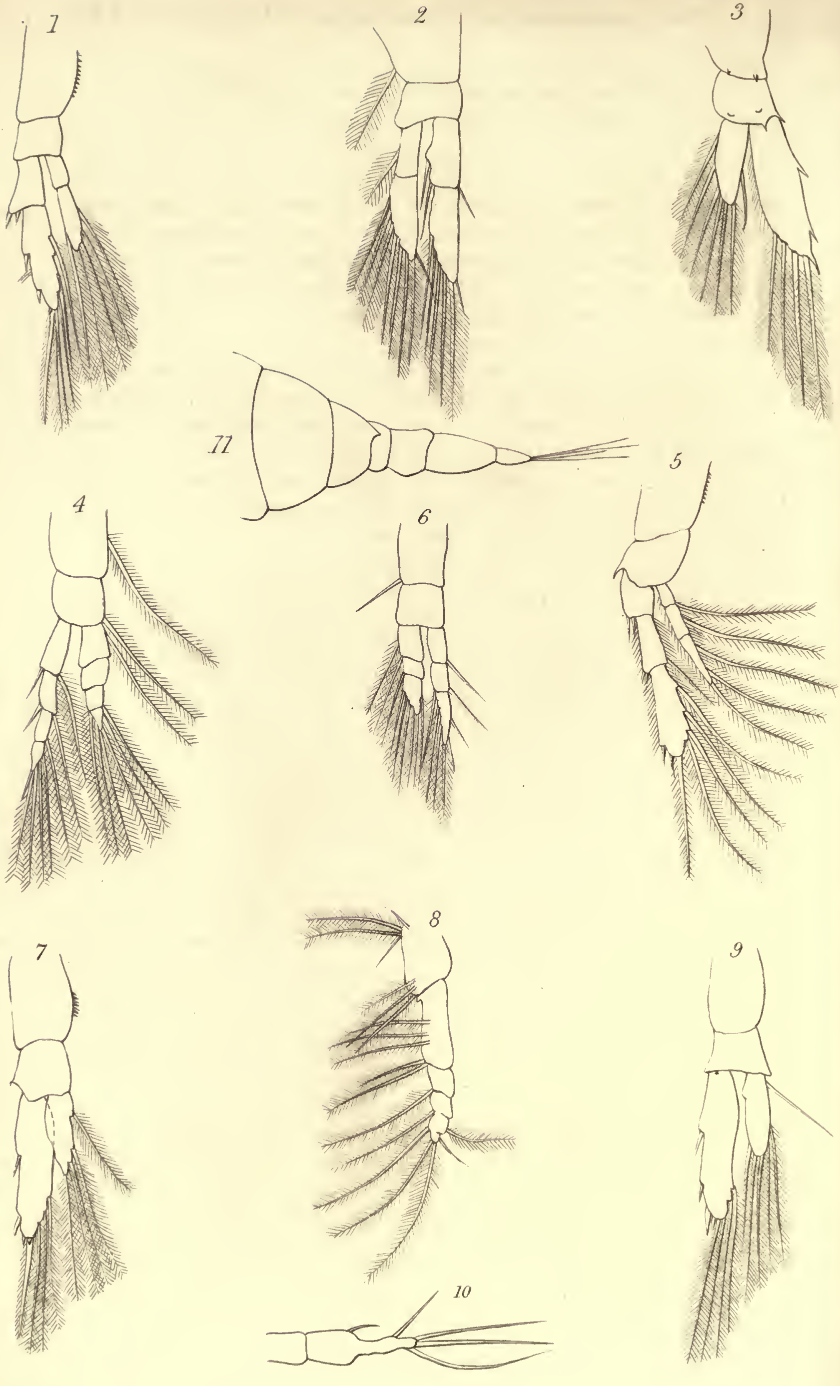
That this is a Littorinidan and almost a strict Rissoidean animal, allowing a trifling margin for specialty-variations, admits of no doubt. It has no malacological community with *Turritella, Aclis*, or *Chemnitzia*; but as the muzzle is carried in nearly a similar position as in the latter genus, the young malacologist must take care in so small an object not to be misled by this circumstance, or by the centrality of the eyes at the base of the tentacula: but the veteran observer with delicate and apt manipulation, patience, and good glasses, will easily detect the vertically cloven disk and corneous jaws, which, with the rissoid simple tentacula, will demonstrate that this animal is merely an elongated *Rissoa*; and in our volume of malacological observations now in the press, we shall deposit it in the section of the elongated species of that genus.

I am, Gentlemen,

Your most obedient servant,

William Clark.

P.S.—The remarks of Dr. T. Williams on my branchial theory, when finished, will be duly acknowledged either in the 'Annals,' or in the appendix to my "Malacological Observations" now in the press.



J. Lubbock. del.

J. de C. Sowerby sc.

XIII.—*On some Arctic Species of* Calanidæ. By John Lubbock, Esq., F.Z.S.

[With a Plate.]

Among the Crustacea collected by Dr. Sutherland in the Arctic Ocean, during the late cruise of the *Isabel*, commanded by Captain Inglefield, are the following species of Entomostraca:—*Arpacticus uniremis*, Gaimard?; *Anomalocera Patersonii*, Templeton; *Calanus arcticus*, Baird; *C. magnus*, n. s.; *C. borealis*, n. s.; *C. plumosus*, n. s.; *C. elegans*, n. s.; *C. longus*, n. s.

Gaimard has figured, but not yet described, the above-mentioned *Arpacticus*, so I do not feel quite sure about the species.

Unluckily I have not been able to find the eyes in any of these species of *Calanus*, for the spirits of wine seem to have removed all traces of them. Considering that *C. arcticus* was the only one as yet described from that part of the world, the large proportion of new species is not surprising.

Calanus magnus, n. s. Frons rotundatus. Cephalothorax magnus, 6-articulatus, postice rotundatus, in medio acutus. Antennæ anticæ corpore paulo longiores, setis longis. Abdomen 4-articulatum, stylis brevibus. Pedes biremes primi, ramis 3-articulatis; quinti ramis 2-articulatis.

Long. $\frac{2}{5}$ unc.

Hab. Mare Arct. N. Lat. 76° 10′–77°, W. Long. 60° 6′–71° 37′.

This species may at once be distinguished from all Dana's species, both of *Calanus* and *Rhincalanus*, by having 6 cephalothoracic and 4 abdominal segments, long antennary setæ, and the 4 posterior cephalothoracic segments of unequal size. The species figured by Gaimard in his 'Voyage en Scandinavie' all have the cephalothorax rounded behind, and in *Cetochilus septentrionalis* the head forms a distinct segment. The general shape of the cephalothorax seen from the side is a long ellipse, the second segment being the broadest part. The anterior segment is much the largest, then the second, and after that the others gradually decrease in length as well as in breadth. The posterior is rounded and obtusely pointed in the centre. It is the largest species of *Calanus* that I know.

The anterior antennæ are a little longer than the body, and about 24-jointed. The fourth segment, counting from the apex, has a small hair on each side at the apex. The third has two small ones on the anterior, one of which as usual is lanceolate, and one long one on the posterior side at the apex. The second has a long one on each side, that at the posterior being however the largest. The apical segment bears several rather long hairs.

The second pair of antennæ consists as usual of a basal part and two rami, which are nearly of equal size. The largest is 2-jointed. The basal segment bears two long hairs on one side and a little tuft of shorter ones on the other. This little tuft is present also in all the *Calani* I have been able to examine, in *Diaptomus Castor*, and in a South American *Diaptomus* not as yet described. The apical segment bears about 12 long hairs. The second branch consists of about 7 segments, only partially divided from one another, of which the first and the last are the largest. There are 3 long hairs at the apex and about 9 along the margin.

The second pair of maxillæ are a somewhat triangular plate, which shows traces of being divided into 3 segments, and bears about 20 setose hairs.

The third pair of maxillæ, or first pair of feet according to Dana, are cylindrical, and consist of 7 segments gradually decreasing in size.

All these organs are attached to the first cephalothoracic segment, the other 5 each bear a pair of natatory legs.

The natatory legs consist each of a 2-jointed basal part and 2 rami. In this species the rami of the first pair each have 3 joints, and the outer one is rather longer than the inner (Pl. V. fig. 6).

The rami of the fifth pair are reduced to 2 segments, and the basal part is armed on its inner margin with a row of short stout teeth (fig. 1).

The abdomen has 4 segments, of which the anterior is the largest, and the second next. The lamellæ are not much longer than the last segment.

Colour ?

C. plumosus, n. s. Frons rotundatus. Cephalothorax magnus, 6-articulatus, postice rotundatus, in medio acutus. Antennæ anticæ corpore paulo longiores, setis longis. Abdomen 4-articulatum, stylis brevibus. Pedes biremes primi, ramis 4-, quinti ramis 3-articulatis.

Long. $\frac{3}{10}$ unc.

Hab. Mare Arct. N. Lat. 77°, W. Long. 71° 37′.

This species much resembles the preceding. The second maxillæ, mandibles, and maxillipeds are similar. The second pair of antennæ differ in having another small segment at the apex of the larger ramus. The hair at the apex of the penultimate segment is about the same size as the rest, while in *C. magnus* it is much longer than the corresponding hair of the preceding segments.

The first pair of natatory legs (fig. 4) have 4 segments to each ramus, and the secondary setæ are larger than in the other species. The inner side of the large ramus also in all the legs has on the second segment a row of short hairs resembling the setæ on the longer ones.

The fifth pair (fig. 5) have the rami 3-jointed. They have small spines on the base like the corresponding pair of legs in *C. magnus*.

Colour ?

C. borealis. Frons rotundatus. Cephalothorax magnus, 6-articulatus, postice rotundatus, in medio acutus. Antennæ anticæ corpore paulo longiores, setis longis. Pedes biremes antici, ramis 2-articulatis; postici unum tantummodo segmentum habent. Abdomen 3-articulatum, stylis brevibus.

Long. $\frac{1}{4}$ unc.

Hab. Mare Arct. N. Lat. 76°–78° 40′, W. Long. 70°.

The apical hairs of the anterior antennæ are short. The posterior antennæ resemble those of *C. magnus* (Pl. V. figs. 2, 3).

Colour ?

C. elegans. Frons rotundatus. Cephalothorax angustus, 6-articulatus, postice rotundatus. Antennæ anticæ corpore paulo longiores, setis longis. Pedes biremes primi ramis 2-articulatis, ultimi maris unum tantummodo segmentum habent; fœminæ pedes postici parvissimi. Abdomen 2-articulatum.

Long. $\frac{1}{9}$ unc.

Hab. Mare Arct. N. Lat. 62° 11′, W. Long. 52°.

This species appears only to have occurred in one place, where it was abundant. The individuals are all about the same size, and I do not think it can be the young of any other species (Pl. V. figs. 7, 8, 9).

Colour ?

C. longus. Frons rotundatus. Cephalothorax 5-articulatus, postice obtusus sed non rotundatus. Antennæ anticæ corpore breviores, setis brevibus, apicalibus tamen longis. Pedes biremes antici ramis 3-articulatis. Pedes postici minimi. Abdomen longum, angustum, 3-articulatum.

Long. $\frac{1}{6}$ unc.

Hab. Mare Arct. N. Lat. 76°–76° 30′.

Of this species there are only three specimens, but it is very distinct from any of the others; the length of the abdomen being its most striking characteristic.

The anterior antennæ are about as long as the cephalothorax, and slender; all the hairs are short except two, one on each side of the apical segment.

The second antennæ have the 6-jointed ramus rather longer than the other.

The third pair of maxillipeds are rather small, and consist of 6 segments, of which the basal has 10 setose hairs arranged by pairs.

The natatory legs increase in size from the first, which are only $\frac{1}{30}$ inch in length, to the fourth, which are $\frac{1}{37}$th. The rami are 3-jointed.

The fifth pair (fig. 10) are small, $\frac{1}{80}$ inch in length. They consist of a basal segment, then a swollen part, which appears to represent the second basal segment; then a narrower part, probably homologous with the larger or outer ramus. It has a constriction in the middle, and bears three hairs at the apex, and a short one externally at the middle.

The abdomen 3-jointed, long, without the lamellæ $\frac{1}{20}$ of an inch in length; the lamellæ themselves are $\frac{1}{80}$, *i. e.* as long as the preceding abdominal segment, and each bears 5 plumose setæ, 4 at the end and 1 on the external side.

In the basal segment of the abdomen is an oblong vesicle; it is present in all the species, but is very conspicuous in this one. I neither know its structure nor its use, but from its position, I imagine it is connected with generation.

In passing I may remark, that Dr. Sutherland collected *C. arcticus* from N. Lat. 59° to 78° 30′, and from W. Long. 29° 30′ to 71° 37′. In several cases Dr. Sutherland remarks, that when none were caught at the surface, after sinking the dredge two or three fathoms, "hundreds were obtained in a few minutes." The colour is red.

These species are on an average $\frac{1}{4}$ of an inch in length, which is much larger than the average of the whole genus. The Arctic seas therefore seem very favourable to the development of the genus *Calanus*. The colour had in every specimen completely disappeared.

Note.—There is some confusion about the name *Calanus*. The genus was founded by Leach, with the type *C. Finmarchicus*, on erroneous characters. Dr. Baird, however, finding, that though Leach's reasons were ill-founded, others made it necessary to erect it into a new genus, dropped Leach's name *Calanus* and adopted a new one, *Temora*, for the same species. Dana in his work on Crustacea uses the name *Calanus*, as I have done in this paper. It is however doubtful whether the species which he and I have referred to *Calanus*, really belong to the same genus as *C. Finmarchicus*; there are no specimens of it in the British

Museum, but Dr. Baird thinks that the rostrum is not furcate like that of *Cetochilus*. Prof. Dana has no doubt that they are similar in this respect, but separates them because the eyes are in *Calanus* close together, in *Cetochilus* at opposite sides of the head. If Dr. Baird is right, then the above-described species will be *Cetochili*; or if they differ as to the eyes, will form a new genus. Till these points are decided, it will be convenient to consider them to be *Calani*. Dr. Baird referred *C. arcticus* to *Cetochilus* on account of its forked rostrum.

EXPLANATION OF PLATE V.

Fig. 1. Fifth pair of natatory legs of *Calanus magnus*.
— 2. First ditto *C. borealis*.
— 3. Fifth ditto *C. borealis*.
— 4. First ditto *C. plumosus*.
— 5. Fifth ditto *C. plumosus*.
— 6. First ditto *C. magnus*.
— 7. Fifth ditto of the male of *C. elegans*.
— 8. Fourth ditto of the female of *C. elegans*.
— 9. Third pair of maxillipeds of *C. elegans*.
— 10. Posterior legs of *C. longus*.
— 11. Abdomen and posterior part of the cephalothorax of *C. magnus*.

XIV.—*Description of a new Genus and Species of British* Curculionidæ. By T. Vernon Wollaston, M.A., F.L.S.

Genus Pentarthrum, Woll.

Corpus angusto-cylindricum, sculpturatum, *Cossoni* formam simulans, sed ab illo certe distinctum: *capite* subporrecto; *rostro* prothorace parum breviore, parallelo, tereti, sat gracili, subrecto; *scrobe* parum profunda, decurva, usque ad oculorum marginem inferiorem retrorsum ducta; *oculis* parvis, rotundatis, lateralibus, leviter prominulis: *prothorace* elongato, subconico, mox pone apicem subito transversim constricto, necnon ad basin ipsam marginato: *scutello* minuto, subrotundato: *elytris* parallelis, ad apicem ipsum leviter acuminatis et singulatim subrotundatis. *Antennæ* breves, robustæ, versus medium rostri (in utroque sexu, nisi fallor) insertæ; *scapo* subrecto (vix incurvo), leviter clavato; *funiculo* 5-articulato, articulis latitudine vix crescentibus, 1mo et 2do sub-obconicis, 3o, 4to et 5to paulo brevioribus, transverso-obconicis; *capitulo* rotundato-ovato, solidissimo (articulis ægre observandis), piloso, necnon ad apicem spongioso. *Pedes* breviusculi, robusti, ad basin valde (præsertim *posteriores*) distantes: *femoribus* clavatis, muticis: *tibiis* rectis, ad apicem externum in uncum magnum robustum acutum inflexum productis: *tarsis* pseudotetrameris, articulo antepenultimo reliquis paulo latiore; ultimo flexuoso, clavato, *unguiculis* sat magnis simplicibus munito.

A πέντε, quinque, et ἄρθρον, artus.

The very interesting little insect from which the above structural diagnosis has been drawn out, although an undoubted member of the *Cossonides* of Schönherr, is so singularly formed as regards its *five*-jointed funiculus, that it may perhaps be looked upon as connective between that subfamily and the *Rhyncophorides*,—in which a like number of articulations (though six is the normal quantity) occasionally obtains. It is, I believe, the only representative of the *Cossonides* hitherto described in which *less than seven* joints to the funiculus has been noticed; and it cannot but be received therefore as a very important addition, not only to our native fauna, but to science at large,—as introducing a totally new modification into that immediate department of the *Curculionidæ*. In its general contour and habit it is more suggestive of a minute *Cossonus* than of anything else, its glabrous deeply-sculptured surface and slender subcylindrical body, in conjunction with its medially-inserted antennæ and its basally-distant anterior legs, bespeaking a close relation with that group: nevertheless (in addition to the peculiarity of its funiculus, in which it recedes from it *in toto*) its rostrum is of perfectly equal breadth throughout (not being dilated at its termination), and the apex of its elytra is somewhat acuminated and rather curiously developed,—each of them having a tendency to be separately rounded off, and subrecurved, at its extreme margin (in a precisely similar manner to what we observe in many of the Apions). Its discovery is due to my nephew, H. W. Hutton, Esq., of Spridlington near Lincoln, who captured four specimens in the vicinity of Exeter during November of 1853. It may be characterized, specifically, as follows:—

Pentarthrum Huttoni, Woll.

P. angusto-subcylindricum ferrugineo-piceum subnitidum glabrum, rostro ad basin profundius sed apicem versus leviter punctato, prothorace elongato valde profunde punctato, mox ante basin latiore, elytris rugulosis punctato-striatis, interstitiis minutissime seriatim punctulatis, antennis pedibusque paulo pallidioribus et rufescentioribus.

Long. corp. lin. $1\frac{3}{4}$.

P. narrow and subcylindrical, pale rufo- (or ferrugineo-) piceous (the prothorax however being, apparently, rather darker than the elytra and the apical portion of the rostrum), slightly shining and glabrous. *Rostrum* of equal breadth throughout; somewhat coarsely punctured at its base, but lightly so towards its apex. *Prothorax* elongated and subconical,—being attenuated anteriorly, and widest just in front of its base, where it is about as broad as (or, if anything, a little broader than) the elytra; very deeply and regularly punctured all over; somewhat convex and even, and with scarcely any indications of a dorsal line. *Elytra* parallel and rugulose, deeply punctate-striated, and with a row of very minutely impressed points down each of their interstices. *Antennæ* (especially their scape and club), and the *legs*, of a paler and clearer colour than the rest of the surface,—being somewhat rufo-ferruginous (or very pale rufo-piceous): the *tibiæ* (particularly the inner edge of the anterior pair, which are strongly setose) and *tarsi* of the former, and the *club* of the latter, very pubescent. *Body beneath* uniformly and deeply punctured all over,—with the anal region minutely fulvo-pubescent.

Respecting its claims to admission into the British fauna there cannot be the slightest question,—the village of Alphington, in which it was detected, affording no local reasons whatsoever for suspecting that it could have been accidentally introduced. On the contrary, indeed, I am informed by Mr. Hutton (to whom I have dedicated the species) that he has made the most careful inquiries, and that no foreign timber (or material) of any kind, so far as he was able to ascertain, had entered the place. The specimens were found amongst logs of wood, recently cut up for burning; and Mr. Hutton states that it was from out of a hard and undecayed portion of a cherry-tree (in which their winding burrows were very apparent) that he succeeded in extracting them. I should add, that I forwarded an example a few months ago, for comparison, to Berlin, where it was totally unknown; and I have no hesitation, therefore, in regarding it as altogether new to the *Curculionidæ* of Europe.

XV.—*On the Genus* Lycium. By John Miers, Esq., F.R.S., F.L.S. &c.

[Continued from p. 20.]

B. Neogeæ.

* *Filamenta lævia.* Sp. 23.

23. *Lycium pallidum* (n. sp.);—ramosum, ramulis tortuosis, subnitidis, fusco-rufescentibus, grosse nodosis, breviter spinosis, creberrime foliosis, foliis e nodis fasciculatis, glaberrimis, spathulato-oblongis, obtusis, imo in petiolum tenuem angustatis, utrinque alutaceo-glaucis, carnosulis, eveniis; floribus majus-

culis, in fasciculis binis, folio æquilongis, calyce pedicello paullo breviori, poculiformi, carnosulo, glabro, lacinulis 5 lineari-acutis, tubo æquilongis, patentibus; corolla pallide ochroleuca, tubo cylindrico, supra medium infundibuliformi, limbi laciniis 5, rhomboideo-ovatis, tubo 4to brevioribus: staminibus 5, subæquilongis, longe exsertis, filamentis glaberrimis, medio tubi insertis, hinc geniculatis, et in nervis totidem pilosis ad imum decurrentibus, antheris ovatis, profunde cordatis, connectivo apice in mucrone excurrentibus: stylo filiformi, longe exserto, stigmate clavato, sub-2-labiato.—In Nova Mexico.—*v. s. in herb. Hook.* (*Fendler*, n. 670).

This species bears greatly the habit of *L. Austrinum*, but has a far more pallid aspect: the spines are barely more than 2 inches long; the nodes are large and prominent, and from each of them arises a fascicle of three to ten leaves, $1\frac{1}{4}$ inch long, $\frac{1}{4}$ inch broad: the pedicels are 3 lines long; the calyx $2\frac{1}{2}$ lines, fleshy, somewhat bell-shaped, and divided half-way into five equal, pointed divisions, which are considerably spreading: the tube of the corolla is 8 lines long, is contracted to a diameter of $\frac{1}{2}$ a line in its lower moiety, while the upper half expands gradually to a diameter of 3 lines in the mouth: the segments of the border are short, broad, obtuse, somewhat rhomboidal, 2 lines long and $2\frac{1}{2}$ lines broad, and as well as the tube are marked with branching nervures; it is quite glabrous, except in the prominent ribs that extend from the base to the point of insertion of the glabrous filaments in its middle: the stamens reach nearly to the extremity of the segments, one however is a little shorter than the others; the anthers, of a deep red colour, are cordate at the base, attached along their upper moiety to an intervening connective, which is excurrently and curvedly mucronate at the apex, as in *L. orientale*; the style is filiform, of a reddish colour, curved above, and extends $\frac{1}{4}$ inch beyond the stamens; the stigma is deeply 2-lobed*.

** *Filamenta pilosa.* Sp. 24 ad 35.

24. *Lycium fragosum* (n. sp.);—fruticosum, ramosum, ramulis cortice fusco rimoso, axillis grosse nodosis, nodis breviter spinosis, foliis e nodis fasciculatis, anguste linearibus, margine revoluto subtus quasi 3-costatis, utrinque glanduloso-rugosis; floribus e fasciculis solitariis, pedunculo capillari folio æquilongo, calyce scabrido, urceolato, ad medium lacinulis 4 acutis erectis partito, corolla glabra, anguste cylindrica, superne paullulo infundibuliformi, calyce 6plo longiori, limbi laciniis 4, brevibus, rotundatis, margine ciliatis, tubo 7mo brevioribus,

* An outline of this plant with floral analysis is given in the 'Illustr. South Amer. Plants', vol. ii. plate 67 C.

staminibus 4 inclusis, 1 paullo longiori, filamentis infra medium tubi insertis, hinc longiuscule pilosis, superne glabris, tenuibus; stylo longitudine staminum, stigmate clavato, 2-lobo.—Peru.—*v. s. in herb. Hook.* (*Cuming*, 948).

This forms a very distinct species, with rugous knotty branches and naked spines, 2 lines in length, springing out of the nodes: there are five to ten leaves in each fascicle, 4 or 5 lines long, and $\frac{1}{4}$ line broad: the slender peduncle measures 4 lines; the somewhat tubular calyx is $1\frac{1}{2}$ line long, half cleft into four narrow, acute, equal segments, each separated by a rounded sinus; the tube of the corolla is 5 lines long, $1\frac{1}{2}$ line in diameter at its broadest part, the lobes of the border being only $\frac{3}{4}$ line; the filaments are inserted into the tube at a distance of a quarter of its length from the bottom, and are pilose at base for one-fourth of their length*.

25. *Lycium implexum* (n. sp.);—fruticosum, intricato-ramosum, ramis ramulisque rimoso-rugosis, ochraceis, glabris, ramulis nodosis, apice spinescentibus, spinisque axillaribus brevibus aciculatis armatis; foliis e nodis fasciculatis, minimis, cuneato-oblongis, carnosis, utrinque aspero-pilosis, floribus e fasciculis approximatis, solitariis, pendulis, pedunculo folio calyceque æquante; calyce parvo, pubescente, æqualiter 4-dentato, corolla pallida, elongata, anguste cylindrica, superne infundibuliformi, extus glabra, intus ad medium pubescente, limbi laciniis 4, brevibus, rotundis, lævibus, tubo 5to brevioribus, staminibus 4 capillaribus, subæqualibus, longe exsertis, infra medium tubi insertis, pro dimidio inferiori molliter pubescentibus, superne lævibus, pro tertia parte exsertis, stylo longitudine staminum.—Chile, ad Coquimbo.—*v. s. in herb. Hook. et Lindley* (*Bridges*, n. 1334).

This very distinct plant bears greatly the aspect of several species of the genus *Alona*, and of *Phrodus*, which I have before described (*huj. op.* iv. 33), all collected in the same neighbourhood, and at the same time, by Mr. Bridges, as their respective numbers will show. The branches and branchlets are very knotty and intricately crossed; the prominent, nodose axils, scarcely 3 lines apart, have a fascicle of four to eight leaves springing from them, and many are furnished with a short needle-formed spine. The leaves are spathulately oblong, obtuse, fleshy, glaucously pubescent on both sides, with short, rigid, erect hairs; they are 1 or $1\frac{1}{2}$ line long, and scarcely more than $\frac{1}{4}$ line broad: the peduncle, often deflexed, is 1 line long, and about the same length as the pubescent calyx, which is divided half-way into

* This species with sectional details is represented (*loc. cit.*) plate 67 D.

four linear, obtuse, erect teeth: the corolla is 5 or 6 lines long, $\frac{1}{4}$ line broad towards the base, but swelling to $\frac{1}{2}$ line in diameter at its mouth, the four smooth, almost orbicular lobes of the border being about $\frac{3}{4}$ line diameter; the capillary filaments are inserted into the tube at a distance of one-third of its length from the base; they are 4 lines long, and are pubescent for two-thirds of their length, the inner surrounding portion of the tube being also pubescent for about the same distance. This species, although with acicular spines, will be seen to be extremely different from *L. rachidocladum*, described by M. Dunal from the same locality*.

26. *Lycium minutifolium*, Remy in Gay Hist. Chile, v. 93; Walp. Ann. iii. 173;—ramosissimum, ramulis spinescentibus; foliis fasciculatis, minutissimis, ovatis, obtusis, hirsutis, pedunculis axillaribus, solitariis, calyce 4-dentato, vix puberulo, corolla anguste tubulosa, longiuscula, apice vix dilatata, limbo 4-fido, staminibus vix exsertis.—Chile.

From the above description we may infer that this plant bears much analogy with the preceding, apparently differing in its ovate leaves and scarcely exserted stamens.

27. *Lycium stenophyllum*, Remy, *loc. cit.* p. 94;—spinescens, ramosum; foliis fasciculatis, inæqualibus, linearibus, crassiusculis, obtusis, pubescentibus, 3 lin. longis; floribus solitariis, axillaribus, calyce 4-fido, pubescente, segmentis oblongis, obtusis; corolla tubulosa.—Chile.

From the above description it is not clear to which section this species belongs; but from its 4-merous flowers and its habit, it is probably nearly allied to the two preceding species.

28. *Lycium cestroides*, Schl. Linn. vii. 70. Acnistus cestroides, *nob. Ill. So. Am. Pl.* i. 23; *Dun. in Prodr. DC.* xiii. 500;—breviter spinosum, ramis subflexuosis, albescentibus, junioribus pubescentibus, ramulis brevibus, floriferis, apice spinosis; foliis alternis, ellipticis, oblongis, apice acuminatis, imo cuneatis, margine subreflexo obsolete crenulato puberulo, nervosis, utrinque subglabris et minutissime rugulosis, sub lente glanduloso-scabridis, subtus pallidis, petiolo tenui, longiusculo, canaliculato, puberulo: floribus pedunculatis, calyce tubuloso pallide membranaceo, lineis 5 viridibus late costatis signato, pubescente, 5-dentato, dentibus acutis, erectis, intus margineque albido-lanatis; corolla longe tubulosa, imo angustiore, calyce 5plo longiore, glabra, limbi laciniis 5, rotundis, margine densissime albo-fimbriatis, erectis, valde imbricatis; sta-

* A representation of this plant with details is given (*loc. cit.*) plate 67 E.

minibus 5, inæqualibus, inclusis, medio tubi insertis, 2 longioribus faucem vix attingentibus, imo pubescentibus, ovario oblongo, corollæ circumscissæ reliquo induto, stylo incluso, apice incrassato.—Banda Oriental et Tucuman.—*v. s. in herb. Hook.* Santiago del Estero (*Tweedie*)*.

This species was formerly referred by me to *Acnistus* (*loc. cit.*) on account of its shrubby habit, large leaves, and crowded fasciculate or umbellate flowers, the lobes of the corolla having woolly margins; but my knowledge of it was then only derived from Schlechtendal's description. Since that time I have seen a specimen of a plant, evidently referrible to the same species, which at a first glance bears more the aspect of an *Acnistus* or a *Cestrum*, than a *Lycium*: on closer inspection, it will be found that the flowers are only crowded, by the close approximation of the axils. The lobes of the border are not tomentose, as in *Cestrum* or *Acnistus*, but densely ciliated, and have a very decided imbricated æstivation; these circumstances, together with the structure of the stamens, and the cupular induvium of the corolla that surrounds the ovarium, mark unquestionably the genus to which it really belongs. Tweedie's plant, although from a somewhat distant locality, is evidently the same species as Sellow's; both may be said to grow within the same region. It appears to be a very frondose shrub, with large leaves, and generally unarmed; but sometimes it bears short spines in some of its upper floriferous axils. The leaves are alternate; and their axils produce in the following year short branchlets, with very approximate leaflets, which assume somewhat the appearance of fasciculated clusters. The younger leaves are pubescent, upon long slender petioles; but as they grow older, they become glabrous, except at the base and on the petiole, where by a lens the remaining pubescence is always distinguishable. The larger leaves measure $3\frac{1}{2}$ inches in length, including the petiole of 5 lines, upon which the narrowing base of the blade is somewhat decurrent; they are 10 lines broad: other leaves vary from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length, and 7 to 9 lines in breadth. Schlechtendal describes the leaves as having short petioles; but the difference is probably accidental, depending on the comparative breadth of the decurrent portion of the blade on the petiole. The floriferous branchlets, often terminating in a spine, are $\frac{3}{4}$ to 1 inch long, and bear many small crowded leaves, and very numerous flowers in almost aggregated clusters. The peduncles are slender, somewhat thicker above, and 4 lines long: the calyx is tubular, $1\frac{1}{2}$ line long, with 5 acute, short, erect teeth, from which as many

* A figure of this species with analytical details is shown (*loc. cit.*) plate 67 F.

costate nervures descend to the base; the teeth, more especially, are covered with whitish pubescence. The corolla is cylindrical, slightly swollen below the mouth; the tube is 6 lines long, $1\frac{1}{2}$ line diameter in the broader part, and quite smooth; the lobes of the border are erect, orbicular, very small, $\frac{1}{8}$th the length of the tube, and are fimbriated on the margin with numerous ciliated white hairs: the stamens are enclosed; two of them nearly reach the mouth of the tube, the other three being little more than half their length; all are pilose for a short portion of their length, above the point of their insertion in the middle of the tube: the style is slender below, much thickened above the middle, slightly curved, and the length of the longer stamens: the stigma is clavate and sub-bilobed: the ovary is narrow, oblong, smooth, somewhat shorter than the calyx, and is invested at its base by the very short induvial cup of the corolla: Schlechtendal states that the berries are globose, red, and 3 lines in diameter.

29. *Lycium elongatum* (n. sp.);—glaberrimum, ramosum, ramulis elongatis, spinescentibus, nodoso-flexuosis, glauco-griseis; foliis 4–8, fasciculatis, lineari-subulatis, obtusiusculis, imo in petiolum gracilem longe attenuatis, carnosulis; floribus in fasciculis solitariis, pedunculo folio dimidio breviori, calyce brevi, tubuloso, 5-costato, acutissime 5-partito, corolla longe et anguste tubulosa, glabra, sicca rubescente, imo coarctata, superne vix infundibuliformi, limbi laciniis 5 breviter ovatis, staminibus brevissimis, inclusis, ultra medium insertis, glabris, in nervis totidem hirsutulis tubi decurrentibus, 3 longioribus faucem vix attingentibus, 2 alteris istis dimidio brevioribus; stylo corollæ tubo æquilongo.—Prov. Argentinas.—*v. s. in herb. Hook.*; *in desertis salsuginosis* intra Cordovam et Santiago de Tucuman (*Tweedie*, n. 1212).

This plant, although very different in its growth, has its flowers very similar to those of the preceding species. Tweedie remarks that this and similar species, all low-growing shrubs, abound here and in Patagonia in endless varieties; (by Patagonia he means the southern portion of the province of Buenos Ayres.) The leaves, including the petiole of one-half their length, are 4 to 6 lines long and $\frac{1}{2}$ line broad: the slender peduncle is $1\frac{1}{2}$ line long: the narrow, glabrous, tubular calyx, marked with deep red lines, is $1\frac{1}{4}$ line long, and is half cleft into five acute linear teeth, having pubescent margins: the tube of the corolla is 4 lines long, its ovate lobes are barely $\frac{3}{4}$ line long, the three longer stamens are 1 line, the two shorter ones $\frac{1}{2}$ line in length*.

* This species is delineated (*loc. cit.*) plate 68 A.

30. *Lycium fuscum* (n. sp.) ;—intricato-ramosum, spinosum, foliis glaberrimis, fasciculatis, late ovatis, in petiolum breviusculum attenuatis, eveniis, crassiusculis, glauco-viridibus, fuscis, utrinque glanduloso-rugosis, vel elevato-punctatis; floribus e fasciculis solitariis, breviter pedunculatis, calyce brevi, cupuliformi, breviter 4-dentato, corolla fusco-purpurea, longe tubulosa, subincurva, imo angustiore et sulcata, superne paullo ampliore, limbi laciniis 4, brevissimis, suborbiculatis, margine dense albo-fimbriatis, staminibus 4 inæqualiter exsertis, filamentis in coarctationem tubi insertis, hinc geniculatis et hirsutis, inferne in nervis totidem prominulis glabris deliquescentibus, superne lævibus, stylo staminibus multo longiore; bacca cærulescente, ovali, breviter apiculata, calyce suffulta.—In Andibus Provinciæ Mendozæ.—*v. v.* ad San Pedro de Uspallata.

I found this plant growing abundantly in the above-named portion of the Cordillera; unfortunately the only specimen gathered during my last rapid journey over the Andes was lost, but some of the leaves and flowers were preserved with the berries, collected at the same time. The leaves are somewhat fleshy, roundly oval, 3 lines long and 2 or 3 lines broad, suddenly narrowed into a short petiole 2 lines in length: the peduncle is 2 lines long; the cup-shaped calyx is $1\frac{1}{2}$ line long, with four short equal teeth; the tube of the corolla is $5\frac{1}{2}$ lines long, the lobes of the border $\frac{1}{2}$ line in diameter, and are remarkable for their fimbriated margins, as in *L. cestroides**.

31. *Lycium confertum* (n. sp.) ;—intricato-ramosum, ramulis nodoso-flexuosis, spinosis, rarius inermibus, cortice cano, rimoso, spinis brevibus in axillis approximatis: foliis 6–10, valde fasciculatis, angustissime linearibus, in petiolum spathulatis, glaberrimis; floribus in fasciculis solitariis, breviter pedunculatis, calyce cylindrico, pilosulo, laciniis 5 subulatis, tubo æquilongis; corolla anguste tubulosa, vix infundibuliformi, imo coarctata, extus pubescente, imo in contractionem tubi annulo dense barbato cincta, limbi laciniis ovatis, glabris, tubo 7mo brevioribus, staminibus inæqualibus, inclusis, filamentis in medio tubi insertis, longiuscule hirsutis, superne lævibus, 2 longioribus faucem attingentibus, 2 vix æquilongis, 1 dimidio fere breviori, stylo exserto, bacca ovata, parvula, coccinea, calyce suffulta.—In desertis salsuginosis Prov. Mendozæ et Sancti Ludovici.—*v. v. et spec. lexi*; *abundat in* Travesiam *a* Mendoza *usque ad* Coral de Desaguadero *et ad* Alto del Yeso, Prov. S. Luiz.

This species I found abundantly along the Desert track all the

* This plant with floral details is shown (*loc. cit.*) plate 68 B.

way from Mendoza to San Luiz. It varies in having the leaves more or less crowded, more or less attenuated; they are from 3 to 6 lines long, $\frac{1}{4}$ line broad; the peduncle is $1\frac{1}{2}$ or 2 lines long; the calycine tube is cylindrical, $\frac{3}{4}$ line long, with narrow, linear, acute segments $1\frac{1}{4}$ line long: the tube of the corolla is 4 or 5 lines long, the segments of its border are $\frac{3}{4}$ line long, the larger stamens are 2 lines in length: the oval berry is 3 lines long*.

32. *Lycium Berlandieri,* Dun. in DC. Prodr. xiii. 520.—Mexico, prope Laredo (*Berlandier*).

33. *Lycium senticosum* (n. sp.);—intricato-ramosum, ramis tortuosis, angulatis, griseo-helvolis, fere aphyllis, ramulis patentibus, apice spinosis, foliis e nodis cottoneis prominentibus paucis (2–3) fasciculatis, parvulis, lineari-spathulatis, obtusis, glabris; floribus solitariis, folio duplo longioribus, pedunculatis, glabris; calyce parvo, poculiformi, inæqualiter 4-dentato, dentibus acutis, tubo duplo brevioribus; corollæ pallide flavæ tubo imo coarctato, infra e medium repente ac late campanulato, limbi laciniis 4, curtissimis, tubo 4to brevioribus, rotundato-deltoideis, reflexis; staminibus 4 exsertis, 2 paullo longioribus, filamentis in coarctationem tubi insertis, hinc geniculatis et longiuscule hirsutis, superne capillaribus et glabris, stylo staminibus longiore.—Mexico, ad Monterey.—*v. s. in herb. Hook.* (*Berlandier,* Jan. 1828).

This is evidently very near *L. Berlandieri,* and may possibly be only a tetramerous variety of it. It appears to be more barren of leaves, which are smaller and fewer in each fascicle: the leaves are $2\frac{1}{2}$–3 lines long, $\frac{1}{2}$ line broad; the pedicels are 2–$2\frac{1}{2}$ lines long, the calyx is nearly a line long, the tube of the corolla 2 lines, the segment of the border $1\frac{3}{4}$ line in length; the contracted portion of the tube is narrow, and a little longer than the calyx, when it is suddenly enlarged into a bell-shaped form; the style is the length of the longer stamens, and the lower part of the ovarium is encircled by the cupular remains of the corolla, which here breaks away by a circumscissile line: this same process is described as existing in *L. Berlandieri*; but it partakes in no degree of the nature of a disk, as stated by M. Dunal†.

34. *Lycium barbinodum* (n. sp.);—intricato-ramosum, subinerme, valde foliosum, ramis angulatis summe nodosis, cortice fusco, nodis majusculis, prominentibus, subglobosis, albido-cottoneis; foliis plurimis (6–8) fasciculatis, internodiis duplo longioribus,

* This species with sectional details is represented (*loc. cit.*) plate 68 C.

† A drawing of this plant with floral analysis is shown (*loc. cit.*) plate 68 D.

lineari-spathulatis, obtusis, imo in petiolum brevem deliquescentibus, glaberrimis, carnosulis; floribus parvulis in fasciculis solitariis, cum pedicello brevi folio dimidio curtioribus, calyce brevi, poculiformi, reticulato, fusco, brevissime 5-dentato, demum inæqualiter 2–3-fisso, dentibus sphacelato-pubescentibus; corollæ tubo imo coarctato, hinc repente campanulato, glabro, limbi laciniis 5, orbicularibus, margine subciliatis, tubo 4to brevioribus; staminibus 5, vix æqualibus, subexsertis, filamentis imo geniculatis in coarctationem tubi insertis, longiuscule hirsutis, superne glabris; stylo imo articulato, staminibus paullo longiore; ovario corollæ reliquo cupuliformi imo circumdato.—Mexico Septentrionali.—*v. s. in herb. Hook.* (Sierra Madre) *Seemann*, no. 2090.

A very leafy species, remarkable for its conspicuous, cottony, knotty axils, which are from $\frac{1}{4}$ to $\frac{1}{2}$ inch apart: the leaves, four to six in each fascicle, are 8 to 10 lines long, $1\frac{1}{2}$ to 2 lines broad: the flowers are about the size and shape of those of the preceding species; the peduncle, equal in length to the calyx, is 1 line long; the corolla is 3 lines long; the segments of the border are $\frac{3}{4}$ line long and broad*.

35. *Lycium glomeratum*, Sendtn. in Flor. Bras. fasc. 6. p. 154; Dunal in DC. Prodr. xiii. 512.

This very distinct species, fully described by Dr. Sendtner and M. Dunal, is remarkable for its approximated large leaves and copious fascicles of flowers. It is a small tree, growing commonly along the banks of the river San Francisco, about eighty miles from its mouth, where it is called Espinha, though it is generally unarmed. Its branches are much used by the natives for making fences. A variety, which may be called *obovatum*, on account of its more ovate and obtuse leaves, exists in Sir William Hooker's herbarium, collected by Mr. Gardner on the Ilha de San Pedro, an island near the mouth of the river San Francisco†.

*** *Filamenta paullo supra basin geniculatum globula pilorum donata.* Sp. 36 ad 38.

36. *Lycium nodosum* (n. sp.);—glaberrimum, inerme, ramis flexuosis, cortice rimoso, albescente, ramulis virgatis, axillis approximatis, nodosis, cottoneis; foliis (2–5) fasciculatis, rarius solitariis et alternis, ovato- vel oblongo-spathulatis, apice rotun-

* A representation of this species with explanatory sections is given (*loc. cit.*) 68 E.

† This species is shown (*loc. cit.*) plate 68 F.

datis, imo in petiolum brevissimum attenuatis, eveniis; floribus in axillis solitariis, calyce cupuliformi, brevissimo, crassiusculo, æqualiter et acute 4-dentato; corollæ glabræ tubo infundibuliformi, limbi laciniis brevibus, latis, reflexis; staminibus 4, subæqualibus, longissime exsertis, filamentis in coarctationem tubi insertis, hinc geniculatis et barbatis, uno paullo breviori; stylo staminibus æquilongo; ovario disco carnoso adnato, et corollæ reliquo cupuliformi imo circumdato.—Provincia Tucuman Argentinorum.—*v. s. in herb. Hook.* (*Tweedie*).

The leaves are 5 to 7 lines long, $1\frac{1}{2}$ to $2\frac{1}{4}$ lines broad; the peduncle is 2 lines long; the calyx is $\frac{1}{2}$ line long; the length of the tube of the corolla is $2\frac{1}{4}$ lines, of the segments of its border $\frac{1}{2}$ line: the stamens are $1\frac{1}{2}$ line longer than the tube, and are inserted one-third of the distance from the base*.

37. *Lycium vimineum* (n. sp.);—inerme, ramulis virgatis, rectiusculis; foliis 2–3nisve (interdum 5nis) fasciculatis, linearibus, imo in petiolum brevem attenuatis, eveniis; floribus e fasciculis 2–3nisve parvulis, calyce 4-dentato pedunculo vix breviori, dentibus æqualibus acutis margine ciliatis tubo lævi, poculiformi paullo brevioribus; corollæ glabræ carnosulæ breviter et late cylindricæ tubo paullo supra basin breviter coarctato, hinc subcampanulato, limbi laciniis 4, late subdeltoideis, reticulato-venosis, tubo tertio brevioribus, reflexis: staminibus 4, æqualibus, exsertis, filamentis paullo supra basin insertis, hinc glabris et geniculatis, mox fasciculatim barbatis, maculis totidem pilosis intra tubum alternatim interjectis, stylo staminibus æquilongo.—Prov. Santa Fè Argentinorum.—*v. s. in herb. Hook.* (*Tweedie*).

This is said by Tweedie to be a shrub 12 to 20 feet high, evidently with long, slender, pendent branchlets, growing very plentifully near the town of Santa Fè, on the river Paraná: the branchlets are slender, of a light brown colour, smooth and striated. Two, three, or more leaves grow in a fascicle out of each cup-shaped axillary node; they are 10 to 16 lines long, 1 or 2 lines broad; two or three flowers spring out of each fascicle of leaves, one after another, at distant periods; the peduncle is $1\frac{1}{2}$ or 1 line long; the smooth cup-shaped calyx is of the same length, and is crowned by four equal triangular teeth with ciliated margins: the corolla is contracted near the base, is broadly campanular above, with four short and broad reflected segments, the length of the tube being $2\frac{1}{4}$ lines, and of the segments $\frac{3}{4}$ line: the stamens, inserted a little above the

* A drawing of this plant with sectional details is given (*loc. cit.*) plate 69 A.

base of the tube, are 3 lines long; the style is $3\frac{1}{2}$ lines in length; the lower moiety of the ovary is enclosed in the cup-shaped induvial base of the corolla*.

38. *Lycium brevipes,* Benth. Voy. Sulphur, 40; DC. Prodr. xiii.; —spinosum, glaberrimum, ramulis striatulis, subflexuosis, nitidis, stramineis, apice spinosis; foliis solitariis, 2–3nisve, cuneato-oblongis subovatisve, obtusis; floribus parvis, brevissime pedunculatis, solitariis; calyce brevi, poculiformi, 5-dentato; corollæ tubulosæ tubo calyce 5plo longiori, limbi laciniis 5, brevibus, rotundatis, reflexis; staminibus insertis. —California.—*v. s. in herb. Hook.*—Magdalena Bay (*Barclay*), *specim. flore manco.*

A spiny shrub with a barren aspect, apparently with few obovate leaves, which are 4 to 9 lines long, narrowed at the base into a slender petiole, and 2 to 3 lines broad. The specimen above referred to has only a single imperfect flower, with a peduncle $\frac{1}{2}$ line long; the calyx measures 1 line, the corolla 3 lines, including the segments of its border $\frac{1}{2}$ line in length; more perfect flowers, according to Mr. Bentham, are 5 lines long†.

[To be continued.]

XVI.—*Note on the supposed Antheridia of* Rhamnus. By J. S. Burdon Sanderson, M.D.‡

[With a Plate.]

In Mohl and Schlechtendal's 'Bot. Zeitung' for 1844, certain peculiar organs are described by Dr. Grisebach as occurring on the stipules of the rudimentary leaves forming the centre of the leaf-bud of several species of *Rhamnus* and other plants belonging to different orders. In these organs, to which he applies the term *corynidia,* Dr. Grisebach finds a structure which he supposes to resemble that of the antheridia of the higher Cryptogamia. Any evidence to prove the occurrence of antheridia among the Phanerogamia must, if confirmed, necessarily alter the views which we are now entitled to entertain of the general signification of the organs in question: it appeared therefore desirable to repeat the observations above alluded to. With this object I procured, through the kindness of Prof. Balfour, a sufficient number of the buds of several species of *Rhamnus,* viz.

* This species with sectional details is represented (*loc. cit.*) plate 69 B.
† This species with floral sections is represented (*loc. cit.*) in plate 69 C.
‡ Read before the Botanical Society of Edinburgh, May 9, 1854.

R. Alaternus, latifolia, cathartica, &c. The last-mentioned was selected for examination as most suitable.

1. *Arrangement and development of parts forming the leaf-bud.*—The leaf-buds were examined at two periods,—first, in the middle of last January, and afterwards early in April, when nearly ready to open. The internal parts are protected by a resistent tegument, composed of scales of a brown colour and horny consistence. Each of these scales presents a modified form, not of the leaf, as is most commonly the case, but of the stipule; or rather, to speak more accurately, each scale corresponds to a combination of the two stipules which belong to one leaf. The arrangement of the scales is imbricated, each scale covering all its successors by both its margins. The rudimentary leaves are arranged in pairs, which alternate with each other; the two leaves forming each pair being opposite and of nearly equal size. The four stipules of the last pair of leaves (viz. the pair most distant from the axis) are enclosed in the first pair of tegumentary scales, while they, on the other hand, enclose the four stipules of the penultimate pair of leaves, and so on to the centre of the leaf-bud; an arrangement that illustrates in a beautiful manner the correspondence between the scales and the stipules. Frequently the scales of the first pair are bifid, thus manifesting a tendency to division into two symmetrical organs. The vernation of the rudimentary leaves is convolute; the stipules occupying the space intervening between the convexities of their rounded folds.

Structure and development of the rudimentary leaves and stipules.—In its earliest condition the leaf is nothing more than a lateral budding out of the axis, which soon becomes compressed from behind forwards *. In a stage slightly more advanced, it is an awl-shaped organ, the lateral margins of which are curved inwards and forwards; it is inserted into the axis by an expanded base. In this condition the stipules are seen as two flattened projections, one on each side (Pl. III. A. fig. 1 *a*). Still later, as in fig. 1 *b*, the involution of the margin of the leaf is more complete, and the stipules have lost their rounded form, having become somewhat spatula-shaped organs,—much broader, however, below than above. In this state both leaf and stipule consist entirely of cylindrical cells, the greatest diameter of which is about 0·009 millim. The breadth of the leaf now diminishes considerably in proportion to its length, a result which is produced by the continued involution of its margins. The con-

* The terms anterior and posterior, right and left, internal and external, &c., are usual in relation to the leaf, taken by itself; its future upper surface being considered as *anterior*, as it is by it that it looks towards the axis.

vexities of the rounded folds are seen on its anterior aspect to form two undulating ridges, one on each side of a median furrow. In the mean time the stipule, originally a mere lateral projection from the base of the leaf, has increased in relative size, and now equals or exceeds the leaf itself. A difference of size is also observed between the two stipules belonging to the same leaf, the right one from the first somewhat exceeding its fellow. After they have arrived at about one-eighth of their ultimate length, both are furnished with a linear median thickening, which extends from the base to the apex. The space intervening between this thickening and the margin is greater on the side next the leaf than on the opposite, as a result of which, the margin itself is convex on the one side, while on the other it is nearly rectilinear. Those of the outer stipules of the leaf-bud, which have assumed the character of protective scales, are brown and horny at their upper part, and much broader in proportion to their length than the rest (fig. 1 *f*).

Origin and development of the so-called Corynidia.—The corynidia are found only in stipules which have arrived at about one-eighth of the length of the whole bud, those of smaller size presenting no trace of their existence. They originate from the median thickening of the stipule, as nipple-shaped buddings-out of the anterior surface (fig. 2 *a*). Soon they assume a clavate form and overhang the inner margin of the stipule, appearing in the interval between this organ and the leaf (fig. 2 *b*). Each consists of a central column of cellular tissue surrounded by a simple layer of others, which do not differ in any respect from those which surround them, and form the superficial layer of the stipule. On the more external stipules of the leaf-bud, the corynidia are found to have altered their form, having become flask-shaped (fig. 2 *b*). It is difficult to determine whether the enlarged extremity is occupied by a cavity containing a transparent fluid, or simply by a lax cellular tissue. It is, however, certain, that if such a cavity exists, it is not limited in any distinct manner.

At this point the development of the corynidia ceases, and they soon become marcescent; the upper part of the corynidium shrinking into a mass of irregular form and dark brown colour, which, after remaining for a time attached to the stipule by a slender pedicle, eventually separates. In examining the leaf-bud, there are always to be found a number of such masses floating free in the water used for dissection. On pressing them between two glasses, they are found to be solid, resistent bodies. When sufficient force is used to disintegrate them, they are resolved into a number of grains of irregular form, which for the most part correspond in size to the cells of which the corynidia were originally composed. This granular matter, there can be little doubt, is to be considered as a resin, with the characters of which, both physical and chemical, its characters correspond.

Conclusions.—The corynidia of Grisebach differ from true antheridia in the following particulars:—

1. They are not developed from a single, special mother-cell, differing in form and contents from those surrounding it, as in the case of the true antheridia; but are merely buddings-out of the tissue of the stipule, and consist even in their earliest condition of several cells.

2. They possess at no period of their growth a central cavity lined by a membrane.

3. They do not discharge their contents, when mature, by dehiscence, but simply shrink up and wither.

4. The most careful observation fails to detect any structures which resemble, in the slightest degree, the antherozoids of the higher Cryptogamia, or which correspond to the "long-tailed globules enclosed in minute spherical cells" described by Grisebach.

There seems to be no reason to suppose that the corynidia are at all connected with reproduction; the function which may be assigned to them with the greatest appearance of probability is that of the secretion of the resinous material, which is so important an auxiliary in the protection of the rudimentary organs of the leaf-bud from external influences.

EXPLANATION OF PLATE III. A.

Fig. 1. (All the objects are represented of the same relative size, as magnified about twelve times.) *a*, a rudimentary leaf with its stipules. The median depression which intervenes between its folded margins may be already distinguished. *b*, the same in a more advanced condition, viewed from the right side. There is as yet no indication of corynidia. *c*, here the two corynidia are seen in the space between the leaf and stipule, and projecting over the inner margin of the latter. *d*, more advanced condition, in which the leaf has arrived at the greatest length to which it attains while enclosed in the bud, but the stipules are considerably shorter. Numerous bunches of corynidia are observed occupying various positions on the median thickenings of the stipules. *e*, later stage, in which the stipules which now equal or exceed the leaf in length, have lost their corynidia and have become brown and horny at their upper part.

Fig. 2. (Magnified about ninety times.) *a*, part of the inner margin and anterior surface of a stipule $\frac{5}{6}$ths of a millim. in length. At the upper part is seen a corynidium in its earliest condition, viz. as a nipple-shaped budding-out of the middle layer of cells. Below are seen two other corynidia more advanced. *b*, a mature corynidium. *c*, a marcescent corynidium.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 25, 1852.—J. Gould, Esq., F.R.S., Vice-President, in the Chair.

Descriptions of a few new recent species of Brachiopoda. By Th. Davidson, F.G.S., Member of the Geol. Soc. of France, etc.

In the valuable collection of recent Brachiopoda assembled by Mr. Cuming, some species seem new, and undescribed in Mr. Sowerby's Monograph; and it is at that gentleman's request that I have prepared the following descriptions, which will complete, with one exception, the *Ter. septigera* of Lovén (still unfigured), all the new recent forms which have hitherto come under my observation.

In a paper published in the 'Annals and Magazine of Nat. Hist.' for May 1852, I endeavoured to class all the recent species according to their internal organization, into *four families* and *thirteen genera*, or *sections*, as it is evident that these, as well as the fossil forms, must be comprised in the proposed subdivisions introduced within the last few years with more or less success into the nomenclature; and singular enough, notwithstanding the greater facilities of examining both the internal arrangements as well as the animal in recent forms, these important characters have not yet been made use of by malacologists, who still place nearly all these Terebratuliform shells in one genus, *Terebratula*; while palæontologists, working under much greater difficulties, have by dint of perseverance and trouble discovered the organization of a multitude of extinct forms, filled by the hardest matrix: and I have no doubt but that before very many years the internal details of all the fossil species will be as well known as if they were in the recent state.

Much, however, remains to be done before the proposed classifications can be decidedly and definitely adopted, and many modifications will be considered requisite, as it is evident, from our present knowledge, that some genera or sections are more or less closely related, and that certain species possess characters common to more than one genus, but these examples are few and exceptional in comparison to those presenting a similar organization: thus all forms with a free, simply attached loop, as in *Ter. Australis*, *Ter. Californiana*, &c., must be placed in the same section; all those with the loop affixed to the hinge plate and to a central more or less elevated septum, such as *Ter. dorsata*, *Ter. rubicunda*, &c., into another group; those also in which the calcareous appendages consist of only two central diverging lamellæ, such as *Ter. rubra*, *Ter. pisum*, and others, must necessarily be placed close to each other, &c. The arrangement of the species is, therefore, not a matter of indifference, but ought to partake of those rules, followed for the other classes of Mollusca, wherein genera are often admitted on far less important differences.

A complete monograph of the recent species thus framed, with figures, synonyms, dates, &c., is still a desideratum, and I hope ere long that the science of Conchology will be enriched by such a valuable and necessary contribution.

The only object of this short paper is to describe some unfigured forms, to which I have added some remarks on a few species not hitherto completely understood.

1. Terebratula Grayii, Dav. 1852.

Diagnosis.—Shell irregularly pentagonal, rather broader than long; valves unequally convex (the perforated being gibbous and the smaller valve rather flattened); beak not much produced, truncated by a very large emarginate foramen—the deltidial plates are disunited, a small portion of the aperture being completed by the umbo; hinge-line straight; beak-ridges sharply defined, leaving between them and the hinge-margin a wide, almost flat area; surface ornamented by a great number of irregular and unequal radiating costæ, augmenting rapidly from numerous bifurcations and intercalations of smaller plaits between the larger costæ; colour partly yellow and red, this last becoming more vivid as it approaches the concentric lines of growth; structure punctate; internal appendages consisting of a simply attached loop, the riband-shaped lamella extending to about four-fifths of the length of the shell before bending back on itself. Dimensions variable: length 14, width 15, depth 9 lines.

Hab. Coast of Korea. Coll. Cuming.

Obs.—This fine species has been known to me for several years, but unobserved by other collectors, who erroneously supposed it to be the *Ter. rubra* of Pallas, to which it bears some external resemblance, but is essentially different in its internal arrangements; the loop of our new form being similar to that of *Ter. Australis* or *Ter. lenticularis*, &c., while the appendages of *Ter. rubra*, which is the type of my lately proposed genus *Kraussia*, consist only of two central diverging branches, somewhat spread out at their extremities. *Ter. Grayii* is also distinct from *Terebratella Zelandica*, the loop of this last being doubly attached, as in all the species of that section.

2. Terebratella Bouchardii, Dav. 1852.

Diagnosis.—Shell of a suborbicular or trapezoidal form, longer than wide, or broader than long; perforated valve most convex, laterally compressed and keeled, the imperforated valve presenting a longitudinal depression extending from about the middle of the valve to the front; beak produced, recurved and truncated by a large circular and entire foramen; deltidium in two pieces, meeting at the umbo; beak-ridges defined, leaving between them and the hinge-margin a slight concave false area; surface smooth, interrupted only by a few concentric lines of growth; colour light yellow; internal calcareous lamellæ fixed first to the crural base, and again to the longitudinal mesial septum, before attaining their greatest length and bending back on themselves to form the loop; structure punctate. Length 14, width 13, depth 8 lines.

Hab. Unknown. Coll. of Mr. Cuming.

Obs.—This species seems to differ from *Terebratella Coreanica* of

Adams and Reeve principally in the form of its beak and in its coloration; the Corean form is beautifully strigated with vivid red, while *Ter. Bouchardii* is of a uniform light yellow colour; the details of the loop seem likewise to differ a little.

3. Terebratella Evansii, Dav. 1852.

Diagnosis.—Shell subovate, longer than wide; perforated valve most convex, smaller one rather compressed; beak tapering, not much recurved, and obliquely truncated by an emarginate foramen; deltidia small; beak-ridges well defined, leaving between them and the hinge-margin a false area; surface ornamented by a few unequal bifurcated and intercalated costæ; colour pale red; structure punctate; apophysary system composed of a central longitudinal septum, not exceeding half the length of the valve, arising rapidly in the form of a narrow elevated plate, almost reaching the centre of the perforated valve, to the middle of which, and to the crural base, are doubly attached the calcareous riband-shaped lamellæ forming the loop. Length 4, width 3½, depth 1½ lines.

Hab. New Zealand. Coll. Cuming.

Obs.—On first inspection, I thought this shell, of which Mr. Cuming has two examples, might be the young of *Terebratella Zelandica*; but on examining the calcareous appendages, I found great dissimilarity in their respective details. In *Ter. Zelandica* the loop is first fixed to the hinge-plate, and again, by a transverse shelly horizontal process, to the extremity of a slightly elevated mesial septum; the lamella proceeding again before bending back, as in all *Terebratellæ*: but in the interesting little form under notice the mesial septum forms a narrow elevated plate, extending as far and further than the greatest length of the lamellæ, which last are fixed to the middle portion of the septum. The remarkable deviation from the general details of the arrangements in this *Terebratella* has prompted me to examine with care a multitude of specimens of different species belonging to the genus, and I was not a little surprised to find that some few other forms presented a similar arrangement, such as *Ter. crenulata*, *Ter. Cumingii*, &c., thus forming a passage into *Magas*, which last, although generically distinct, can no longer constitute a separate family from the *Terebratulidæ*.

4. Terebratella? Cumingii, Dav. 1852.

Diagnosis.—Shell very thick, ovato-oblong; larger valve most convex, slightly keeled; imperforated one rather depressed; beak produced, tapering, not much recurved, and truncated by a small oval foramen, beginning at the summit of the beak, and directing itself on the opposite side to the area; no visible deltidium; a concave triangular area; surface smooth, strongly marked by concentric lines of growth; colour white, or slightly tinged with red; shell articulating by means of two strong teeth in the larger and corresponding sockets in the smaller valve; apophysary system very complicated, composed of a mesial longitudinal elevated triangular septum extending to about two-thirds of the length of the smaller valve, and which arising from under the cardinal process and crural base, by a gentle curve reaches and touches the larger valve near to its anterior portion, from whence it descends by an almost perpendicular line to the bottom of the valve; the calcareous riband-shaped lamellæ first proceed from the socket walls, directing themselves by a gentle curve to the anterior portion of the septum, to which they become attached before bending on themselves to form a loop; the arms are of a brilliant red colour. Length 5, width 4, depth $2\frac{1}{2}$ lines.

Hab. New Zealand. Coll. Cuming.

Obs.—Two specimens of this remarkable shell have been obtained by Mr. Cuming, and it is one of the most interesting among the recent forms, presenting great difficulties from an assemblage of characters peculiar to more than one of the proposed sections. In outward shape, character of its foramen, and interior of perforated valve, it much resembles *Bouchardia rosea*; its foramen is likewise very similar in position to that presented by several species of *Trigonosemus*; the shape and position of its central elevated septum, which touches a portion of the centre of the larger valve, relates it to *Magas*, and the disposition of the lamellæ to *Terebratella*. I therefore do not feel certain in what genus this curious shell should be placed: it is not a true *Terebratella*, but there I have placed it for the present, on account of the form of the loop.

5. Terebratella Spitzbergensis, Dav. 1852.

Diagnosis.—Shell ovate, slightly pentagonal, longer than wide; valves almost equally convex; beak produced, recurved, and truncated by a middle-sized foramen; deltidium in two pieces, partly surrounding the aperture; beak-ridges not very sharply defined; smaller valve slightly depressed near the front; surface smooth, strongly punctate, and marked by a few concentric lines of growth; colour light yellow; apophysary system composed of a central longitudinal septum, extending to a little beyond half the length of the shell, in the form of a narrow plate somewhat elevated at its extremity, to which and to the hinge-plate are attached the calcified riband-shaped lamellæ forming the loop. Length 4, width 3, depth 2 lines.

Hab. Spitzbergen.

Obs.—This small *Terebratella* seems distinguishable from all the other recent forms of the genus, by its dimensions, regular ovate shape, thinness of shell, and comparatively short, doubly-attached loop, which does not exceed half the length of the valve. I have hitherto been able to examine but one specimen, from the collection of Robert M'Andrew, Esq., and Mr. Cuming.

6. Terebratulina Cumingii, Dav. 1852.

Diagnosis.—Shell ovate, somewhat pentagonal, nearly as wide as long; valves almost equally convex; beak small, obliquely truncated by a circular emarginate foramen; deltidial plates disunited, a small portion of the aperture being completed by the umbo; auricular expansions on either side of the umbo very small; surface ornamented by a great number of minute radiating elevated striæ, augmenting rapidly by the intercalation of smaller costæ at variable distances between the larger ones; the front margin of the larger valve indents the smaller one; colour white, tinged with yellow; structure punctate; internal apophysary supports short and annelliform. Length $3\frac{1}{2}$, width 3, depth 2 lines.

Hab. Chinese Seas. Coll. Cuming.

Obs.—This little *Terebratulina* may be easily distinguished from all the other recent species of the genus by its size and relative width and length, being much more convex and globular.

7. Morrisia anomioides, Scacchi, sp. 1843.

Orthis anomioides, Scacchi in Phil. Moll. Sicil. ii.

Terebratula appressa, Forbes, Report on the Mollusca and Radiata of the Ægean Sea, 1843.

Diagnosis.—Shell minute, circular, depressed; foramen large, round, encroaching equally on both valves; larger valve with a straight hinge-area; deltidial plates minute, widely separated; smaller valve deeply notched at the umbo; apophysary system consisting of two branches originating at the base of the dental sockets, and united to a small elevated process arising from the centre of the valve.

Animal furnished with two subspiral or *sigmoid* arms fringed with comparatively large cilia; the shell is of a green colour, with bright orange ovaries contrasting with the brilliant white of the ciliated arms; structure punctate. Length 1, width $1\frac{1}{4}$, depth $\frac{1}{2}$ line.

Hab. Mediterranean; depth 95 fathoms (Forbes).

Obs.—Some of Philippi's figures of *Ter. seminulum* are so like specimens of *T. appressa* (Forbes), that I at first imagined they might belong to the same type; and in my paper published in the 'Ann. and Mag. of Nat. Hist.' for May 1852, I placed *Ter. appressa* of Forbes as a synonym of Philippi's species: but since that period I have had reasons to believe this to be an error, and that in reality the Italian author's type does not belong to the same species nor even genus, but would be a synonym of *Argiope* (*Ter.*) *Neapolitana* of Scacchi. I have also ascertained that the shell and animal of this species are figured by Philippi, in the second volume of his 'Sicilian Mollusca.'

8. Kraussia Lamarckiana, Dav. 1852.

Diagnosis.—Shell of a somewhat tetragonal form, flattish, with a moderately deep longitudinal depression in the smaller valve and a corresponding keel in the larger one; hinge-line nearly straight; beak truncated by a large emarginate foramen, completed by two small deltidial plates, and by a portion of the umbo of the smaller valve; hinge-area flat, well defined; surface ornamented by a number of small costæ, augmenting here and there by bifurcation and intercalation at various intervals; apophysary system consisting of two short, central, diverging branches, bifurcated at their extremities; structure punctate; colour light yellow. Length 3, width 3, depth $1\frac{1}{2}$ lines.

Hab. Sydney and New Zealand.

Obs.—This species is found near Sydney, living in company with *Ter. Australis,* as may be seen by the specimen in the British Museum; it is distinguished from *K. pisum* and *K. Deshayesii,* by its somewhat tetragonal shape, stronger and fewer costæ, as well as by the details of its loop, relating it more than any of the other species of *Kraussia* to the section *Megerlia*; its colour is likewise of a uniform yellowish tint, while the above-mentioned species are differently tinged with red.

9. Kraussia Deshayesii, Dav. 1852.

Terebratula Capensis, Adams and Reeve, Voyage of the Samarang, p. 70. pl. 21. f. 4, 1850 (non *T. Capensis,* Gmel.).

Diagnosis.—Shell subovate, generally rather longer than wide; valves nearly equally convex, a deep longitudinal depression extending from near the umbo to the front in the smaller valve, with a corresponding keel in the perforated one; beak produced, and truncated by a large emarginate foramen; deltidia small, nearly triangular, a portion of the circumference being completed by the umbo; surface ornamented by a great number of small raised costæ, augmenting rapidly by bifurcation and intercalation of smaller plaits at variable distances from the beak and umbo; structure punctate; colour light yellow, with stripes of red; apophysary system consisting of two short, central, diverging lamellæ expanded at their extremities. Length 6, width 4, depth 2 lines.

Hab. Korea. Coll. Cuming.

10. Argiope Neapolitana, Scacchi, sp.

Terebratula Neapolitana, Scacchi, Oss. Zool. ii. p. 18.

Terebratula seminulum, Philippi, En. Moll. Siciliæ, 1836; Sow. Th. Conch. pl. 71. f. 85, 88.

Argiope Forbesii, Dav. Ann. and Mag. of Nat. Hist. May 1852.

Diagnosis.—Shell small, suborbicular, nearly as long as wide, compressed, emarginated in front; valves unequal, slightly convex, almost smooth or ornamented by a few rounded and nearly obsolete radiating costæ; a longitudinal depression extending along the centre of the smaller valve; beak produced; foramen large, with a small, lateral, deltidial plate, and an area on either side; hinge-line straight; apophysary system consisting of a small longitudinal mesial septum, with a complete two-lobed loop; colour light yellow; structure largely punctate. Length $1\frac{1}{2}$, width $1\frac{1}{2}$, depth $\frac{1}{2}$ line.

Hab. Naples, and different parts of the Mediterranean, in from 60 to 105 fathoms (Forbes).

Obs.—Since the publication of my paper in the 'Annals,' May 1852, I have, through the kindness of Mr. Hanley, been enabled to examine two specimens, said to be the types of Scacchi's *Ter. Neapolitana,* and, according to Küster, the *Ter. seminulum* of Philippi would be a synonym; although the last-named author's species, from his illustration presenting a deep notch in the umbo (a character never seen in any *Argiope*), had led me erroneously to believe *T. seminulum* the same as Prof. Forbes's *T. appressa.* The figures of

Ter. Neapolitana given both by Scacchi, Philippi, and Küster, do not represent the characters of the species under notice,—so much so that I believed it new, and gave to it the name of *Argiope Forbesii*, which must now be considered only a synonym: and Sowerby's figure correctly illustrates the species.

11. Rhynchonella nigricans, Sow. sp. 1846.

Diagnosis.—Shell inequivalve, irregularly tetrahedral, wider than long; beak acute, and slightly recurved; foramen not entirely surrounded by the deltidial plates, a portion being completed by the umbo; beak-ridges well defined, leaving between them and the hinge-line a false area, not indenting much the smaller valve; surface ornamented by a variable number of sharp plaits, about twenty-five on each valve, a few of which are due to intercalation; mesial fold not prominent, but defined, with a corresponding shallow sinus in the larger valve; apophysary system consisting of two short curved lamellæ; colour bluish black; structure impunctate. Length 8, width 9, depth 4 lines.

Hab. Five miles east of Ruapuke Island, New Zealand; dredged by Mr. Evans, R.N., in 19 fathoms off coral and rock. Coll. Cuming.

Obs.—When Sowerby described this interesting shell, only one small young specimen, without locality, was known; since then Mr. Evans has dredged several, some of which exceeded the dimensions above given. I therefore thought it advisable to redescribe the species, more especially as it is scarcely distinguishable from half-grown specimens of *R. concinna*, Sow.

12. Orbicula Evansii, Dav. 1852.

Diagnosis.—Shell irregularly circular, nearly as wide as long, very thick; both valves almost equally orbicular or suborbicular; apex subcentral; the unattached valve is ornamented by numerous strong, radiating, elevated striæ, which augment rapidly by the intercalation of numerous smaller costæ at variable distances from the apex; these are intersected by numerous concentric laminæ of growth; attached valve very deep; disk of adhesion small, almost central; fissure minute, elongated; surface covered by concentric raised laminæ, with longitudinal striæ all round and near the edge; colour yellow; texture horny. Length 5½, width 6, depth 4 lines.

Hab. Bodegas. Coll. Cuming.

Obs.—Mr. Cuming has three specimens of this *Orbicula*, all similar in appearance, and distinguishable from *O. Cumingii* and *O. strigata* by the great convexity of the attached valve, which is flat in the two above-mentioned species; the disk of adhesion is likewise much smaller in *O. Evansii*, and the striation stronger.

BOTANICAL SOCIETY OF EDINBURGH.

May 11, 1854.—Professor Balfour, President, in the Chair.

Dr. Greville mentioned that he had been in correspondence with Mr. Wilson upon the subject of the North Uist Moss, which had been referred by that gentleman to *Leucodon Lagurus*, while he himself had been disposed to consider it a variety of *Hypnum cirrhosum.* Mr. Wilson had, however, satisfied him that it could scarcely be so considered. In the absence of fructification, Mr. Wilson preferred to regard it as a variety of *Leucodon Lagurus* (although there were certainly some differences of character) rather than unnecessarily to multiply species. Dr. Greville was still disposed, on the strength of the great difference in habit, to doubt of its claim to the place assigned to it, and thought it probable that the fructification, when discovered, would remove it altogether from *Leucodon.*

The following papers were read:—

1. "On the Structure of Diatomaceæ," by E. W. Dallas, F.R.S.E.

The author directed attention to the list of species which follows, and which, although imperfect, exhibits great variety in the forms, showing the Medway to be very fertile in these organisms.

Epithemia Musculus.
Campylodiscus cribrosus.
Surirella striatula.
—— linearis.
Tryblionella marginata.
—— Scutellum.
—— punctata.
—— gracilis.
—— acuminata.
Cymatopleura elliptica.
Triceratium Favus.
—— striolatum.
—— undulatum.
Cyclotella Kützingiana.
—— operculata.
And three species undetermined.
Actinocyclus undulatus.
—— senarius.
—— septenarius.
—— octonarius.
—— nonarius.
Eupodiscus Argus, 2 vars.
—— radiatus.
—— maculatus.
Coscinodiscus radiatus.
—— minor.
—— eccentricus.
—— Thwaitesii.
And an undetermined species.
Cocconeis Pediculus.
—— Scutellum.
Nitzschia sigmoidea.
—— dubia.
—— reversa.
And an undetermined species.
Navicula elliptica.
—— convexa.
—— Westii (?).
—— didyma.
—— pusilla.
—— punctulata.
—— palpebralis.
Pinnularia divergens.
Stauroneis pulchella.
Cocconema parvum.
Pleurosigma balticum.
—— Hippocampus.
—— angulatum.
—— acuminatum.
—— distortum.
Doryphora Amphiceros, vars.
—— Boeckii.
Achnanthes brevipes.
Grammatophora marina (?).
Biddulphia aurita.
Zygoceros rhombus.
Dentricella sp.
Orthoseira sp.
Dictyocha.
Bacteriastrum furcatum (?).
—— curvatum (?).

Some of the species in the foregoing list have been described as new to Britain, by Mr. Roper in a paper recently published in the 'Microscopical Journal.' The *Coscinodiscus*, not named, seems from the description to be the same with that found at the mouth of the Thames, and is an exceedingly beautiful disc. The four species of

Actinocyclus are those described by Ehrenberg, and are new British species. They exhibit the strong siliceous cellular tissue underneath the moniliform structure of the surface. The examples of *Triceratium striolatum,* and also *Zygoceros rhombus* differed somewhat from the figures and descriptions given of them, being provided with two spines placed close to the projecting terminations or angles of the valve, and which were always present in the examples that had come under observation. The surfaces of the valves were also seen to be dotted over with small projecting nodules which gave them a very remarkable appearance. These appearances may perhaps be attributable to a more matured development of the siliceous structure.

Among the remarkable forms found, although not considered to belong to the Diatomaceæ, are the two varieties of *Bacteriastrum,* the discs of which were three or four times the diameter of those described by Mr. Shadbolt, from Port Natal, and the radiations more numerous.

Mr. Dallas directed attention to the structure of the Diatomaceæ as affording some of the most beautiful examples of geometric arrangement of cells with which we are acquainted. There are only three of the regular polygons which can be employed alone to fill up the space about a point in a plane surface, namely the equilateral triangle, the square, and the hexagon ; these forms and their angles are accordingly found to prevail in the structure of the tissues. By constructing the polygons it was shown that they arrange themselves in straight lines, determined by the shorter axis of the figures, the quadrilaterals having two directions in which the lines run, and the hexagons three.

2. "On the various sections of Coal, considered in their relation to the Block, and the relative views of Histologists thereon," by Mr. Neil Stewart.

The author stated :—"Since last July, I have frequently been employed in making drawings of sections of coal as seen under the microscope by transmitted light. In the prosecution of this work, I have felt great difficulty in bringing to my aid the willing zeal so necessary to spirited delineation, and which can only be commanded in proportion to the knowledge which the artist has of his subject. This I can only account for by stating, that a suspicion passed upon my mind from the beginning, that something was wrong with regard to sections ; and this suspicion, which I frequently mentioned to gentlemen engaged in the investigation of this subject, increased with my knowledge, until on reading Mr. Quekett's paper in the 'Microscopical Journal' for January last, I found that he there expresses a notion similar to mine, but immediately contradicts it by again returning to the usually received opinion. With a view, therefore, to satisfy my own doubts, and if possible to make a contribution to scientific truth, I have examined cubical blocks of various coals by direct light, and with my own hands have made sections from all the sides of these, and again examined them by transmitted light. I have also made drawings of such sections.

"Professor Bennett expresses it as his opinion—and I believe he holds it in common with others—that the red-coloured striæ seen in the longitudinal section of household coal are tubes or ducts—that the yellow rings seen in the transverse section are the ends of those tubes—and that the red colour of the tubes, like blood seen in the veins of the Frog's foot, is an aggregation of the yellow bodies strewed over the section like blood-cells in single file.

"For a moment let us reflect upon the appearance presented by a cell or tube, as seen on the field of the microscope. In order that either of these bodies may be seen by transmitted light, a certain amount of transparency is necessary; the slightest curvature or undulation on the surface causes the light thrown from the reflector to be diverted from the eye of the observer, and the part so curved appears dark; this is invariably the case at the margins: the outlines of such bodies are distinctly defined and black, whatever may be their colour or form, and this blackness is diffused inwards according to their rotundity.

"How is it, then, that histologists have in this case departed from an invariable optical law, and have described appearances void of outline as cells and tubes? But even admitting them to be so, I would then ask, why have these not been carbonized like the adjacent structures which form the black mass? Wanting these two characteristics, no one need hesitate to say that they are neither cells nor tubes.

"With regard to the red colour being an aggregation of the yellow, it is enough simply to state that that is impossible, from two facts—the section is reduced to an equal thickness, and the yellow bodies occur within the red spaces, their definition being then as complete as when imbedded in their usual black matrix.

"I have said that Mr. Quekett expresses a notion similar to mine, but again returns to the usually received opinion; here are his words:—'If a small cubical block of any kind of coal be examined under a power of fifty diameters, four of its six sides will exhibit more or less of a fibrous structure, *precisely like that of wood.*'

"Now, if a block of wood and a block of coal be examined together, with the longitudinal striæ of each laid in the horizontal direction, they will present very different appearances. In the case of the wood it will be seen that only two of its sides, which I shall call the back and front, present the striated appearance; in the other two the ends are distinctly transverse sections, and show the ends of organisms. But this is not the case with a block of coal, which may be likened to a pack of cards, the four sides in question having a similar appearance, and, so far as structure is concerned, having each an equal title to be called a longitudinal section. Where, then, is the transverse section of coal, and where are the yellow rings?

"Hitherto our attention has been directed to the sides of the block, let us now examine the top and bottom, or horizontal surfaces: there the rings are found, and being there, cannot be the ends of the supposed tubes, nor have any relation to them, seeing that their longitudinal direction is that of the surface now under examination.

"The grinding and polishing process is very instructive. On the sides of the blocks many series of rings may be ground off without much alteration in the appearance of the striæ, while in reducing the horizontal surface the transparent parts are constantly changing their form. The first evidence of transparency which presents itself is a deep blood-red spot, beautifully soft at the edges; grind a little farther, and it assumes the appearance recognized as the resinoid cell; a little more grinding, and the spore-case makes its appearance; still grind on, the process will be found to be as fertile of form as the frost is on the window-pane, or the burning embers of the fire to a musing fancy; and when the section is reduced to the last degree of thinness, the shallowest of all peep through. These are the yellow rings, with their dark centres, on which I shall venture a few observations suggestive of their origin.

"A painting of a transverse section, executed by Dr. Adams of Glasgow, and shown by Professor Bennett to the Royal Society, represents the rings as if they were all in the level, and of a uniform colour. This has no doubt been in some measure the cause of their having been mistaken for the ends of tubes. Nature shows them different. Some are distinct and bright yellow, while thin as the section is when they come into view; others are still obscured by a layer of dark matter, and have a bistre-brown colour. Mr. Quekett admits this to be the case; it is therefore a matter of astonishment that, with such a high and well-earned reputation for acute observation, he, at the same time, describes them as transverse sections of thick-walled cells or woody fibre.

"In the longitudinal section these bodies present their edges, are seen strewed all over the sections, and sometimes assume the appearance of an interrupted yellow line, and individuals now show their dark centres flattened.

"The dark bodies in the centres of the ring seem to me to be carbonized spores. They have the characteristic outline of a cell, are some of them still quite spherical, and in Professor Balfour's specimen of Wigan Cannel Coal, where the edge of the section is reduced to a rag, some of them are partially divested of the encircling yellow, when the spore is seen to project into the empty field. The remains of some are also seen as black circular lines, sticking in the varnish with which the specimen had been fixed to the glass.

"The transparent yellow I suppose to have been pressed out in the process of carbonization, or perhaps gathered round them as a pool of water encircles a stone on the sea-beach long after the retiring tide has left all else dry.

"In short, living vegetable matter may with tolerable accuracy be considered as a semi-opake substance. The process of carbonization by which it is changed into coal, seems to separate the structural from the non-structural, the opake from the transparent, and as the former is compressed and blackened, the latter is insinuated between the layers, and into every minute fissure and crevice left vacant around the more resistent particles of the carbonaceous mass; while decomposed portions are being constantly carried to the surface of the earth, by capillary attraction, there to be thrown off into the atmosphere or taken up by the minute spongioles and rootlets of the existing vegetation."

3. "On the effects of the recent frosts on vegetation, in different parts of the country," by Mr. M'Nab.

MISCELLANEOUS.

On the Embryogeny and Propagation of Intestinal Worms. By MM. Ercolani and Vella. Abstract by Prince Charles Bonaparte.

The recent investigations of German naturalists on the propagation and metamorphoses of the Cestoid worms have already engaged the attention of the Academy, but our authors have occupied themselves with the same phænomena in the Nematoid worms, of which we know scarcely anything.

After combating the most specious arguments that have been advanced in favour of the doctrine of *heterogeny*, they endeavour to show by simple and clearly stated facts, that, in spite of the general opinion, the *Entozoa* enjoy a marvellous tenacity of life. To such an extent does this go, in fact, that their embryos have lived six days immersed in alcohol, and been revived after thirty days of complete dryness.

The embryogeny of the *Ascaris megalocephala* of the horse, hitherto scarcely known, appears to be almost completely elaborated. The artificial development of this worm was effected by Dr. Ercolani in the lung of a dog. The description of these experiments is followed by some new observations in comparative embryogeny relating to the Graafian vesicle, the formation of the chorion and of the vitelline membrane, and especially to the successive development of the organic constituents of the worms.

Lastly, he shows how the ova of the *Nematoids*, after passing into the bodies of animals with their food, insinuate themselves into the walls of the intestine, so that their presence completely escapes detection. In this position these ova undergo a sort of incubation, and the embryo becomes sufficiently developed to return into the intestinal cavity, where it is afterwards to pass its life.

In concluding their memoir the authors give the following *résumé* of their facts :—

1. "The progressive metamorphoses of the *Entozoa*, hitherto studied by Van Beneden, Küchenmeister and Siebold, although revealing to us new and astonishing facts, are not applicable to the entire solution of the questions connected with the genesis of all *Entozoa*.

2. "Although the retrogressive metamorphosis of the ova of *Tæniæ* into *Cysticerci* and *Cœnuri* have not succeeded with the authors as with some other observers, they have nevertheless led them to recognize a lower phase in the development of the *Cysticercus cuniculi*, a phase which approaches this worm to the lowest and most simple worms : although they present an invaginated head, they are destitute of the small openings, the hooks, and the caudal vesicle, so that the opinion entertained by some that the *Cysticerci* are degenerated *Tæniæ* is not well founded.

3. "The Nematoid worms do not undergo anything like a progressive metamorphosis; the changes observable in the embryo are

only phases of development; thus the generative organs are always the last formed, and are not perfectly presented until the complete development of the animal.

4. "The horny appendages and hooks, which are wanting in the *Cysticercus cuniculi* in the first stages of its development, are also wanting round the mouth of the *Strongylus armatus* until after complete development, and are then formed but slowly.

5. "The eggs of the *Ascaris megalocephala* of the horse may be artificially developed in the pulmonary tissues of the dog.

6. "The cessation of movement and the fluidity of the body in the *Nematoids* are not sufficient signs of the death of these animals, as they recover from this state as soon as they are placed in warm water; even in the state of embryos, although completely dried up, they return to life very quickly by this means. The Nematoid worms consequently die with great difficulty; the ova and embryos are endowed with a marvellous tenacity of life; they even exhibit signs of life after immersion for six days in alcohol of 30 degrees.

7. "This tenacity of life, joined with the power of development of the ovum when placed in circumstances different from those in which it lives naturally, besides giving evidence of new and important facts, destroys the strongest arguments employed by many naturalists in favour of heterogeny.

8. "The ova of the Nematoid worms require a considerable time for their development after being introduced with the food into the bodies of animals; they adhere at first around the villosities of the mucous membrane of the intestine, whence they afterwards penetrate to the peritoneum, there to complete their development free from all danger of being eliminated, returning afterwards into the cavity of the intestine.

9. "This simple mechanism, in harmony with the laws which govern the introduction of foreign bodies into the organism, may be readily observed by examining the yellowish spots which occur in the intestines of the rabbit, or in the cæcum of the horse, which are nothing but the ova of the *Oxyuris* of the rabbit or of the *Strongylus* of the horse; amongst these ova we often meet with the microscopic embryos of these *Nematoids*.

10. "In the adult females of the *Ascaris megalocephala* and *lumbricoides* it may readily be shown that the ova are not formed in the last portion of the oviduct, but in the superior, slender portion which represents a true ovary.

11. "From the inner surface of the ovaries of the *Ascarides* just mentioned, an immense quantity of elongated, pyriform bodies are suspended; these represent the Graafian vesicles of the superior animals.

12. "The Graafian vesicle, as in the higher animals, is not torn to permit the passage of the ovum, but detaches itself completely from the stroma, and loses its pyriform shape to become round, whilst the membrane of the vesicle becomes the chorion of the egg.

12. "The vitelline membrane is formed after the detachment of the ovum."—*Comptes Rendus,* 24th April 1854, p. 779.

On two new species of South American Birds. By Philip Lutley Sclater.

1. Culicivora boliviana, Sclater. *C. suprà plumbea; infrà alba plumbeo paululùm tincta; ventre niveo; fronte regione oculari et genis nigris; alis nigricantibus, tectricibus et secundariis latè, primariis strictissimè albo limbatis; caudâ nigrâ lateralibus rectricibus albo terminatis* 4; *extimis ferè omninò albis—rostro et pedibus nigris.*

Long. tota $4\frac{3}{4}$; alæ $2\frac{1}{8}$; caudæ $2\frac{1}{4}$.

Hab. Bolivia (Bridges), D'Orbigny.

The present bird is the fifth of this interesting genus, of which the best known are the *C. cærulea* (Linn.) of the United States, and the *C. dumicola* (Vieill.) of Brazil and Paraguay. The Prince of Canino notices two other previously unrecognized species in his 'Conspectus Avium,' p. 316. These I have never seen; but his fifth species, the *C. budytoides*, De la Fresnaye, of which I have examined the type, belongs, I believe, more properly to another genus. There are specimens of the present species in the British and Paris Museums, and in the fine collection of the Baron de la Fresnaye at La Fresnaye near Falaise.

2. Pipra flavo-tincta, Sclater. *P. alba, flavo pallidè tincta; pileo alis caudâque cum dorso inferiore nigris; uropygio cum ventre viridescente-cinereis; rostro nigro; pedibus flavis.*

Long. tota $3\frac{1}{2}$; alæ $1\frac{7}{8}$; caudæ $1\frac{1}{8}$.

Hab. S^ta^ Fe de Bogota.

This species is very like the common *Pipra manacus*, but is smaller, and has the white parts of its plumage tinged with yellow and much less black on the back. There are examples in the Museum of the Jardin des Plantes at Paris and of the Baron de la Fresnaye.—*Proc. Zool. Soc.* Feb. 24, 1852.

Description of a new species of Hyrax *from Fernando Po.* By Louis Fraser, H.M. Consul at Whidah.

Hyrax dorsalis, Fraser.

Adult male. General colour grizzled brown, becoming darker towards the back, where the hairs are annulated with black; a line of yellowish white, about four inches long, commencing over the short ribs and running hindways; muzzle naked and of a brown colour; eyes light hazel.

Length of head $4\frac{1}{2}$ in.; neck and body about 18 in.; hind feet, from heel to toe, 3 in.

Hab. Island of Fernando Po.

Its native name is '*Naybar*; it is nocturnal in its habits, and is no doubt common, as its loud cry of ccurr-ccurr-ccurr may be heard every evening after dark, during the commencement of the rains.

The Boobies say, it sleeps in the trees all day, and feeds upon leaves at night, but is very difficult to find.

Mr. Waterhouse, in a letter to Mr. Cuming, writes as follows respecting this *Hyrax*:—

"The *Hyrax* is certainly distinct from the two species which I am acquainted with, viz. *H. Capensis* and *H. Syriacus*, and upon comparing the skin with the description of *H. arboreus*, the only other described species, I find several discrepancies which lead me to believe it will prove distinct. I allude more especially to the texture of the fur. In Mr. Fraser's Fernando Po animal the fur is coarse, whilst in *H. arboreus* it is said to be soft. This latter animal moreover has a transverse black stripe about the middle of the lower jaw which does not exist in Mr. Fraser's species."—*Proc. Zool. Soc.* Nov. 23, 1852.

METEOROLOGICAL OBSERVATIONS FOR JUNE 1854.

Chiswick.—June 1. Fine: cloudy. 2. Rain. 3. Cloudy: clear. 4. Cloudy: clear and cold at night. 5. Uniformly overcast: fine. 6. Cloudy and cold. 7, 8. Cloudy. 9. Overcast. 10. Fine. 11. Fine: overcast. 12. Densely clouded: slight shower: very clear at night. 13. Rain: clear. 14. Cloudy: very fine. 15. Hazy and drizzly. 16. Hazy: rain. 17. Uniformly overcast: very fine: clear. 18. Clear and very fine. 19. Very fine: cold at night. 20. Slight haze: cloudy: fine: clear. 21. Fine: cloudy: rain. 22. Very fine. 23. Uniformly overcast: very fine: clear. 24, 25. Cloudy and fine. 26. Fine. 27. Fine: rain at night. 28. Showery: very clear. 29. Cloudy: clear. 30. Very fine: rain at night.

Mean temperature of the month .... 56°·93
Mean temperature of June 1853 .... 59 ·16
Mean temperature of June for the last twenty-eight years . 60 ·51
Average amount of rain in June .... 1·90 inch.

Boston.—June 1. Cloudy. 2. Rain A.M. 3—11. Cloudy. 12. Cloudy: rain A.M. 13—15. Cloudy. 16. Cloudy: rain P.M. 17, 18. Cloudy. 19—22. Fine. 23. Fine: thermometer 83° half-past 2 P.M. 24. Fine: thermometer 80° half-past 2 P.M. 25. Fine: thermometer 87°: rain P.M. 26. Cloudy: rain A.M. 27. Cloudy. 28. Cloudy: rain A.M. and P.M. 29. Cloudy. 30. Cloudy: rain P.M.

Sandwick Manse, Orkney.—June 1. Drizzle A.M. and P.M. 2. Cloudy A.M. and P.M. 3. Bright A.M.: cloudy P.M. 4. Cloudy A.M. and P.M. 5. Damp A.M. and P.M. 6. Cloudy A.M. and P.M. 7. Cloudy A.M.: drizzle P.M. 8. Damp A.M.: cloudy, fine P.M. 9. Drops A.M.: small rain P.M. 10. Cloudy A.M.: drops P.M. 11. Clear A.M.: rain P.M. 12. Clear A.M.: clear, fine P.M. 13. Clear A.M.: drops P.M. 14. Cloudy A.M.: showers, cloudy P.M. 15. Cloudy A.M.: clear P.M. 16. Bright A.M.: cloudy P.M. 17. Clear A.M.: cloudy P.M. 18. Damp A.M.: cloudy P.M. 19. Rain A.M.: fog P.M. 20. Clear A.M. and P.M. 21. Clear, fine A.M. and P.M. 22. Bright A.M.: cloudy P.M. 23. Drizzle A.M.: cloudy, fine P.M. 24. Rain A.M.: clear, fine P.M. 25. Clear, fine A.M.: cloudy, fine P.M. 26. Showers A.M.: damp P.M. 27. Showers A.M.: cloudy P.M. 28. Clear, fine A.M.: cloudy P.M. 29. Clear, fine A.M.: drizzle P.M. 30. Drizzle A.M.: drizzle, showers P.M.

Mean temperature of June for twenty-seven previous years . 52°·81
Mean temperature of June 1853 .... 55 ·21
Mean temperature of this month .... 52 ·86
Average quantity of rain in June for thirteen previous years. 2·24 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London;*
by Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1854. June.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·916	29·830	29·60	30·08	30·13	67	50	58	49	47½	ne.	e.	ne.	·04	....	·04
2.	29·735	29·679	29·43	30·09	30·11	57	47	50	50	46½	ne.	n.	ne.	·05	·03	....
3.	29·916	29·775	29·44	30·14	30·17	60	44	54	50½	46	ne.	n.	wnw.	·02	....	....
☽ 4.	30·125	30·036	29·74	30·19	30·22	62	36	56	48	47½	ne.	nne.	nw.	....	....	....
5.	30·110	30·038	29·76	30·22	30·24	62	49	54	49½	48½	ne.	ne.	nw.	....	....	....
6.	30·083	30·040	29·70	30·21	30·19	59	47	54	50½	49½	n.	nne.	nw.	....	....	....
7.	30·070	30·043	29·72	30·13	30·10	57	45	52	52½	49	ne.	n.	nw.	....	....	....
8.	30·073	29·980	29·67	30·04	29·96	65	48	57	48	49½	ne.	wnw.	calm	....	....	....
9.	29·961	29·929	29·56	29·84	29·72	64	46	61	54	51½	nw.	nw.	calm	....	....	....
○ 10.	29·908	29·881	29·44	29·59	29·63	66	40	57	48	48	w.	w.	wnw.	....	....	·24
11.	29·870	29·654	29·35	29·41	29·08	65	55	61	52	51½	sw.	ssw.	sse.	....	....	....
12.	29·642	29·565	29·13	29·19	29·24	67	46	60	57	51	sw.	ssw.	sse.	·01	....	·13
13.	29·642	29·585	29·10	29·32	29·24	65	47	59	55½	51	sw.	ssw.	ese.	....	·35	....
14.	29·725	29·670	29·75	29·27	29·47	66	52	62	54½	51½	w.	sw.	sw.	·14	....	·05
15.	29·720	29·662	29·30	29·62	29·80	60	50	65	53	51½	e.	ne.	sw.	·04	....	·04
16.	29·772	29·622	29·40	29·78	29·84	60	53	66	55½	51	e.	ne.	ese.	·04	....	....
☾ 17.	29·657	29·569	29·10	29·87	29·85	67	45	65	54½	51½	sw.	sw.	ne.	·45	·12	....
18.	29·856	29·743	29·33	29·86	29·94	70	45	59	51	51½	s.	s.	ese.	....	....	....
19.	29·929	29·912	29·44	29·80	29·72	66	38	59	54	51½	s.	sw.	se.	....	....	·40
20.	29·908	29·876	29·46	29·81	29·80	66	44	60	57	52	sw.	w.	ese.	....	....	·47
21.	30·030	30·008	29·52	29·77	29·83	67	46	63	57	56	sw.	sw.	e.	·96	....	....
22.	30·077	30·067	29·68	29·91	29·88	72	59	66	60	56	sw.	w.	se.	....	....	....
23.	30·139	30·103	29·60	29·85	30·01	77	52	67	57	55	sw.	w.	e.	....	....	....
24.	30·159	30·078	29·60	29·95	29·89	77	52	69	56½	63½	sw.	w.	calm	....	....	·17
● 25.	29·987	29·853	29·45	29·79	29·77	81	61	71	61½	57	s.	s.	wnw.	·01	....	....
26.	29·690	29·651	29·14	29·65	29·46	68	48	74	57	56	sw.	sse.	ese.	....	·48	·10
27.	29·790	29·725	29·25	29·42	29·61	65	49	60	57	53	sw.	s.	sse.	·17	....	·21
28.	29·649	29·611	29·22	29·74	29·85	68	43	66	57	55	sw.	s.	e.	·06	....	....
29.	29·615	29·590	29·18	29·89	29·85	71	41	60	56	54	sw.	w.	nw.	....	·27	....
30.	29·803	29·666	29·25	29·85	29·85	70	51	63	56	50	w.	nw.	n.	·44	....	....
Mean.	29·885	29·814	29·44	29·809	29·815	66·23	47·63	60·9	53·96	51·76				1·53	1·25	1·85

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XVII.—*On the Occurrence of "Cinchonaceous Glands" in* Galiaceæ, *and on the Relations of that Order to* Cinchonaceæ. By George Lawson, F.R.P.S., F.B.S.E., Demonstrator of Botany and Vegetable Histology to the University of Edinburgh*.

[With a Plate.]

A few years ago, Dr. Weddell of Paris, in his magnificent monograph of the Cinchonas†, drew attention to a singular feature in these plants, viz. the constant presence of peculiar glands on their interpetiolar stipules; and the attention of this Society was called by Professor Balfour to Dr. Weddell's observations.

The inner faces of the stipules are in many cases firmly glued to the terminal bud, which they embrace, by a gummy or gum-resinous matter exuded by the small sessile glands to which reference has been made. This secretion is stated by Dr. Weddell to be fluid and transparent in Cinchonas and Cascarillas, but solid and opake in several other genera, remarkably so in *Pimentelia glomerata*. In the genus *Rondeletia* it is soft like wax, and of a beautiful green colour. The inhabitants of Peru, who give it the name of *Aceite-Maria* (oil of Mary), carefully collect it, and employ it as an external application in various maladies. It is well known to horticulturists that Cinchonaceous plants under cultivation are very liable to the attacks of *Acaridæ* and other parasites; and Mr. M'Nab has drawn my attention to the fact, that it is invariably in the neighbourhood of the stipules on the young shoots that these pests are most abundant, viz. at the points of the plant where the secretion is most copiously given off.

* Read to the Botanical Society of Edinburgh, July 13, 1854.

† Histoire Naturelle des Quinquinas, ou Monographie du genre *Cinchona*, suivie d'une Description du genre Cascarilla et de quelques autres plantes de la même tribu, par M. H.-A. Weddell, M.D. Paris, 1849.

The glands occur at the extreme base of the stipule on its inner or upper surface, and are most plentiful in the immediate vicinage of the nervures of the stipule, where spiral vessels are abundant; but these do not enter the tissue of the gland. In those plants whose stipules early become reflexed (*Rogera* for example) the glands are conspicuously exposed to view; but in those whose stipules remain closely glued to the stem, it requires careful dissection to show them. It is in the young state of the stipule, when it envelopes the terminal bud, that the glands are in best condition for examination; they get quite dried up before the stipule decays.

These stipular glands appear to be of universal occurrence throughout the whole order *Cinchonaceæ*, but as this has not been ascertained from actual observation of all the species, it seems desirable here to record the names of those in which they have been particularly noticed, in order that botanists who have the opportunity may, from time to time, extend the list of observations. These glands have been examined in the following species, viz.—

Cinchona Calisaya, *Wedd.*
—— Condaminea, *Humb. et Bonpl.*
—— lancifolia, *Mutis.*
—— amygdalifolia, *Wedd.*
—— scrobiculata, *Humb. et Bonpl.*
—— australis, *Wedd.*
—— boliviana, *Wedd.*
—— ovata, *Ruiz et Pav.*
—— rufinervis, *Wedd.*
—— Chomeliana, *Wedd.*
—— micrantha, *Ruiz et Pav.*
—— pubescens, *Vahl.*
—— cordifolia, *Mutis.*
—— purpurascens, *Wedd.*
—— carabayensis, *Wedd.*
—— asperifolia, *Wedd.*
Cascarilla Carua, *Wedd.*
Ladenbergia dichotoma, *Kltsch.*
Rondeletia odorata, *Jacq.*
Burchellia capensis, *Brown.*
Cephaëlis Ipecacuanha, *A. Rich.*
Coffea arabica, *Linn.*
Ixora javanica, *DC.*
—— coccinea, *Linn.*
Mussænda frondosa, *Linn.*
Pavetta indica, *Linn.*
Luculia gratissima, *Sweet.*
—— Pinciana, *Hook.*
Pentas carnea, *Benth.*
Gardenia Stanleyana, *Hook.*
Pimentelia glomerata, *Wedd.*
Exostemma longiflorum, *R. & S.*
Rogera Rœgelia.
—— versicolor.
—— elegans.

In all 35 species.

The Cinchonaceous glands are, in general, minute, more or less conical bodies, rising from the surface of the stipule, and are mostly colourless, but in some instances highly coloured, and are then conspicuous objects.

Their plan of structure is perhaps more distinctly seen in *Cinchona Calisaya* than in any other species, and is well illustrated in Dr. Weddell's book. In that plant the gland is sessile, of an oval or lanceolate form, and somewhat pointed at the apex. It consists of a mass of dense tissue of somewhat elongated cells, forming a central nucleus of a conical shape. This axial nucleus is surrounded by a layer of much more elongated obconical, somewhat prismatic cells, which are closely set around the nucleus in a radiant manner, lying upon it like achenes upon a conical receptacle.

These elongated cells are described by Weddell as having, in the centre of the outer extremity or apex of each, a minute canal or perforation in the cell-wall, communicating with the interior of the cell, and serving to discharge the secreted fluid. This he says is particularly evident in *Cinchona Calisaya*; and the Commission appointed by the Academy of Sciences to report upon Dr. Weddell's investigations (MM. Richard, Gaudichaud and Jussieu) specially drew attention to the circumstance, as of rare occurrence in vegetable glands.

I have not been able as yet to demonstrate the canal satisfactorily, although the glands of *Cinchona Calisaya,* and of other species, have been carefully examined with this view. But, by this expression of my own failure to see what no doubt requires a combination of favourable circumstances, supplemented by patient examination, I do not mean to impute error of observation to so excellent an observer as Dr. Weddell; and refrain, in the meantime, from entering upon a discussion of the point, as it has specially occupied the attention of my friend Dr. John Kirk, whose researches I trust will ere long be laid before the Botanical Society. It may here, however, be remarked, that the secretion is certainly discharged from the apex of the elongated cells forming the outer layer of the gland, and under certain circumstances appears in the form of minute globules on their surface. It is not likely that such globules were taken by Dr. Weddell for canals, but they have sufficiently that appearance to be mistaken by an inexperienced observer.

In size and form the glands vary considerably in different species. In *Cinchona Calisaya* they are of an ovato-lanceolate form, and measure $\frac{1}{40}$th of an inch in length by $\frac{1}{70}$th in breadth; while in *Ixora coccinea* they are very much attenuated, of a linear lanceolate form, and measure $\frac{1}{30}$th of an inch in length by only $\frac{1}{250}$th in breadth.

In occasional cases, though rarely, two glands are found in adhesion.

These stipular glands have been hitherto regarded as quite peculiar to the Natural Order *Cinchonaceæ,* and have been employed as a character whereby to distinguish that order from *Galiaceæ,* in which their presence has not hitherto been suspected, or has rather by implication been denied.

I have recently ascertained, however, that the so-called Cinchonaceous glands are by no means limited to *Cinchonaceæ.* They likewise occur in the *Galiaceæ,* and I believe that the

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strong odour (in some agreeable, in others fetid) which many of these plants give off may be found to proceed from the secretions of their glands. It is not in isolated cases merely that I have been able to trace the presence of glands in *Galiaceæ*. In every plant of the order of which I have been able to obtain fresh examples for examination, I have found them to occur; and being quite unable to find a single instance of a Galiaceous plant in which they are absent, I think I am, in the meantime, fairly entitled to presume their general occurrence throughout the order. The plants examined (and found to exhibit these glands) were the following, viz.—

Rubia peregrina, *Linn.*
—— tinctorum, *Linn.*
Asperula taurina, *Linn.*
—— odorata, *Linn.*
—— valantioides.
Crucianella suaveolens.
—— molluginoides, *Bieb.*
—— stylosa, *DC.*
—— aspera, *Bieb.*
Galium Aparine, *Linn.*
—— rubioides, *Linn.*
—— tomentosum, *Thunb.*
—— tauricum, *Rœm. et Schult.*
—— saccharatum, *All.*
Galium Mollugo, *Linn.*
—— Chersonense, *Rœm. et Schult.*
—— glabrum, *Thunb.*
—— cruciatum, *With.*
—— saxatile, *Linn.*
—— rostratum.
—— urceolatum.
—— purpureum, *Linn.*
—— lucidum, *All.*
—— verum, *Linn.*
—— pusillum, *Linn.*
—— boreale, *Linn.*
Sherardia arvensis, *Linn.*

In all 27 species.

In *Galiaceæ* the glands occur apparently in the axils, but in reality on the inner or upper surface of the bases, of the leaves. In structure they bear a considerable resemblance to the stipular glands of many *Cinchonaceæ*, with this difference, however, that they are generally either distinctly stipitate or club-shaped, whereas those of *Cinchonaceæ* are usually thickest at the base, and taper (more or less gradually in different species) towards the apex. When stipitate, the stalk (of the Galiaceous gland) is composed of two or three (sometimes more) series of cells, those running up the centre sometimes containing green chlorophyll granules; none of these, however, being usually exhibited in the body of the gland. In *Rubia tinctorum* each cell of the gland contains a large green central nuclear body. In form the glands of *Galiaceæ* present even greater variety (in different species) than those of *Cinchonaceæ*.

Another feature in which the glands of *Galiaceæ* differ from those of *Cinchonaceæ* is their small size, which is especially observable in some of the dwarf, small-leaved species of *Galium*, as in *Galium saxatile*, for instance, whose glands are not more than $\frac{1}{150}$th of an inch in length by $\frac{1}{800}$th in breadth, whereas I have stated those of *Cinchona Calisaya* (which are not unusually large for that genus) to average $\frac{1}{40}$th of an inch in length by $\frac{1}{70}$th in breadth.

The *Cinchonaceæ* and *Galiaceæ* form two well-marked groups of plants, abundantly distinct from each other in habit and in geographical distribution; the one consisting of trees, shrubs, and herbs, almost exclusively inhabiting the hotter parts of the world, most of them eminently conspicuous for their œconomical products and the beauty of their broad foliage and flowers, although some of their number are mean weeds; the other composed entirely of straggling herbaceous plants, with weak angular stems and narrow verticillate leaves, inhabiting northern countries, and (if we except the Madder) alike inconspicuous for use and ornament. Unfortunately, however, fructification does not supply any character whereby those two ideally distinct groups of plants can be clearly separated from each other; and in the limitation of natural orders, something more than a difference of habit is considered desirable by all, and by many absolutely requisite. Therefore, although the *Cinchonaceæ* and *Galiaceæ* are kept separate by several of our best systematic writers, there is still a considerable difference of opinion as to the propriety of so doing, notwithstanding the detailed discussion of the subject at different times by some of the most distinguished botanists of Europe.

The principal character whereby these two orders are separated, depends upon the leaves of *Cinchonaceæ* being opposite (sometimes verticillate), and *furnished with interpetiolar stipules*; while *Galiaceæ* have normally verticillate leaves *without stipules*.

DeCandolle, Bentham, and others, who regard *Cinchonaceæ* and *Galiaceæ* as forming only one natural order, *Rubiaceæ*, reduce the distinguishing character above indicated in the following manner. They regard the *Galiaceæ* as opposite-leaved plants, their foliaceous organs being in part true leaves, and in part leaf-like stipules, for the following reasons:—

1. That the foliaceous organs in *Galiaceæ*, if viewed as consisting entirely of leaves, do not bear that relation to the angles of the stem which is usual in Dicotyledons; but that the relation becomes apparent if only two of them are taken as leaves and the rest as stipules. Only two of the apparent leaves have buds in their axils.

2. That in a number of cases, especially in *Asperula*, two opposite leaves are much larger than the others.

3. That in *Spermacoceæ* and other tribes of *Cinchonaceæ*, the stipules are connected with the petiole of the leaf into a sheath, and that this sheath exists in *Galiaceæ*.

4. That the number of parts in each whorl is not necessarily some power of 3, as argued by Dr. Lindley (each leaf having two stipules), but that taking two of the parts for leaves, it is imma-

terial by what number of similar parts those two are separated, because the intermediate processes are analogous to the setæ of *Spermacoceæ*, the number of which is variable*.

Dr. Lindley objects to this line of argument, (1.) that in *Labiatæ* and similar orders the apparent leaves are never opposite the angles of the stem, but are always placed between them, and that the number of angles in the stem of verticillate plants does not necessarily correspond with the number of their leaves, *Dysophylla* for example (a Lamiaceous genus) having whorls of ten parts, while the stem has but four angles; that the non-production of buds in their axils is no proof of bodies not being true leaves, all foliaceous organs, and especially stipules, having that power or not according to circumstances. (2.) That the greater length of two opposite leaves occasionally observed in *Asperula* is to be ascribed to their greater development consequent upon their higher functions. (3.) That the argument derived from the occasional connection of the leaves by a membrane loses weight, when it is remembered that in such cases the intermediate leaves are less like stipules than in those cases where no membrane exists. (4.) That the comparison of the supposed stipules of *Galiaceæ* and the setæ of *Spermacoceæ* is inadmissible, because the former are at all events single simple organs, be they what they may, while the setæ of *Spermacoceæ* are the result of the splitting of two parallel-veined stipules, and therefore will necessarily be uncertain in number.

Dr. Lindley likewise draws attention to the fact, that in *Galiaceæ* the supposed stipules are always what first disappear in the process of reduction in the number of foliaceous appendages; but that in *Cinchonaceæ* it is in many cases the leaves which are first lost when such a reduction takes place, which is illustrated by the capitate Spermacoces, where the bracts are evidently stipules, and especially by *S. calyptera*, in which the leaves are gradually merged in the large membranous cup that subtends the flower, while the stipules suffer no diminution.

From these arguments it will be seen that the principal distinction between the orders *Cinchonaceæ* and *Galiaceæ* depends entirely upon the theoretical notion we adopt of their foliaceous organs, and that from whatever point of view they be regarded, the two orders are structurally closely related to each other.

The observation of the glands now described, in the *Galiaceæ*, establishes another point of relationship between the orders, the presence of stipular glands in the *Cinchonaceæ*, and especially in the arborescent species, having been hitherto looked upon as a singular feature of their structure, serving to remove them from

* Vegetable Kingdom, 3rd edit. p. 769.

the herbaceous *Rubiaceæ* of cold countries. It appears to me that these glands may likewise be instrumental in throwing light on the nature of the foliaceous organs of *Galiaceæ*, as well as on the morphology of those of *Cinchonaceæ.*

In *Cinchonaceæ* the glands are invariably confined to the stipule; and, on observing their occurrence in *Galiaceæ*, it at once occurred to me that if a portion of the foliaceous organs of *Galiaceæ* were in reality leaves and the others stipules, then we had here a key whereby to determine what were leaves and what stipules. With the view of doing so, I have carefully examined the position of the glands of all the *Galiaceæ* within my reach; and, although I came to the subject with a prepossession in favour of the view of DeCandolle, I have been quite unable to find any indication, by the arrangement of the glands, of two kinds of foliaceous organs in these plants. In *Galiaceæ* the stipules occur at the base of the foliaceous organs; they are not limited to a certain number in each whorl, but occur in all, being equally present in those opposite "leaves" which bear branches in their axils, as in those so-called "stipules" that are barren, although more abundant in the latter.

In the *Cinchonaceæ* I have said that the glands constantly occupy the base of the stipule, and are in no case found on a leaf or petiole. Here then the presence of these glands is a certain indication of the stipulary nature of the organ on which they occur, no dubiety whatever having hitherto been expressed respecting the nature of the usual foliaceous organs of *Cinchonaceæ.* I am not sure in how far we are warranted in applying this fact to the case of *Galiaceæ*; but where all other characters have failed, it is not to be entirely overlooked. If then we follow the rule which obtains in *Cinchonaceæ*, that stipules are bodies furnished with glands at their base, we shall come to a conclusion differing essentially from all those that have hitherto been brought forward, viz. that *Galiaceæ* are *leafless plants with whorls of stipules.*

It is worth while to keep in view that this idea, although at first sight sufficiently paradoxical to caution us against its too hasty adoption, is perhaps in reality less liable to objection than either the views of Lindley or of DeCandolle and Bentham. At the same time, even if it were proved to be correct, I do not precisely see in what manner it could help us out of the difficulty.

In organography, as well as in regard to the disposition of these two natural orders, the subject is one of considerable interest in a theoretical point of view.

In viewing the whole question, it appears to me, even admitting (with Lindley) the foliaceous organs of *Galiaceæ* to be true leaves, that the character thus established between the two orders is not of that great importance with which it seems to be generally regarded. The leaves are truly verticillate in a certain portion of the *Cinchonaceæ*, and, without any violence to truth, they may be regarded as verticillate in the whole of these plants, in this way. All botanists will admit that stipules are merely reduced or rudimentary, partially-developed leaves. In *Galiaceæ* we have plants with leaves in whorls, all equally developed, but in many cases with an undoubted tendency to reduction in part of the whorl. In *Cinchonaceæ* a certain number of the leaves of the whorl are invariably much more fully developed than the others, which assume the character of stipules, but do not appear in the form of ordinary stipules, as appendages to other leaves, but occupy independent positions around the stem like true leaves. If the argument had proceeded in this direction, we should probably have had less discussion upon a point which still remains to be satisfactorily cleared up*.

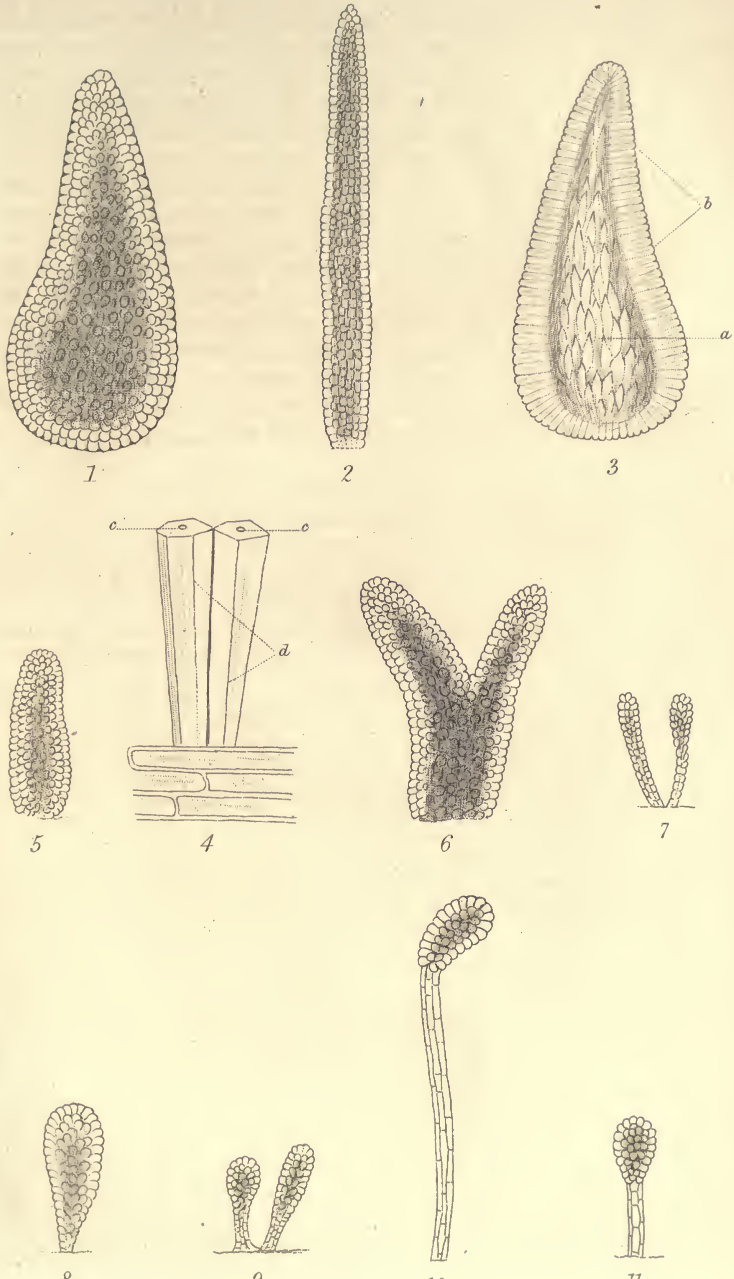
EXPLANATION OF PLATE IX.

Fig. 1. Stipular gland of *Cinchona Calisaya*. 70 diameters.
Fig. 2. Stipular gland of *Ixora coccinea*. 70 diameters.
Fig. 3. Vertical section of gland of *Cinchona Calisaya* (after Weddell), showing (*a*) central nucleus of compact tissue, and (*b*) outer layer of elongated cells.
Fig. 4. Diagramatic view of two of the cells of the outer layer of the gland (*C. Calisaya*), exhibiting the canals (*c, c*) at their apex, as shown by Weddell.
Fig. 5. Stipular gland of *Exostemma longiflora*. 70 diameters.
Fig. 6. Twin gland from stipule of *Luculia Pinceana*, formed by the adhesion of two glands throughout the greater part of their length. This is only of occasional (accidental) occurrence, the usual form of the gland being not unlike that of *Exostemma longiflora*, but of greater size. 70 diameters.
Fig. 7. Glands of *Galium saxatile*. 70 diameters.
Fig. 8. Gland of *Crucianella stylosa*. 70 diameters.
Fig. 9. Glands of *Galium cruciatum*. 70 diameters.
Fig. 10. Gland of *Galium urceolatum*. 70 diameters.
Fig. 11. Gland of *Asperula odorata*. 70 diameters.

XVIII.—*Miscellaneous Notes on the Fauna of Dacca, including remarks made on the line of march from Barrackpore to that Station.* By Capt. Robert C. Tytler, of the 38th Regiment Bengal Native Light Infantry.

I have already, in page 365, Ser. 2. vol. xiii. of this work, given my observations on the fauna of Barrackpore; I shall now add

* To Professor Balfour, Mr. M'Nab, and Mr. Evans, my best thanks are due, for the unlimited use of plants from the Royal Botanic and Experimental Gardens, for examination.



G. Lawson, del.

J. Basire, sc.

some further remarks, confining myself solely to the few notes made during a most tedious march of twenty days from Barrackpore to Dacca, in company with my regiment. The entire distance between the two stations is about 180 miles, through a country intersected by numerous streams and rivers; these we had to cross almost daily, besides encountering various other difficulties; I had therefore to work under every kind of disadvantage, and was perfectly unable to make any minute observations on the journey; however, as opportunities offered, I lost no time in making the following notes, which although brief and scanty, may not altogether prove uninteresting.

The road from Barrackpore to Dacca is seldom employed for troops, for it frequently occurs that portions of the country become entirely inundated for months together, consequently quite impassable to land carriage; Europeans are therefore not very familiar with this part of Bengal, notwithstanding its proximity to the capital of India.

To as far as the civil station of Jessore, or even as far as Furreedpore, there is no very remarkable difference in the country, although the aspect decidedly gradually assumes a change; but after crossing the magnificent broad river Puddur, the difference is most observable: jungles become more wide and dense, and the whole country bears a different feature, which continues to the city of Dacca; this latter is both a civil and military station. European travellers now feel for the first time since leaving Calcutta, that they are fairly in the wilds of Hindostan, surrounded by swamps and unhealthy jungles, infested by tigers and numerous other ferocious as well as venomous animals. The unhealthiness of this portion of Bengal is proverbial, owing to the numerous swamps, the quantity of rank vegetation, coupled with the natural damp and heat that prevail during several months of the year. *"See Dacca and die"* is not an uncommon native saying. The reader may now imagine the style of country in which the few following notes were made during a stay of about five months, when sickness made a change of climate absolutely necessary.

To as far as Jessore the fauna is similar to that already mentioned of Barrackpore, with very slight exceptions; the larger species of Raptores observed at the last station become more common, and frequently very abundant, and after leaving Jessore I obtained two specimens of *Pomatorhinus leucogaster*, *Timalia pilcata* and *Aquila nævia*. I was astonished at getting specimens of *Pomatorhinus leucogaster*, their known habitats being Deyradhoon, Nepaul, Assam, and Tenasserim. The *Cuculus striatus* has become a most common species; their note is heard constantly during the day, and not unfrequently at night: the *Cuculus varius* pair during April, for I had several opportunities of witnessing it; they are also exceedingly common.

When at Gunagutty enormous flights of the *Falcinellus igneus* flew over our camp; they are excellent eating and much sought after both by European and native sportsmen, and known to the former as the small Black Curlew. Owing to the numerous swamps the number of aquatic birds is surprising, and the country is perfectly dotted by the *Anastomus oscitans* and *Ciconia leucocephala*. I was fortunate in obtaining two eggs of this latter species, one of which is now in the museum of the Honourable East India Company, and the other in my own collection; they are larger than a hen's egg, and of a pure white colour. The *Plotus melanogaster* and *Graculus pygmæus* are plentiful; the former is the well-known Snake-bird of India; both these species are peculiar in their habits, and may be seen constantly seated for hours, apparently motionless, on trees or stakes in or near water, watching their prey; they are also in constant attendance on the nets of fishermen, perching themselves familiarly on the nets; here they sit in solitary silence, occasionally spreading out their wings to dry in the burning sun, placing themselves while so doing in most eccentric attitudes. I had a splendid specimen of *Anas pœcilorhyncha* shot and sent to me by a brother officer, who mentioned seeing numbers in the same jheel where he killed this bird. I also obtained a very curious *Tringa*, of what species I am at present uncertain; it may prove to be only an albinoid variety of *T. minuta*. The *Lanius superciliosus* (Ind. var.) is quite disappearing, and the *Lanius nigriceps* is very common. The *Megalaima asiatica* and *Sciurus palmarum* become scarce, nor did I see one of either after crossing the river Puddur; so scarce seems the common Palm Squirrel of India, that the natives of Dacca are almost ignorant of its existence.

I observed large flocks of the *Larus brunnicephalus* fly down the stream of the river Puddur, as also a flock of that elegant duck, *Anas caryophyllacea*: the *Acridotheres ginginianus* and *Sphenura striata* are not uncommon on the banks of the same river; the latter confining themselves to the grass and bush jungle in the neighbourhood. I had several opportunities of observing the actions of *Glareola orientalis*; they are not uncommon; about dusk numbers are seen actively engaged, like swallows, in search of insects, which they take on the wing, to which latter birds their movements bear a great similarity.

Amongst the Raptores the *Haliaëtus macei* are very common; they are not choice in their selection of food, for I have seen them eating carrion in company with vultures and other carrion birds. Whilst on the subject of Raptores, I shall relate a curious circumstance connected with the habits of *Milvus ater* and *Ha-*

liastur indus, which I observed whilst sitting out in a field with several others after sunset:—A solitary white ant or termite was observed to fly out of a small hole near us, and went almost perpendicularly into the air; another and another followed in quick succession, till at length myriads formed a stream of living insects. Notwithstanding the lateness of the evening, several crows (*Corvus splendens*) observed the insects, and commenced cawing and flying about, but were too timid to approach, owing to our proximity; suddenly not less than fifty common kites (*Milvus ater*) made their appearance, and in less than a few seconds afterwards at least two hundred of these birds congregated together and attacked the termites; the birds flew within 20 feet over our heads, and notwithstanding the number collected, so graceful and exquisite were their movements, that no confusion, striking of wings, or jostling of each other could be observed, the birds passing and clearing themselves with the greatest nicety: the insects were invariably seized with their claws and instantly devoured. During this singular spectacle a Brahminee Kite (*Haliastur indus*) joined the party; the motions and actions of this bird, though equally graceful, were considerably more rapid than the other kites which showed no symptoms of timidity, but continued their feast till almost every insect disappeared. The birds now separated and flew off in various directions, so that in a few minutes scarcely one was to be seen. Where they came from and how they congregated so rapidly appeared quite a mystery.

I obtained a perfectly-formed egg from a female *Eudynamis orientalis* shot near Jessore in April, at which station five young *Viverra zibetha* were brought to me during the same month, as the young of *Canis aureus*. They had been dug out of a hole in the side of a bank, and appear not uncommon in this neighbourhood or at Dacca, where several adult specimens were brought to me, as well as of a *Paradoxurus,* which I have every reason to believe is *P. musanga,* although the ascribed habitat of this latter species is the Indian Archipelago. Specimens of *Herpestes griseus* are occasionally obtained, but by no means common; the *Pteropus edwardsii, Megaderma lyra, Nycticejus castaneus, Cynopterus marginatus,* and *Taphozous longimanus* are very plentiful; the *Kirivoula pictus,* of which I obtained and saw but two specimens, is excessively rare at Dacca. This elegant Bat is found in thick jungle, and is only observed when disturbed, by suddenly flying out of its retreat and taking almost immediate shelter like a moth among the bushes; the prevailing colour of this species is a bright orange, marked with black on the wings; this orange colour fades after the death of the animal into a dirty yellowish tint.

I have already mentioned that the *Sciurus palmarum* is unknown at Dacca, but it is replaced by a fine species found in the jungles and by no means uncommon. The European residents as well as the natives appeared not to know of the existence of this animal, and were astonished at my bringing home several specimens; they were also found in mango topes and small orchards. This Squirrel is decidedly not *S. lokriah* of Hodgs., and appears to differ from *S. lokroides* of Hodgs., to which however it bears a strong resemblance and is closely allied. I would therefore, if the species is new, and I have every reason to believe it is, suggest for it the name of *S. blythii*, after my esteemed friend E. Blyth, Esq. The colour of this Squirrel is of a peculiar yellow-gray above; the whole of the under surface, as well as the inner side of the legs, are of a light gray; on the back the yellowish hue is most perceptible, sprinkled over with abundance of minute black marks; the whiskers are black; eyes full, brilliant and dark; the tail bushy and carried over the back; the inner part of the thighs is brownish; the entire length of the animal is 15 inches, of which the tail measures alone 7½. They are by no means timid, but after being once disturbed and alarmed, run and hide among the branches and are most difficult to obtain.

One of the most common species of Mammalia, and which cannot fail to attract the notice of the most unobservant, are the common tame Otters of the fishermen in this neighbourhood (*Lutra chinensis*); several are kept by each family for the express purpose of catching fish, and the nicety with which they train and educate these Otters is extraordinary. I have invariably found them fishing in small streams, branches of rivers, or swamps; the method adopted is as follows:—a boat is usually fastened to a stake a few yards from the bank, the sides of the boat seldom exceeding a few inches in height from the surface of the water; the Otters, usually two or three, jump overboard and swim about the neighbourhood of the boat, diving and catching fish; these they carry to the side of the boat and drop in; the sport continues for several hours, the fishermen in the meantime remaining on shore otherwise engaged. Another mode adopted for fishing with Otters is to train these animals to drive fish into nets placed for that purpose.

The large Bengal Tiger (*Felis tigris*) and the common Leopard (*Felis leopardus*) are by no means uncommon, both species frequently visiting the neighbourhood of cantonments sufficiently near to render their presence anything but agreeable to the inhabitants. Leopards have been shot within the boundaries of cantonments. I had a magnificent specimen of *Felis viverrinus* sent to me. This species appears very rare, few of the older residents being aware of its occurrence at Dacca; the party who brought it in persisted in believing it to be a variety of the common leopard, so large was this magnificent specimen in its dimensions.

Amongst the small Mammalia, the common House Rat requires further comparison; it is decidedly closely allied to *Mus indicus,* but of a considerably darker colour. This dark colour has also been remarked in specimens of *Mus indicus* received from southern India; but as the species found at Dacca seems to differ from both, to which, however, it is closely allied, I would suggest for it the name of *Mus daccaensis,* provided it is, as I have every reason to believe it to be, an undescribed species. The *Sorex murinus,* or common Musk Rat of Europeans, is very abundant, frequenting houses and other suitable localities.

When I arrived at Dacca, the number of *Megalaima lineata* about cantonments surprised me not a little; the call of this bird, which is a very abundant species, might be expressed thus: *kootur'r kootur'r kootur'r,* heard incessantly at intervals during the day. The *Megalaima asiatica* is not to be found, at least during the months I remained at Dacca. Several young of the former species were brought to me alive in the month of June; they live and thrive well in confinement, feeding freely on fruit, milk and bread, &c.; however, they are disagreeable pets, from the incessant noise they make. The *Centropus lathami* is also a common bird, found in bush jungle; the calls of this species vary, and are curious; one resembling the bark of the Bengal Fox (*Vulpes bengalensis*), whilst the other might be imitated thus: *clack, clack, clack, clack, clack, gouk, gouk, gouk, gouk, kurr, kurr, kurr, kurr, kurr, clack, clack,* &c. I was fortunate in obtaining the nest and egg of this bird during the month of June; the eggs are pure white, and very round in formation. The nest, which was composed of straw and grass, resembled a large ball supported on sticks, with a hole in the side for the bird to enter; the nest was well concealed, and with great difficulty discovered.

The *Leptoptilos argala* and *L. javanica* occasionally visit this neighbourhood. I was much interested in seeing in the possession of Major Graham, the executive officer, a specimen of a living *Leptoptilos,*—I should say *javanica,* but the bird was so young that I felt rather uncertain as to the exact species; from the scaly nature of the back feathers, it much resembled the latter species. I am aware that the young of *Leptoptilos argala* vary much in colour, judging from the young birds which visit Bengal; it is this, therefore, which causes me to hesitate about the young specimen alluded to. Major Graham found two young in the same nest, and not very far from Dacca; the nest was on a high tree.

There is a species of the genus *Caprimulgus* (*C. albonotatus*) common in cantonments; they fly about dusk, frequently sitting on the tops of houses, where they remain for hours calling in a most disagreeable manner; their note resembles *gouch, gouch, gouch,* varied occasionally by a hoarse sound resembling *bur'r'r'r'r gur'r'r'r'r,* &c. The *Corvus culminatus* is equally plentiful with the *Corvus splendens.* I may here mention that the *Iora typhia,* which is also common, assumes a much blacker appearance than those obtained at Barrackpore. The *Sphenura striata, Arundinax olivaceus,* and *Malacocercus earlei* are by no means uncommon; the latter are very plentiful, and found chiefly in bush and grass jungle. I also received good specimens of the following, comparatively speaking, common birds: *Halcyon gurial, H. syrnensis, Spizaëtus limnaëtus, Pontoaëtus ichthyaëtus, Bubo umbratus,* and *Ketupa ceylonensis;* the last two are fine large species, the first being easily recognized from the latter by its feathered feet, whereas the *Ketupa ceylonensis* has a naked yellow tarsus. The *Cuculus tenuirostris, Malacocercus bengalensis, Anthus richardi, Copsychus saularis, Tephrodornis pondicerianus,* as well as *Trichastoma abbotti,* are by no means uncommon; the latter species I had no conception was found in this part of Bengal, specimens having been received only from Arracan: that they breed at Dacca is beyond a doubt, for I obtained just-fledged young following the parent birds. The *Lanius nigriceps* is a very plentiful species, and the only examples I have seen at Dacca of this genus.

Several fine specimens of the *Hæmatornis cheela,* and one of *Aquila nævia,* have been brought to me; the former are constantly found near swampy ground, where specimens of the *Limosa ægocephala, Charadrius virginicus,* and *Casarca rutila* (the *Chuckwa-chuckwee* of the natives, and the Brahminee Duck of Europeans) are found. In the dense thick jungle, numbers of the *Zanclostomus tristis, Chrysomma sinense, Francolinus vulgaris,* and a local variety? of *Turnix ocellatus* are found; occasionally a few *Oriolus indicus, Tantalus leucocephalus,* and *Plotus melanogaster* visit the station. The *Brachypternus aurantius* I have not seen, but find it plentifully replaced by the *Micropternus phaioceps,* which is very abundant. The specimens of the *Tephrodornis pondicerianus* are whiter over the eye than the specimens I have received from elsewhere; this seems to be merely a local peculiarity. Numbers of *Acridotheres griseus* build in the old temples and houses about the sepoys' huts; this is rather curious, for at Mussoorie, in the Himalayas, they invariably select large trees for their nests. It is not unusual, during the hours of parade or drill in the morning, to see numbers of these birds feeding fearlessly near the soldiers. This reminds me of what I have frequently seen in the *Acridotheres tristis* and *Sturnopastor contra,* that they become so accustomed, from living in the neighbourhood of regimental target butts, as to allow the balls to pass over them whilst they have fearlessly fed between the targets and the soldiers practising. Before the commencement of the rainy season, a pair of *Nettapus coromandelianus* built their nest amongst the branches of a large Peepul tree (*Ficus religiosus*) in the very centre of cantonments; and what was most extraordinary, the tree was situated at a great distance from water.

The birds occasionally brought for sale to the markets of the city are very interesting: the *Palæornis schisticeps,* at all times a rare bird in the markets of Bengal, are to be had; the *Gallicrex cristatus* and *Porzana akool* may also be purchased;—the natives keep them in cages as pets. Captain Middleton sent me a cage full of *Nectarinia goalpariensis,* which had been caught in the neighbourhood; these exquisite little creatures I kept for a very long while, feeding them on water and sugar, bread and milk, occasionally varying their diet with honey; the males sing in captivity, and soon become familiar and confiding in their dispositions. Few *Nectarinia zeylonica* are found, but the *Nectarinia asiatica* are common; the latter breed amongst the bushes; two or three nests were brought to me.

In the long grass jungle for several days I observed a small bird, excessively wild in its habit and apparently strong on the wing, and very difficult to approach, flying about, a specimen of which I eventually obtained, and subsequently several others, a couple of which I sent to Edward Blyth, Esq., in Calcutta, and which I took the liberty of calling after myself, namely *Cisticola tytleri.* In Appendix 6. of his preface to the Catalogue of the Birds in the Museum of the Asiatic Society, Calcutta, page xxvii, in No. 1935, *Cisticola erythrocephala,* Mr. Blyth makes the following remark :—"Albinoid, young? from the vicinity of Dacca, presented by Captain Tytler, 38th B.N.I. (Qu. n. s. *C. tytleri,* nobis.)" I allude to this simply because I obtained several specimens, and feel perfectly satisfied that it is distinct from *Cisticola erythrocephala* (Jerdon, Blyth) from S. India; they were observed to be building prior to my leaving Dacca.

In the neighbourhood of cantonments several specimens of that curious animal, *Caprolagus hispidus,* were shot and sent to me; the formation of this species resembles more the appearance of a tail-less rat than a rabbit or hare. Many doubts arise in the opinion of sportsmen as to its being good for food; but of this fact there is not the slightest doubt, for its flesh is equal to that of any hare. The ears are particularly short, and the hair coarse and stiff. The other hares found at the station are *Lepus ruficaudatus,* which are common, and another hare closely allied to *Lepus nigricollis,* but distinctly different, a specimen of which I have already forwarded to E. Blyth, Esq., under the name of *Lepus tytleri,* as I have every reason to believe it is a new species; they are not uncommon at Dacca. The circumstance of my having been so unsettled since leaving Dacca has for the present prevented my giving a minute description of this animal, several specimens of which are in my collection, but I shall endeavour to do so as soon as possible.

Among other novelties obtained by me at this station I have to enumerate two decidedly new species of birds. The first is of the genus *Megalurus*?, for which I suggest the name of *Megalurus*? *verreauxii,* after the Messrs. Verreaux of Paris, a drawing of which I will endeavour to leave in the Museum of the India House prior to my departure for India, as well as of the other new birds described.

The next new species is of the genus *Sturnopastor,* closely allied to *Sturnopastor contra,* but apparently different, being in size slightly larger, and the black more spread over the entire plumage, giving the bird a darker appearance than the other species. At first I was induced to treat this bird as a mere cage variety; but after seeing three specimens, and each agreeing in every respect with the others, I cannot help supposing and believing it to be a new species; if so, I suggest for it the name of *Sturnopastor moorei,* after F. Moore, Esq., Assistant, Museum, East India House. The birds I saw came from the jungles about Midnapoore and elsewhere of Lower Bengal. The natives are not altogether unfamiliar with this bird: that it is not a mere local variety is proved from the size being larger, and the specimens coming from different localities.

Amongst the cage birds seen in the market, I remarked a curious specimen of the genus *Carpodacus,* evidently a mere cage variety of *C. erythrinus,* or the common Tootie of all India: the colour of this bird showed symptoms of being a partially albinoid variety. I will however, if necessary, on a future occasion remark more fully on this bird after making minute comparisons, for the owner asserted that it was a distinct bird from the Tootie, and a species well known about the foot of the Cherrapoonjie range of mountains.

Before proceeding further, I will give an account of a remarkable circumstance, and which appears difficult to account for:—A sepoy of my regiment keeps several large scorpions; these animals he has always been in the habit of collecting; whatever his secret is, I know not, but it is interesting, for he allows the scorpions to crawl over his hands, breast, and in fact all over him; they never attempt to sting; besides which he puts them on other people. I examined the stings minutely; the tip of each was perfect, and in no way rubbed or injured; the scorpions appeared healthy, and carried their tails in the usual position. The sepoy asserted that he possessed the juice of a bulbous root, which, when applied to a fresh-caught scorpion, prevents it for the future from stinging; he also mentioned that several of his family possess the same secret, but from the manner in which he evaded my questions respecting the bulbous root, I am inclined to doubt that portion of his assertion.

The domestic animals of Dacca are precisely similar to those found at Barrackpore, with the exception of one solitary animal worthy of attention, and which is called the Dacca Cow; they are highly prized by natives, and the breed is not known to many. All that I can gather respecting the history of this domesticated animal is, that it is a breed introduced years ago; but when, and from what locality, no one knows. The colour is invariably of a pure white, the tail long and bushy at the end; the animal is of a small size; eyes large, full and dark; skin round the eyes of a pinkish hue, the same colour prevails on the muzzle; they do not give any large quantity of milk, but are prized highly as a breed, by the natives of the higher class. The males are similar to the cow in appearance, both possessing little or no symptoms of a hump. It is very rarely that these cattle are permitted to leave the houses in which they are kept, nor are they ever seen grazing in the fields; that they are totally different from the cattle of the country is beyond a doubt, and I regret that I could gain no satisfactory information about them.

The jungles of Dacca abound with insects, nor have I seen a finer field for the naturalist than this part of Bengal presents; the unhealthiness of the place, however, precludes all pleasure from visiting it as a matter of choice. With these few brief observations I now conclude my observations on the fauna of Dacca, simply mentioning that on my return to Calcutta by water, *viâ* the Soonderbunds, I saw great numbers of *Blagrus leucogaster* and *Halcyon amauropterus*; both species were extremely abundant.

XIX.—*A Reply to some Statements of* Dr. Williams *on the controversy respecting the Branchial Currents in the Lamellibranchiata.* By Joshua Alder, Esq.

To the Editors of the Annals of Natural History.

Gentlemen,

I have read with much interest the series of papers "On the Mechanism of Aquatic Respiration in Invertebrate Animals," by Dr. Williams, which have appeared from time to time in your Journal. That on the Mollusca, however, published last month, contains some statements, which, as they are not founded on fact, and are likely to be injurious to the scientific reputation of a brother naturalist, I take the liberty of endeavouring to correct. I allude to the remarks on Mr. Hancock. Dr. Williams gives that gentleman due credit for most of his investigations into the mechanism of respiration in the Bivalves, but against that praise he sets off certain errors which he alleges Mr. Hancock has committed, as follows:—"By Mr. Hancock, representing one class of observers, it is maintained that the inhalent current is set in motion exclusively by the action of vibratile cilia seated on the lining membrane of the siphon itself. By Mr. Clark this explanation is denied. The former naturalist rests his theory upon the alleged demonstration of cilia on the *internal* surface of the inhalent siphon, the latter upon observation of the currents." "Mr. Hancock is undoubtedly in error in stating that the water entering this cavity is drawn in by cilia of the siphon. The microscope disproves completely the assertion that the internal lining membrane of the inhalent or extra-branchial siphon is the scene of ciliated epithelium." And concerning the exhalent current it is stated, "The uninterruptedness of this current was supposed by Mr. Hancock to be due to the action of *cilia* lining the interior of the siphon. The statement of this distinguished naturalist in this particular is indisputably erroneous. This siphon, like the in-current one, is *not* lined with vibratile epithelium." Again, we find it stated that "Mr. Hancock is inaccurate in affirming that *all* the water which enters this cavity travels *exclusively* along the inhalent or extra-branchial siphon, and never, under any circumstance, through either the ventral or pedal openings."

Mr. Hancock has made none of the statements here imputed to him. The only place where any of his opinions concerning these points are expressed is in a joint paper with myself, "On the Branchial Currents in *Pholas* and *Mya*," read at the British Association Meeting in 1851, and afterwards published in your Journal*. Certainly no such statements are there made: indeed the subject of cilia lining the siphons is not at all alluded to. Dr. Williams, however, speaks of Mr. Hancock's controversy with Mr. Clark, from which, and his not mentioning my name in connexion with it, I am led to infer that he attributes to Mr. Hancock a series of letters that I wrote in your Journal on the subject. These letters bear my signature, and for anything therein contained, I alone am responsible. Presuming that

* 2nd Ser. vol. viii. p. 370.

Dr. Williams has made this mistake, I may be permitted to say that he has not correctly stated the opinions there advocated. The letters arose from the denial by Mr. Clark of the correctness of a statement I made in a notice of *Kellia rubra*, that the anterior tubular fold in that species performed the office of an ingress siphon. The controversy arising out of it led to the expression of our different views on the theory of branchial and siphonal currents. I contended for the reception and discharge of these currents by separate apertures (or in separate portions of the cloak where two apertures do not exist), and that by the action of cilia; but not by the cilia lining the siphons *alone*, as will be evident from the following extracts. In the first letter my views are thus stated:—"The inhalent is always kept distinct from the exhalent current, and admitted by a separate aperture from that by which the latter is expelled. This seems to be necessary, as the currents, being caused by the motion of the *branchial cilia*, and not by the expansion and contraction of the walls of a cavity, are continuous in one direction*." In my second letter I add a note to this effect:—"The internal surface of these siphons is usually (perhaps always) covered with vibratile cilia, more minute than those of the branchiæ, but *acting in conjunction with them* in producing the currents. Mr. Cocks informs me that he can see the cilia in the anterior tube of *Kellia suborbicularis*, with a lens of $\frac{1}{4}$ inch focus†." These statements surely cannot be taken to imply that the currents are produced by the cilia lining the tubes *alone*; and where does Dr. Williams find Mr. Hancock's "alleged demonstration of cilia" on these organs? The existence of cilia lining the internal walls of the siphons had been previously noticed by Mr. Garner‡ and other authors; and notwithstanding the decided opinion now given by Dr. Williams against this view, I still believe that it is correct; but however this may be, the well-earned scientific reputation of Mr. Hancock cannot be brought in question by the result.

With respect to the apertures by which the water is admitted, I have stated, from the evidence of repeated observations (and in this Mr. Hancock's observations agree with my own), that the regular current for the supply of the branchiæ passes in by the branchial siphon, when it exists, and instances are adduced where, when a strong current was passing in by that siphon, no motion of the water was perceptible opposite the pedal opening. We have nowhere asserted, however, as stated by Dr. Williams, "that *all* the water travels *exclusively* along the inhalent siphon,

* Ann. Nat. Hist. 2nd Ser. vol. iii. p. 384.

† 2nd Ser. vol. iv. p. 51.

‡ Charlesworth's Mag. Nat. Hist. vol. iii. p. 298.

and never, *under any circumstance*, through the ventral or pedal opening." On the contrary, I admit the flowing in of water through all the apertures (not voluntarily closed) as a natural consequence of the opening of the valves*, which action the animal has of course frequent occasion to perform. I have stated, too, in recording my observations on *Turtonia minuta*, that "at first the water was observed to pass into the widely-open mantle of this little mollusk at *all parts of the base of the shell* †;" and that "in *Montacuta bidentata* the principal ingress current is decidedly anterior, though the water is admitted occasionally *through the whole length of the open mantle* ‡." The occasional expulsion through all the orifices is treated as an acknowledged fact throughout; the only reservation I make is that it must be considered an occasional action, unconnected with the regular branchial currents. Mr. Hancock has also distinctly stated in his paper on *Chamostrea* that, when the valves are suddenly closed and the siphons withdrawn, the contained water will escape by the pedal opening and the minute fourth opening, which is found in this and some other bivalves with closed mantles §. In our joint paper "On the Branchial Currents in *Pholas* and *Mya*," a description is given of the action of the currents, observed in an individual of *Mya arenaria, in situ*. This instance is adduced in illustration of the general law of the distinct and simultaneous action of separate currents through the siphons. The question of occasional action under different circumstances or in other families is not gone into, so that no such extreme opinion on this matter as Dr. Williams attributes to Mr. Hancock, can, by any fair construction of words, be deduced from it. Indeed the holding of such opinions we both distinctly deny. Concerning this joint paper I take the opportunity of stating that, Mr. Clark having brought forward the non-connexion of the branchial and anal chambers in *Pholas* as a proof that the currents could not pass in at one siphon and out at the other, I felt myself unable, from the want of sufficient skill in delicate anatomical investigations, to give a correct solution of the difficulty, though aware of the fact of communication from repeated observation of the currents. I therefore had recourse to the assistance of my friend Mr. Hancock. The result was the discovery of the communication existing through the minute network of the gills, which Dr. Williams rightly attributes to Mr. Hancock. He considers it very extraordinary, however, that Mr. Hancock should not have been aware of the discovery of the same fact by Dr. Sharpey, published ten years

* Ann. Nat. Hist. 2nd Ser. vol. iv. p. 49. † Vol. iv. p. 243.
‡ Vol. v. p. 211. § Vol. xi. p. 106.

before. The pointed manner in which this is put may suggest to some persons a doubt on the subject. But why should Dr. Williams express so much surprise in this instance, when he must know that Dr. Sharpey's discovery has been overlooked by every subsequent writer on the œconomy of the Lamellibranchiata up to the present time? Nay, there appears some reason to believe that Dr. Williams himself may have been amongst the number, for at the same Meeting of the British Association at which our paper, now acknowledged to contain the true theory of branchial action, was read, a paper by Dr. Williams on the same subject was also read, in which it is stated as the result of his researches, "That the branchial siphon acts in drawing in water into the chamber of the mantle by the dilating of the valves of the shell;" and "That a part of the water which is thus drawn into the branchial chamber *is swallowed, and eventually rejected by the fæcal orifice,* and that *the rest is expelled by the orifice in the mantle, and in part by the branchial orifice**." Had Dr. Williams been then aware of Dr. Sharpey's discovery of the passage of the water through the gills, he could scarcely have had recourse to the extraordinary idea that the water found its way into the anal chamber through the intestine. Curiously enough, it is announced in the same paper as another of the conclusions come to, "That in *Pholas the siphons are richly lined with vibratile cilia,* as well as the branchial plates."

There can be no doubt, now that the passage is pointed out, that Dr. Sharpey had got hold of the true explanation of the branchial currents, in examining the common Mussel, and that the right of priority must be assigned to him. That his discovery has remained so long unnoticed probably arises, partly from its being introduced under the head of 'Cilia,' where we should not expect to find new views on the structure and œconomy of the bivalve mollusks, and partly from the modest manner in which the facts are stated, without attention being drawn to the points where they differ from the accounts of other observers. For ourselves it may be necessary to say, that we had not seen the article by Dr. Sharpey, as in the library we consult for books not in our own, that of the Literary and Philosophical Society of Newcastle, the volume of the 'Cyclopædia of Anatomy,' containing the article 'Cilia,' was lost in 1848 (before we turned our attention to the subject) and has never been replaced. Had we known that it contained any original matter on the œconomy of the Bivalves, we should certainly have made a point of procuring a sight of it, as we have done since the appearance of Dr. Williams's remarks.

* Report Brit. Assoc. for 1851, p. 82.

My sole object in the present communication being to vindicate Mr. Hancock from the charges of error brought against him, which I trust I have now done satisfactorily, I shall leave the discussion of controverted points to some future opportunity.

I am, Gentlemen,
Your obedient servant,
JOSHUA ALDER.

Newcastle-upon-Tyne, 19th August 1854.

XX.—*On the Genus* Lycium. By JOHN MIERS, Esq., F.R.S., F.L.S. &c.

[Continued from p. 141.]

2. MESOCOPE. *Corolla infundibuliformis, limbi laciniis dimidium tubi superantibus, sed ejus longitudinem non excedentibus.*

A. GERONTOGEÆ.

* *Stamina lævia.* Sp. 39 ad 41.

39. *Lycium Barbarum*, Linn. ex parte, non aliorum; Dunal in DC. Prodr. xiii. 511, cum synonymiis variis ibi relatis.—In Persia Australi, Scinde et Afghanistan.—*v. s. in herb. Hook.* Abouschir (*Aucher Eloy*, n. 5037).—Dalechi, distr. Abouschir (*Kotschy*, n. 166).—Afghanistan (*Griffiths*, n. 670 et 672).—Scinde, Kurdigass (*Dr. Stocks*, n. 995).

This species was well distinguished by Linnæus, though confounded by other botanists and horticulturalists with *L. vulgare* and *L. Europæum*, from which it is marked by very peculiar characters. It is very spinose, with flexuose, knotty, crooked branches, its splitting bark being of a glaucous whitish or brownish hue; the nodes are large and very prominent, often woolly: the leaves, three to five in each axillary fascicle, are linear, obtuse, spathulate at base, diminishing into a short slender petiole; they are 5 to 10 lines long and 1 to $1\frac{1}{2}$ line broad; three to five flowers spring out of each fascicle; the peduncle is very slender, 5 lines long; the campanular and somewhat scarious calyx is very thin in texture, of a pale glaucous hue, is $1\frac{1}{2}$ line broad and long, at first with five short minute teeth, but they become irregularly cleft into one, two, or three longer fissures: the corolla is thin in texture, funnel-shaped, the tube, contracted a little above the base, being 3 lines long, and the five equal, smooth, oblong segments of its border being 2 lines in length: the stamens inserted below the middle of the tube are quite smooth, one being shorter, reaching the mouth, while the other four are a little longer and somewhat exserted; the immature berries are slightly obovate, apiculated at the summit, and barely 2 lines in diameter. No. 670, from Afghanistan, has a much paler and smoother bark. The specimen from Kurdigass appears to have grown luxuriantly in a moist situation, for the leaves are much larger, and frequently solitary in each axil, being 1½ inch long, and 3 to 5 lines broad*.

40. *Lycium Turcomanicum*, Turczan. MSS. *sp. adhuc indescripta*; —ramis virgatis, ramulis apice in spinis abeuntibus, axillis sæpe nodosis et ramulis spinescentibus aphyllis; foliis solitariis 2–3nisve, oblongis vel lanceolato-oblongis, glaberrimis, eveniis, imo cuneatis: floribus parvis, solitariis, interdum binis ternisve, brevissime pedunculatis, calyce late cupuliforme inæqualiter 5-dentato, dentibus acutis, sparse ciliatis, corollæ tubo striato imo valde contracto, superne late infundibuliformi, glabro, limbi laciniis 5, ovatis, tubo tertio brevioribus, margine subciliatis, staminibus 5, inæqualibus, exsertis, filamentis omnino glabris, medio tubi insertis, 3 paullo longioribus, laciniis limbi æquantibus.—Turcomania.—*v. s. in herb. Hook.* (*Turczaninow*).

A plant bearing greatly the aspect of the specimens of *L. Barbarum*, from Scinde and Afghanistan; differing in its more angular branches, the shorter peduncles of its flowers, and the proportions of its floral parts. The larger leaves measure 1½ inch in length, 5 lines in breadth; the peduncle is 1½ line long, the calyx 1 line long and broad, the tube of the corolla 2½ lines long, and the segments of its border 1 line in length†.

41. *Lycium Edgeworthii*, Dun. in DC. Prodr. xiii. 525;—intricatissimo-ramosum, spinosum, cortice cretaceo rimoso: cæt. ut in char. citat. except. in sequentibus; corolla extus glabra, sed intus circa insertionem staminum sæpe pilosiuscula, filamentis omnino glabris, circa medium tubi insertis, 2 minoribus faucem attingentibus, 3 longioribus exsertis.—Beloochistan.—*v. s. in herb. Hook.* (in montibus sursum Kelât, versus Johan.) *Dr. Stocks*, n. 1117.

This species is probably widely distributed through Scinde, Cabul, and Upper India: the habit of Dr. Stocks' plant is different from the specimen from the Punjaub, collected by Mr. Edgeworth, according to the description above quoted of M. Dunal: the former is very thorny, of bare and stunted growth, with

* Sectional details of this species are shown in the 'Illustr. South Amer. Plants,' vol. ii. plate 69 D.

† This plant with an analysis of its flower is represented (*loc. cit.*) plate 69 E.

twisted and interlaced branches and small leaves, and has evidently grown in an exposed and arid situation; while the latter has long, slender, virgate branches, and abundant foliage of much larger leaves, and was apparently produced in a damp and sheltered places, favourable to its more luxuriant growth. Dr. Stocks' specimens present more the aspect of *L. Barbarum*, but are distinguished by their much shorter peduncles, more fleshy leaves, and a generally more tartareous appearance; the very flexuose divaricating branches are covered with a splitting bark of a cretaceous hue, with fascicles of few leaves (three to six) proceeding out of the knotty base of the axillary spines: the leaves are linear, obtuse at the summit, tapering below into a short petiole; they are remarkably thick and fleshy, of a pale glaucous hue, 4 to 9 lines long and ½ line broad: one to five flowers grow out of each fascicle; the peduncle is 2 lines long; the pale glaucous, tubular calyx, often unequally cleft, is 1½ line long: the tube of the corolla, greatly contracted in its lower moiety and funnel-shaped above, is 3 lines long, the oblong segments of its border being 2 lines in length; it is quite smooth, excepting a little appearance of pubescence about the insertion of the stamens, which are unequal in length, the filaments being quite smooth, one not extending beyond the mouth of the tube, two of the length of the segments, and the other intermediate; the style is the length of the longer stamens. It will be seen how little this structure differs from *L. Barbarum*, and it might be almost considered as a mere variety of that species, from which it is easily distinguishable by the characters above enumerated*.

** *Staminibus imo hirsutis.*

42. *Lycium Ruthenicum*, Murray, Comm. Gött. 1779, p. 2. tab. 2; Willd. Sp. i. 1058; Dunal in DC. Prodr. xiii. 514, cum aliis synon. (excl. *L. Tataricum*).—In Siberia et Russia Australi.—*v. s. in herb. Hook.* (Mare Caspico) *ex herb. Acad. Petropol.*—(Iberia orientali) *W. Busen*;—*et in herb. Lindley, Hort. Chisw. cult. sub nom. L. carnosum.*

A plant completely with the habit of *L. Barbarum*, but differing in the structure of its flowers. The stems are smooth, very pale, flexuose, with spinose spreading branchlets; the axils are nodose; the leaves, two to four in each axillary fascicle, 8 to 15 lines long and 1 to 2½ lines broad, are quite smooth and fleshy: several flowers spring out of each fascicle; the peduncles are 2–2½ lines long, the calyx 1 line, the tube of the corolla 3 lines, the segments of the border 2 lines; the filaments are

* This plant with its floral analysis is drawn (*loc. cit.*) in plate 69 F.

inserted about the middle of the tube, and are hirsute towards the base, smooth above, reaching the extremities of the border-segments*.

*** *Staminibus imo fascicula pilorum barbatis.* Sp. 43 ad 47.

43. *Lycium vulgare*, Dunal in DC. Prodr. xiii. 509, cum omn. synon. ibi citat. Lycium Chinense, *Miller*, *Dunal in DC. ibidem*, 510, *cum suis respectivis synon.* Lycium megistocarpum, *Dunal, ibid. cum synon.* Lycium subglobosum, *Dunal, ibid.* Lycium Cochinchinense, *Lour.*; *Dunal ut supra citat*;—fruticosum, erectum, glabrum, inerme, vel sæpe sparse spinosum, ramulis angulatis, virgatis, arcuato-nutantibus; foliis subalternis, rarius fasciculatis, ovatis, vel ellipticis, apice subacutis, vel obtusis, imo cuneatis, vel in petiolum tenuem spathulatis, junioribus lanceolatis: floribus ex axillis solitariis, aut 2 ad 6, pedicello filiformi, flore longiori, calyce tubulari, breviter 5-dentato, sæpe in laciniis 2–3 rupto, glabro, textura tenui, dentibus margine subciliatis, corollæ tubo imo coarctato, mox infundibuliformi, limbi laciniis oblongis, striato-reticulatis, violaceis, expansis, tubo fere æquilongis; staminibus 5, fere æqualibus, exsertis, filamentis in tubi constrictionem insertis, hinc geniculatis et glabris, mox fascicula densa pilorum barbatis, superne glabris et filiformibus, apice laciniarum attingentibus: bacca rubro-aurantiaca, ovata, vel conico-oblonga, sæpe incurva, calyce fisso suffulta.—Ubique in Europa australi, Africa et Asia, præsertim in China.—*v. s. in herb. variis, specim. plurimis ex Europa. In herb. Hook.*, China (*Fortune*, 48 et 57). Loo-choo (*Beechey*).

On comparing original specimens from China with those of European growth and those of Western Asia, I cannot detect the smallest essential difference between them; and on examining carefully all the details registered concerning the various species above comprehended in this one, I cannot discover any character that can possibly separate them, except such small variations in the shape of the leaves as we frequently meet with in the same specimen: in the length and number of the peduncles, the form of the calyx, the structure of the corolla, and especially of the stamens, and in the size, shape, and colour of the fruit, they closely resemble one another: under such circumstances it appears to me desirable to unite them all under one common specific character. The observation of M. Dunal almost confirms this, for he states that this species has in all likelihood been introduced into Europe from the East, which is rendered more

* This species is shown (*loc. cit.*) plate 70 A.

probable from the record of its being used from the earliest periods by the Persians, Greeks, and Romans for ornamental hedgings. In favourable positions the leaves often attain a size of $2\frac{1}{2}$ inches in length, including the petiole, and $1\frac{1}{4}$ inch in breadth; the peduncles are 4 to 6 lines long, the calyx 2 lines, the tube of the corolla 3 lines, the segments of the border $2\frac{1}{2}$ lines, and the stamens extending beyond the mouth of the tube $2\frac{1}{2}$ lines; the berry is from 5 to 8 lines long and 4 lines broad. Intermediate with the globular fascicles upon the stamens, an equal number of tufts of hair are seen on the tube of the corolla, upon the central nervure that runs from the apex of each segment to the base; an excellent analysis of the flower is given in Nees' Flor. Germ. Several varieties, cultivated by gardeners under the names of *L. ovatum, Trewianum, carnosum, latifolium,* &c., may be referred here*.

44. *Lycium Kraussii,* Dun. in DC. Prodr. xiii. 517.—C.B.S.

Of this species I am unable to form an opinion, not having met with any specimen that corresponds with the description given, as above cited: M. Dunal appears to doubt its being a valid species, and asks whether it may be only a variety of *L. cinereum,* Thunb.

45. *Lycium rigidum,* Thunb. Prodr. 37; Linn. Trans. ix. 152, tab. 14; Dunal in DC. Prodr. xiii. 522.—C.B.S.

I have not met with any specimen that corresponds with this plant of Thunberg, although M. Dunal describes a specimen from the collection of M. Drège: I infer from that description that it must belong to this section. It is evident however that many Cape plants that have been referred to this species do not belong to it: for instance, the variety γ. *angustifolium* of M. Dunal (*loc. cit.* p. 523), from Drège's collection, *sub nom. L. rigidum,* and which I find also under this name in Sir. W. Hooker's herbarium, is manifestly a specimen of *L. Afrum*: so also from the same collection a plant distributed under the name of *L. campanulatum,* E. Mey., and referred by M. Dunal to *L. rigidum,* var. β. *latifolium-grandiflorum,* from the specimen in Sir W. Hooker's herbarium, is also *L. Afrum*: it is not unfair to conclude that the other variety, *a. latifolium-parviflorum,* belongs to some other species.

46. *Lycium Requieni,* Dunal in DC. Prodr. xiii. 520.—Patria ignota.

This plant, cultivated in the Botanic Garden of Montpelier

* This species with sectional details is given (*loc. cit.*) in plate 70 B.

under the name of *L. carnosum*, is probably of African origin. From M. Dunal's description I have placed it in this section.

47. *Lycium prunus spinosi*, Dunal in DC. Prodr. xiii. 515.—C.B.S. (*Drège*, n. 7871).

I have not seen a specimen of this species, but from M. Dunal's account of it I have stationed it here.

**** *Filamenta basi glandula lineari fimbriata donata.* Sp. 48 ad 49.

48. *Lycium Tataricum*, Pallas, Flor. Russ. i. 78. tab. 49. L. Ruthenicum, *Dunal* (*non Murr.*) *in Prodr. DC.* xiii. 514;—fruticosum, glaberrimum, intricato-spinosum, ramulis pallidis, flexuosis, nodis spinescentibus, approximatis; foliis plurimis (6-8) fasciculatis, linearibus, spathulatis, obtusis, carnosulis; floribus e fasciculis solitariis, rarius geminis, calyce pedunculo breviori, poculiformi, subscarioso, inæqualiter 3-4-fisso, laciniis rotundatis, corolla imo coarctata, superne infundibuliforme, limbi laciniis oblongis, tubo 2-3tio brevioribus, staminibus exsertis, filamentis imo in glandulam linearem margine ciliatam expansis.—Rossica australis.—*v. s. in herb. Hook. ex herb. Pallas.*

This is certainly very distinct in the structure of its flowers from *L. Ruthenicum*: the nodes are about $\frac{1}{4}$ inch apart, the spines of the same length, the leaves 3 to 5 lines long, and barely a line broad: the pedicels are 3 lines, the calyx $1\frac{1}{2}$ line, the tube of the corolla 3 lines, the segments of the border 2 lines long; the stamens, inserted in the lower portion of the tube, have a long basal expansion which is ciliated on the margin; the stamens are equal, and nearly attain the length of the segments*.

49. *Lycium ferocissimum* (n. sp.);—fruticosum, ramosissimum, glaberrimum, ramis griseo-pruinosis, ramulis horizontaliter divaricatis, validis, apice spinosis, spinis giganteis efformantibus, axillis globoso-nodosis; foliis e nodis fasciculatis, obovato- vel oblongo-spathulatis, obtusis, carnosulis; floribus e fasciculis solitariis vel binis, longe pedunculatis, calyce tubuloso, majusculo, carnoso, breviter 5-dentato, dentibus margine ciliatis, imo longiusculo, corollæ tubo infundibuliformi, imo angustato, calyce vix longiori, limbi laciniis 5, oblongis, reticulato-venosis, tubo fere æqualibus; staminibus in constrictionem tubi insertis, filamentis imo geniculatis et in glandulam linearem margine densissime tomentosam expansis, superne

* A representation of this plant with floral sections is shown (*loc. cit.*) in plate 70 C.

glabris, inæqualibus, 2 versus apicem, 3 ad medium limbi attingentibus; stylo staminibus majoribus æquante: bacca pisi magnitudine, calyce fisso suffulta.—C.B.S.—*v. s. in herb. Hook.* Uitenhag (*Harvey*, n. 105).

This is a species evidently allied to *L. rigidum*, Thunb., differing in its thick gigantic spines, its broader leaves, its much bigger calyx and larger flowers. The spines are from 2 to 2½ inches long; the leaves are 6–10 lines long, 2½–4 lines broad; the peduncle 4 lines long, the calyx 3 lines long and 2½ lines in diameter; the tube of the corolla is a trifle longer than the calyx, and the segments of the border about the same length; the berry is globular, 3 lines in diameter*.

B. Neogeæ.

* *Stamina lævia.*

50. *Lycium capillare* (n. sp.);—fruticulosum, inerme, ramulis virgatis, valde gracilibus, horizontaliter divaricatis, albo-pubescentibus, lineis helvolis e nodis utrinque decurrentibus angulato-striatis: foliis fasciculatis (5–8), e nodis cupularibus capillari-linearibus, minutissime pubescentibus, carnosulis; floribus solitariis, parvulis, pedunculo gracili, calyceque parvo, poculiformi, 5-striato, 5-dentato, subpubescente, dentibus glabris, acutis: corolla tubulosa, glabra, tubo profunde 5-sulcato, limbi laciniis 5 oblongis, margine ciliolatis tubo paullo brevioribus: staminibus æqualibus, exsertis, filamentis medio tubi insertis, glabris, ad medium limbi attingentibus: bacca pisi minoris magnitudine, rubra, calyce fisso suffulta.—In prov. Mendozæ Argentinorum, in desertis salitrosis.—*v. v.*

I found this plant in the Travesia of Mendoza, a desert plain near the foot of the Andes, and at La Dormida, in the same province. It is a very distinct species, not only on account of its extremely capillary leaves, but of its perfectly glabrous stamens. The leaves are about 4 lines long and ⅛th of a line broad; the capillary peduncle is 2 lines long, the calyx ¾ line, with teeth one-third of its whole length; the tube of the corolla is rather broad, is deeply sulcated opposite the stamens, and is 3 lines long, the lobes of the border being 2 lines in length; the thick, fleshy, smooth filaments are 2¼ lines long; the berry is somewhat ovate and apiculate, 2 lines long†.

** *Stamina imo hirsuta.* Sp. 50 ad 54.

51. *Lycium floribundum*, Dun. in DC. Prodr. xiii. 513.—In

* This species with analytical details is given (*loc. cit.*) in plate 70 D.

† This species with sectional details is drawn (*loc. cit.*) in plate 70 E.

prov. Mendozæ (ad Jarillal circa Mendozam) et in prov. Sanctæ Ludovicæ Argentinorum (ad Alto del Yeso) (*mihi lectum*); circa Mendozam (*Bacle in herb. Moricand*); Chile, *in herb. Lindley*; ad Coquimbo (*MacRae*).

The name of *floribundum* is ill applied to this very distinct species, for it is generally very sparse of flowers, although Bacle's specimen, like that collected by me at the Alto del Yeso, may have presented more flowers than usual. It is of very straggling growth, the tortuous branches spreading out at right angles: the spines are generally ¾ inch long, and slightly bent and recurved; they are all covered with a whitish pubescent bark, marked by reddish longitudinal lines, decurrent from the angles of each cup-shaped node: the spines have many gemmiferous axils; the leaves are fasciculate in each closely approximate node, are spathulately ovate, fleshy, covered with short, simple, and glandular hairs, mixed together, and proceeding out of as many whitish rugous spots; they are 2–2½ lines long, ¾–1 line broad; the flowers are solitary in each fascicle, ½ line long; the calyx is pubescent, tubular, 2 lines long, half-cleft into five rather equal, lanceolate acute teeth, which are somewhat recurved at their apex: the tube of the corolla is cylindrical, and slightly funnel-shaped above, but constricted a little above the base, is 2½ to 3 lines long, and is covered with short glandular hairs; the segments of the border are oblong, and 1¼ line long: the stamens are inserted about the middle of the tube; the filaments are hirsute at base, smooth above; the two shortest reach the middle, the three longer attain the extremity of the segments: the style is even longer: the corolla, as in other species of this genus, breaks off by a circumscissile line above its base, leaving the ovary half surrounded by a cup-shaped process. In the specimen from El Alto del Yeso, the spines are fertile to the extremity, the leafy fascicles being only 1 line apart: the berry is globular, apiculated, 1½ line diameter. The specimen from Coquimbo agrees in all respects with the others, except that the ramifications are more intricately branched and spinose; the bark is darker, more striated and pubescent, and the leaves are smaller; the axillary nodes, however, are equally approximate, and the flowers are exactly similar in size and structure*.

52. *Lycium rachidocladum*, Dun. in DC. Prodr. xiii. 519;—intricato-ramosum, spinosum, ramulis rufescente-roridis, glandulis glutinoso-resinosis et pilis articulatis vestitis, spinis junioribus acutis, gemmiferis, adultioribus tortuoso-ramiformibus: foliis parvis, obovatis, carnosis, apice rotundis, imo in

* A drawing of this plant with floral sections is given (*loc. cit.*) in plate 70 F.

petiolum tenuem spathulatis, utrinque viscoso-puberulis, pilis crebris, brevissimis, crassiusculis, glanduliformibus; floribus subsolitariis, breviter pedunculatis, calyce inæqualiter 4- rarius 5-fido, segmentis acutis, subreflexis, utrinque glanduloso-pubescentibus; corollæ tubo extus glandulis brevibus farinoso-puberulis, calyce 2plo longiore, infundibuliforme, limbi laciniis 5, oblongis, margine ciliatis, tubo brevioribus: staminibus 5 inæqualibus, 3 longioribus laciniis æquilongis exsertis, filamentis tenuibus, medio tubi insertis, imo geniculatis et longe hirsutis, superne glabris: stylo exserto, cum ovario articulato; ovario corollæ reliquo semi-vestito.—Chile.—*v. s. in herb. Lindley* (Coquimbo) *MacRae.*

This species differs little from *L. floribundum*, Dun., but its branches are more intricately spreading and spinose, the bark is darker and more farinose, the leaves are smaller and more oblong; on the other hand, their axillary nodes are equally approximated, and there is no difference in the size or structure of the flower. The leaves are 1½ to 2 lines long, ¾ line broad; the barren spines are 2 to 3 lines, the gemmiferous 4 to 6 lines or longer; the peduncle ¾ line; the calyx 1½ line long, cleft nearly halfway into five very acute teeth; the tube of the corolla is 2 lines, and its segments 1½ line long; it is glabrous, except near the point of insertion of the stamens: the filaments are pilose at their base for a quarter of their length, three of them reach the extremity of the segments, two are shorter; the slender style is the length of the longer stamens, and is articulated with the ovarium*.

53. *Lycium tenuispinosum* (n. sp.);—fruticosum, intricato-ramosum, ramulis helvolis, viscoso-puberulis, valde divaricatis, tenuiter et crebre spinosissimis: foliis minutis, fasciculatis, anguste linearibus, viscoso-puberulis; floribus e fasciculis solitariis, calyce tubuloso, pilis articulatis crebre pubescente, ultra medium 5-fido, segmentis lanceolatis, subreflexis, pedunculo gracili æquilongo; corolla tubulosa, tubo calyce æquante, parte infimo cylindrico, attenuato, pilosulo, superiori inflato, glabro, limbi laciniis tubo brevioribus, oblongis, staminibus exsertis, filamentis supra medium insertis, hinc geniculatis et hirsutis, 2 ultra faucem prolatis, 3 fere ad apicem laciniarum extensis. —Circa Mendozam in aridis petrosis.—*v. v.*

This species, which I found near Mendoza, in the desert tract called La Travesia, in many points resembles *L. floribundum* and *rachidocladum*, but is widely distinct. It is remarkable for its almost denuded, slender, spreading branchlets, armed with short, closely-set, neeedle-like spines; they are generally 2 or 3 lines

* This species with analytical details is shown (*loc. cit.*) in plate 71 A.

long and 1 or 2 lines apart, furnished at their base with a fascicle of four to six minute linear subulate leaves, barely $\frac{3}{4}$ line long; a few of the fascicles bear a single flower, the peduncle of which is $1\frac{1}{2}$ line long; the calyx is $2\frac{1}{2}$ lines long; the tube of the corolla measures $2\frac{1}{2}$ lines, and the segments of the border $1\frac{1}{4}$ line in length; the stamens are inserted above the middle of the tube, where it is pubescent, they are considerably hirsute at their lower part, and smooth above; the hairs that clothe the pedicel and calyx are dense and articulated; the style exceeds the length of the stamens*.

54. *Lycium stolidum* (n. sp.);—fruticosum, glaberrimum, ramis flexuosis, ramulis intricato-divaricatis, spinescentibus, cortice rimoso, striato, griseo, nodis approximatis, spinis brevibus imo foliosis; foliis (2–5) fasciculatis, spathulato-linearibus, obtusis, carnosulis, pallidis; floribus e fasciculis binis, parvulis, pedunculo tenui, calyce parvo æqualiter ac breviter 4-dentato, corolla lævi, pallida, textura tenui, tubo imo coarctato, superne subcampanulato, limbi laciniis 4, tubo vix dimidio longitudine, oblongis, acutiusculis, reflexis; staminibus 4, æqualibus, longe exsertis, filamentis in contractionem basalem insertis, hinc geniculatis et hirsutis, superne glabris, apice limbi attingentibus, stylo æquilongis, tubo circa insertionem filamentorum piloso; bacca globosa, piso minori, apiculata, calyce suffulta.—Texas.—*v. s. in herb. Hook.* Paso del Norte (*Wright*, no. 540, 542).

A plant not unlike *L. Barbarum* in habit. Owing to the close approximation of the nodes, which are only $\frac{1}{4}$ inch apart, the leaves are somewhat crowded; they are 5 to 7 lines long, 1 line broad; the slender peduncle measures $2\frac{1}{2}$ lines, and the narrow calyx 1 line; the tube of the corolla is $2\frac{1}{2}$ lines long, and the reflexed broad segments of the border are 1 line in length; it is thin in texture and pale when dried; the filaments are inserted above the basal contraction of the tube, are hirsute below, slender and smooth above, and attain the length of the segments of the border: the berries are small, apparently red, 2 lines in diameter, and contain eight seeds, which are flattened; these have a helically spiral embryo†.

*** *Filamenta paullo supra basin fasciculo pilorum donata.* Sp. 55 ad 58.

55. *Lycium spinulosum* (n. sp.);—virgato-ramosum, ramulis helvolis, striatis, pilosis, patentibus, tenuiter spinosis, inferioribus

* A representation of this plant, with analysis of its flowers, is given (*loc. cit.*) in plate 71 B.

† This species with floral sections is drawn (*loc. cit.*) in plate 71 C.

subnudis, superioribus foliiferis, axillis nodosis approximatis, spinis acicularibus, gemmiferis; foliis fasciculatis (2–5) oblongis, apice acutis, basi in petiolum brevissimum cuneatis, valde crassis, utrinque pilosis, pilis brevibus articulatis, nonnullis apice glandulosis; floribus solitariis, pedunculo brevi, calyce majusculo, glanduloso-piloso, pedunculo 3plo longiore, tubuloso, ultra medium 5-fido, segmentis rigidis, lanceolatis, acutissimis; corolla glabra, tubo infundibuliformi calyce æquilongo, limbi laciniis fere dimidio brevioribus, oblongis; staminibus 5, longe exsertis, filamentis medio tubi insertis, hinc geniculatis et glabris, mox infra faucem fasciculo pilorum barbatis, et ore claudentibus, 2 longioribus apice limbi attingentibus, 3 paullulo brevioribus.—Circa Mendozam.—*v. v.**

This plant, gathered by me in the Travesia of Mendoza, in the year 1826, is certainly a distinct species: it bears greatly the habit of *L. tenuispinosum*, but its branches are straighter, the spines stronger, the leaves larger, the calyx of much greater size and more rigid in its texture, and the stamens are of different structure. It is at once distinguished by its peculiar calyx. The spines measure 2 lines, the leaves, including the petioles, are 3 lines long and 1 line broad; the peduncle is 1 line; the calyx 3 lines in length, the tubular portion being only $\frac{3}{4}$ line; the tube of the corolla measures 3 lines, the segments of the border 2 lines.

Var. β. parvifolium, Gill. MSS., is a more intricately nodose plant, becoming with age more glabrous; the leaves are more linear, smaller, $2\frac{1}{2}$ to 3 lines long, $\frac{1}{4}$ line broad: the flowers do not differ from the former in size or structure; it was found by Dr. Gillies in the Travesia, and is preserved in Sir Wm. Hooker's herbarium.

56. *Lycium infaustum* (n. sp.);—intricato-ramosum, spinosum, glaberrimum, ramulis pallidis, angulato-costatis; foliis paucis, minutis, alternis vel fasciculatis, obovatis, vel spathulato-oblongis, carnosulis, pallidis; floribus solitariis, glabris, longe et gracile pedunculatis, calyce parvulo, urceolato, crasso, breviter 5-dentato, dentibus triangularibus, acutis; corolla infundibuliformi, limbi laciniis ovatis, tubo brevioribus, staminibus 5 æqualibus, longe exsertis, filamentis medio tubi insertis, imo glabris et geniculatis, mox fasciculo pilorum barbatis et faucem claudentibus, superne filiformibus, glabris, apice limbi paullo excedentibus, tubo globulis 5 pilorum inter fasciculos staminum alternantibus; bacca globosa, coccinea, piso minori.

* A representation of this plant with analysis is given (*loc. cit.*) in plate 71 D.

—In Prov. Argentinorum Australioribus.—*v. s. in herb. Hook.* (*Tweedie.*)

This plant was found by Tweedie in the southern portion of the province of Buenos Ayres, always called by him Patagonia. It is remarkable for its small ericoid leaves, which are 1½ to 2½ lines long and 1 to 2 lines broad: the peduncle measures 2 lines, the calyx 1 line, the tube of the corolla 3 lines, the segments of its border 2 lines, all being quite smooth except the five barbate tufts that alternate with the hairy pellets of the stamens*.

57. *Lycium Martii*, Sendtn. Flor. Bras. fasc. 6. Sol. 154; Dunal in DC. Prodr. xiii. 512.—Brasilia (in Prov. Bahia) ad fluv. S. Francisco prope Joazeiro.

58. *Lycium Carolinianum*, Mich. Fl. Bor. Amer. i. 95; Walt. Fl. Carol. 84; Pursh, Fl. Amer. Sept. i. 97; Dunal in DC. Prodr. xiii. 513. L. salsum, *Bartr. Trav.* 59. *nec R. & P.* L. quadrifidum, *Moç. et Sessè, Ic. Mex. Coll. Cand.* t. 914. Panzera Caroliniana, *Gmel. Syst.* i. 247;—fruticosum, inerme, glaberrimum, ramulis rectis, striatis, rarius spinosis; foliis alternis, rarius fasciculatis, spathulato-lanceolatis vel linearibus, acutis aut obtusiusculis, crassis, eveniis; floribus solitariis, folio brevioribus, tetrameris, pedunculo elongato, calyce campanulato, grosse 4-dentato, corolla cærulescente, tubo infundibuliformi, imo crassiore, supra basin constricto, limbi laciniis tubo brevioribus, staminibus 4 subæqualibus, exsertis, filamentis longe subtus medium tubi insertis, imo geniculatis et fascicula oblonga pilorum dense barbatis: bacca cerasi parvi magnitudine, rubra.—America Septentrionali.—*v. s. in herb. Hook.* (Galveston Bay, Tenessee) *Drummond.* (Rio Brazos, Texas) *Drummond.* (New Orleans) *Drummond,* n. 234. (Circa Laredo) *Berlandier* (n. 1502 et 242). *In herb. Lindley* (Texas) *Drummond.*

This well-known species, long since established upon very distinct characters, appears to differ in no essential respect from the plant described by Moçino and Sessè, and which may safely be considered as identical with it, especially as I find the description of its fruit corresponds with the specimen above noticed from New Orleans. The leaves are generally single and alternate, from 7 to 18 lines long and 1½ to 2½ lines broad, narrowing at the base into a short channelled petiole: the peduncle is slender below, thicker at its apex, and is from 5 to 8 lines long; the cup-shaped calyx is nearly 2 lines in length, with four short

* This plant with floral details is shown (*loc. cit.*) in plate 71 E.

triangular teeth, ciliated at their points, but it is afterwards split irregularly into larger segments: the tube of the corolla is 3 lines long, the oblong segments of its border 2½ lines; the filaments arise in the mouth of the basal constriction of the tube, and present a dense oblong brush of hairs at their geniculated origin, their summits attaining the length of the middle of the segments, two of them being a trifle shorter; the style far exceeds the length of the stamens: the crimson globular or oval berry is somewhat apiculated, and 5 lines in diameter*.

**** *Filamenta imo glandula lineari carnosa margine ciliata donata.* Sp. unica.

59. *Lycium ignarum* (n. sp.);—fruticosum, ramulis longe virgatis, dependentibus, angulato-striatis, pallidis, rarissime spinescentibus, nodis axillaribus cupulatis; foliis alternis ternisve, elliptico-oblongis, utrinque subattenuatis, subpallidis, textura tenuibus, nervosis, utrinque sub lente albo-punctulatis, margine obsolete ciliatis, breviter petiolatis; floribus solitariis, longe et gracilente pedunculatis, calyce urceolato, striato, membranaceo, pubescente, æqualiter 5-dentato, dentibus lanceolatis, acutis, tubo dimidio brevioribus; corolla extus pubescente, imo densiter tomentosa, sicco pallida, tubo infundibuliformi, calyce duplo longiore, limbi laciniis 5, reticulato-nervosis, staminibus 5 æqualibus, exsertis, filamentis circa basin tubi insertis, hinc geniculatis et glandula adnata oblonga latiuscula margine ciliata donatis, superne membranaceis, gradatim angustioribus, vix apicem laciniarum attingentibus; stylo staminibus æquilongo; stigmate sub-2-labiato.—Patria ignota: an America meridionali?—*v. s. in herb. Lindley* in hort. Soc. Hortic. cult. sub nomine *L. Sinense.*

This plant has much of the habit of *L. erosum,* and from many peculiar points of analogy, I have little doubt is of South American origin. The leaves are 19 lines long and 7 lines broad, the peduncle of the flower 4½ lines, the calyx 2 lines, the teeth being equal in length to the tube, the corolla 6 lines, the tube being 3 lines long, and the segments of the border the same length†.

* A representation of this species with structural details is given (*loc. cit.*) in plate 71 F.

† This plant with analytical sections of the flower is shown (*loc. cit.*) in plate 72 A.

[To be continued.]

XXI.—*Rejoinder to Professor Milne-Edwards and Mr. Bowerbank.* By Professor Sedgwick.

To the Editors of the Annals of Natural History.

Gentlemen,

On my return to the University, after an absence of almost three months, I found that Professor Milne-Edwards and Mr. Bowerbank had replied to my comment on "two statements published by the Palæontographical Society in their volume for 1852*." I now request you to publish my final, and short, rejoinder, both to Professor Milne-Edwards and to my friend Mr. Bowerbank.

I have the honour to be,
Gentlemen,
Your faithful Servant,
A. Sedgwick.

Cambridge, August 21, 1854.

Rejoinder, &c.

So far as regards Professor Milne-Edwards, I have only to request any Member of the Palæontographical Society carefully to read over Professor M'Coy's letter to myself, and then to put it side by side with Professor Milne-Edwards's reply. That *reply* does not so much as *touch* the facts and statements of Professor M'Coy's clenching letter. The reader must, therefore, conclude, that Professor Edwards can neither prove, nor make probable, the charges he has insinuated against Professor M'Coy, and consequently that the insinuations recoil upon their author. Under this entire conviction, I venture to call upon the Council of the Palæontographical Society, as a matter of common literary justice, to disclaim the charges insinuated against Professor M'Coy in the 151st page of their volume for 1852.

My rejoinder to my friend Mr. Bowerbank need not be very long. On one point (and one point only) he has the advantage over me. He alludes to a "short" conversation he held with me, during a public meeting at Ipswich (in 1850), when he made a request for a loan of certain Cambridge corals. Of that request I have no remembrance; and, considering the occasion

* My comment (containing a letter from Prof. M'Coy) was published in the 'Annals' for April 1854. The Replies of Professor Edwards and Mr. Bowerbank were published in the 'Annals' for May and June 1854.

when it was made, I may surely be excused for a little lack of memory.

All the statements of my former communication (of April last) stand good and are unshaken. MM. Edwards and Haime visited Cambridge (about the end of the year 1849) and made arrangements with Professor M'Coy for procuring figures of certain Oolitic corals, with a view to their publication in the essay on "British Oolitic Corals," which appeared in 1851. These arrangements were given up, without any further communication from them on the subject, either to Professor M'Coy or myself. Some time afterwards (early in 1850) an application was made by Mr. Bowerbank (in behalf of the Palæontographical Society) for a loan of certain Oolitic corals in the Cambridge Museum, in order that they might be figured at Paris. This request could not be complied with, for reasons given in my "Reply," &c., which was published in the 'Annals' of April last. I can state most positively that Mr. Bowerbank's application (made by letter) did not include so much as one Palæozoic species: but along with it was a formal list (at this moment preserved among the papers of the Woodwardian Museum) of the specimens wanted—all of which were Oolitic.

When, therefore, my friend Mr. Bowerbank laughs at my lack of memory while I was in the pains of a parturient speech; I can, with like good humour, retort upon him with interest, and convict him also of an occasional fit of obliviousness. For in a letter I have before me, he asserts that, on behalf of the Palæontographical Society, "he never wrote to me but once, and that once was regarding the Palæozoic fossils." Now, if he ever wrote about the Palæozoic fossils he must (at the least) have written *twice*; for he *once* assuredly wrote, very specifically and formally, about the Oolitic fossils and about them only.

In his Reply he gives a list of those to whom he *did write* on the subject of Palæozoic fossils, to be published by the Palæontographical Society in 1852. And he appears to have no doubt that he also wrote to me on the same subject. I affirm, on the contrary, that I *never received* from him any letter on this subject. And (if I mistake not), I can, out of his own letters, give him a convincing reason why he did *not* write to me. For he tells me (in a letter I have before me), that my verbal reply at Ipswich (in 1850) was considered by him "as equivalent to a refusal;" and that the subject could not be introduced to me *afterwards* "without the appearance of importunity." Having in 1850 been refused the loan of the Oolitic corals, he quite naturally abstained, on the year following, from making any application to me for the Cambridge Palæozoic corals.

I should be indeed foolish were I to boast of a memory which has often failed me, or done me but a slippery service. But in what I have stated above, I do not lean upon my memory. On the contrary, I rest only upon documents which admit of no contradiction.

Not to dwell any longer upon blunders and slips of memory, I again affirm, as I did in my communication of April last, that had MM. Edwards and Haime, in their great essay on British Oolitic Corals (published in 1851), charged the University of Cambridge with unwonted illiberality, because the Oolitic corals of our Museum had not been sent to Paris, their charge would, *in letter*, have been true; although (after what took place during their visit to Cambridge) it would, I think, *in spirit* have been both uncourteous and unjust. But they let that occasion slip; and when their charge at length appeared (in 1852), in their essay on the British Palæozoic Corals, it came in such a form as not merely to be wanting in courtesy, but to be incompatible with common historical truth: for, most assuredly, no application had been made to Cambridge for a loan of a single Palæozoic coral.

XXII.—*Notice of a new species of* Caulerpa. By R. K. Greville, LL.D. &c.*

[With a Plate.]

The Alga which forms the subject of the present notice was communicated to me for determination along with several others, by my friend Professor Balfour; and was collected in Bass's Straits, Australia, by Mr. James E. Cox.

Singularly variable in external conformation as are the species of this fine and most natural genus, presenting no fewer than six or seven well-defined groups, it will be at once perceived that the present one differs entirely from them all. In general habit it stands alone; and upon a closer view may be said to unite those which possess a dendroid character with others which have a more simple, plane, and pinnate or pinnatifid frond.

The prostrate stem is robust, branched, 12 inches or more, probably, in length, rough with linear simple or forked processes (abortive ramuli), and altogether strongly resembling the creeping stem of a *Lycopodium*. The fronds are erect, arising singly, or often two together, 4 to 7 inches high, of an ovate-oblong outline, and bushy like some species of *Bryopsis*. The numerous ramuli are given off on all sides, an inch or more

* Read before the Botanical Society of Edinburgh, July 13, 1854.

long, spreading, pectinato-pinnate, compressed; the pinnæ very narrow, linear and acute. When magnified, the apices of the pinnæ are found to be frequently minutely forked in a divaricate manner, like some *Cladoniæ*. The lower part of the stalk of each frond is naked for about half an inch, and covered with linear scales or processes, like those of the creeping stem.

I propose the following name and character for this very beautiful Alga:—

Caulerpa superba, frondibus ovato-oblongis, ramulis numerosis pectinato-pinnatis undique obsitis.

EXPLANATION OF PLATE X.

Fig. 1. A frond of *Caulerpa superba*, natural size.
Fig. 2. A portion of a pinna.
Fig. 3. Apices of ditto, magnified.

BIBLIOGRAPHICAL NOTICES.

Geodephaga Britannica. By J. F. Dawson. London: J. Van Voorst, 1854.

To investigate a new country, and to draw conclusions from facts and objects, concerning the *novelty* of which (as contrasted with what we ordinarily experience) there can be no question, however interesting and important may be the results arrived at, is a comparatively easy undertaking; but, to search for information along the beaten highways of science, to aspire to advance knowledge in paths which have been explored by others, and to gain additional points of light by destroying the error which has been permitted gradually to accumulate, is a laborious task which no one can accept without becoming a public benefactor in his particular line. And hence it is that we hail the appearance, more especially, of those works the professed aim of which is to simplify rather than to discover,—believing that the greatest boon which can be conferred upon any given subject is to separate the true from the false, and so to pave the way for the advance of the former, and, as a necessary consequence, the annihilation of the latter. Such has been the primary object of the author of the publication now before us; and therefore, whatever may be its intrinsic merits, we must plead guilty to a certain *à priori* prejudice in its favour.

But, if we turn to the pages of this Monograph, and compare the results arrived at with those of the standard works which have gone before it, we shall perceive that it has not been taken in hand wantonly; but that it is the fruit of much close observation and practical research, and that it may in fact be looked upon as the most successful attempt which has been hitherto made to clear up the difficulties of nomenclature, and the confusion which has arisen as regards the species themselves, in so large a section of the British Coleoptera.

R.K. Greville. delt. J. De C. Sowerby sct.

Having applied himself for many years past, almost exclusively, to the study of our native *Geodephaga*, it is not surprising that Mr. Dawson should have found himself compelled, not only to create many changes in the general classification (so as to embody, as far as seemed desirable, the more recent views of the continental entomologists), but also to sweep away a vast number of "species" (so called) which had been proposed at a time when differences were less philosophically inquired into than now, and when almost every modification which savoured in any degree of permanency was at once considered as *specific*.

Regarding the *arrangement* put forth, it appears to be that which is now universally acknowledged throughout Europe, and which was first adopted in this country by Mr. Westwood,—from whose invaluable 'Introduction to the Modern Classification of Insects' the characters have been mainly borrowed. Mr. Dawson has however transposed the third and fourth subfamilies of Mr. Westwood (in accordance with the system at present received), by which means the *Trechi* (of the *Harpalides*) are brought into direct contact with the *Bembidiades*,—a step which is certainly desirable, on account of the gradual manner in which these groups merge into each other both in structure and habits.

The *genera* also have been treated according to the law which the implicit followers of Erichson invariably endorse; by which means a large array of names which have been long familiar to the ears of British naturalists have been entirely cancelled. Thus, for instance, the *Anchomeni* are made to embrace *Platynus, Anchomenus* proper and *Agonum*; *Pterostichus* includes *Pœcilus, Abax, Pterostichus* proper, *Platysma, Adelosia, Steropus, Omaseus, Argutor* and *Platyderus*; and the *Bembidia* are composed out of *Cillenum, Tachys, Ocys, Philocthus, Peryphus, Notaphus, Leja, Lopha, Bembidium* proper and *Tachypus*,—as formerly understood.

There can be no doubt whatever that the major part of these amalgamations have become, in the advanced state of the science, absolutely necessary,—the numerous species which have been brought to light since the days of Bonelli, Megerle, Ziegler, and Leach having so far supplied connecting links between groups once apparently isolated, as to render it impossible that the latter should be any longer upheld. Yet we may question whether Mr. Dawson has not carried this principle somewhat too far; and, whilst endeavouring to simplify, whether he has not rejected more than (especially *in a local fauna*) is altogether desirable. In the details of their oral organs the *whole* of the *Carabidæ* display so great a similarity *inter se*, or rather shade-off into each other by such imperceptible gradations between their extremes, that the *tendency* which various clusters of them possess to assume modifications of form which attain their maximum only in successive centres of radiation, must oftentimes be regarded as *generic*, if we would not lose sight altogether of the natural collective masses into which the numerous species (however gradually) do unquestionably distribute themselves. It is possible indeed that, as our knowledge advances and new discoveries take place, we shall so far unite many of the consecutive nuclei which are *now* considered well defined, that we shall be driven at last *either* to accept the Linnæan genera only, or else the whole host of subsidiary ones (albeit perhaps in a secondary sense) which are, one by one, being expunged. And, since under the former contingency the *determination of species* would become practically well nigh impossible, it is far from unlikely that we shall eventually hail the latter as after all (at any rate to a certain extent) the more convenient of the two. The naturalist who looks upon *harsh* lines of demarcation as *alone* generic would perhaps be doomed to disappointment, were he able to glance into the future some hundred years hence and survey the innumerable links (unthought of now) which science will in all probability have then revealed. Every year indeed is proving more and more that in nature *such do not in reality exist*; and if this should be the case, it is clear that our definition of genera must, sooner or later, be altogether remodelled; and that (if they are to be accepted at all,—and it is difficult to conceive, under our present system of nomenclature, how we are to do without them) we shall have to content ourselves eventually in regarding them as the emanations (within given areas) from centres of radiation, rather than as uniform and isolated types.

In his elimination of "species," Mr. Dawson has certainly done a public service; for it has long been evident to the working coleopterists of this country, that a very extensive weeding was indispensable before even an approximate idea of our Geodephagous fauna could be arrived at. As a proof of the wholesale destruction which he has committed, it will be enough to mention that, whilst in Mr. Stephens's list the section which he has monographed numbered 449 species (supposed to be truly indigenous), *he* has catalogued but 290! And yet, in spite of this extraordinary falling-off, many *bonâ fide* novelties are introduced with which Mr. Stephens was not acquainted,—and which are, in fact, for the first time recorded as British. Such, for instance, are *Harpalus sulphuripes*, Germ. (discovered by Mr. Jacques near Bristol); *H. melancholicus*, Dej. (captured by Mr. Wollaston on the sandy coasts of Swansea and Tenby, in South Wales); *Stenolophus elegans*, Dej. (detected by the Rev. Hamlet Clark in the Isle of Sheppey); *Bembidium fluviatile*, Dej. (taken by Mr. Hadfield on the banks of the Trent, near Newark); *B. Stomoides*, Dej. (found by Mr. Bold along the margins of a stream between Lanercost Abbey and Naworth Castle, in Cumberland); and *B. callosum*, Kust. (discovered by Mr. Steuart on Woking Common).

In addition to these well-known European insects (which he is the first to admit into our fauna), Mr. Dawson has described five as altogether new to science: namely, *Dyschirius impunctipennis* (a large and distinct species discovered by himself on the Smallmouth sands, near Weymouth); *D. jejunus* (due to the researches of Mr. Bold of Newcastle, who detected it on the banks of the river Irthing in Cumberland); *Harpalus Wollastoni* (found by Mr. Wollaston at Slapton Ley, in Devonshire,—but which appears to be very nearly akin to, if not actually identical with, the *H. litigiosus*, Dej.); and *Stenolophus* *derelictus* (allied to the *S. brunnipes* of Sturm, and captured by Mr. F. Smith in the vicinity of London).

Perhaps the main defect in Mr. Dawson's volume may be said to be the paucity of the *habitats* which he records,—a circumstance the more to be regretted from the facility with which an extensive series of localities might have been made known; whilst it is a universally admitted fact, that nothing tends so much to increase the general interest in a subject like that which he has so skilfully handled, as a copious and well-selected list of the various districts in which the several insects have been ascertained to occur. It is by this means indeed alone that we can obtain a correct estimate of their topographical distribution, and so be enabled to compare the productiveness of distant portions of the British Isles; whilst the pleasure which it naturally affords to labourers in the same field, to see the fruit of their investigations brought together for the general good, would amply repay the small additional trouble which such an arrangement would have involved.

These however, desirable though they may be, are subsidiary points. The general accuracy of Mr. Dawson's monograph, and the amount of judgment which he has shown in grasping his specific differences, will sufficiently attest its merit; and we can only add that, if his example should induce others to clear up the intricacies of equally difficult departments with as much success, our coleopterous fauna will not be long in assuming a more definite shape than it has hitherto done.

The Medals of Creation, &c. By (the late) G. A. Mantell, F.R.S. 2 vols. small 8vo. Second Edition. London: Bohn.

It is with somewhat melancholy pleasure that we notice these volumes, as they remind us of one, now passed away, who both by his writings and lectures certainly assisted in rendering the science of geology popular among the many, and whose poetic temperament enlivened the society of private friendship. Previous to the appearance of this work, Parkinson's 'Introduction to the Study of Organic Remains' was, we believe, the only one especially devoted to the subject; and that simply professed to give a mere outline of the principal generic forms, then known, which were found in a fossil state. With the advanced state of science a more compendious work was required—avoiding at the same time mere technicalities and dry details, and yet giving the facts connected with a general view of fossil botany and zoology in such clear and readable manner, as to render the work a popular introduction to the study of palæontology. To a considerable extent, this attempt has been successful; and we should feel the more grateful for the success, when it is considered that the work was the production of leisure hours extracted amidst the onerous duties of a laborious profession.

Regardless of the censure too frequently attached to the medical man who studies Nature, although best qualified to interrogate her, Dr. Mantell fearlessly followed the pursuit, and not only derived thence a solace, but enlarged our knowledge of the evidence of Creative power and design in the ancient physical revolutions of our globe, the history of which is fraught with so much interest and replete with so much instruction. Ten years have elapsed since the publication of the first edition of the "Medals," which, it is not too much to say, materially assisted the inquirer and student; and many a person who enjoyed the living representative, little thought until reading this work that there was a lesson to be learnt from the worn cockle and oyster shell or broken lobster's claw.

So great has been the advance and so numerous the cultivators of palæontological science of late years, that a new edition was requisite for the student; the present one has been entirely rewritten and arranged, and the first volume was nearly printed at the period of the late author's decease. Fortunately for the public, and certainly for the publisher, the second volume has been issued from under the *mantle* of the able Secretary of the Geological Society, Mr. T. Rupert Jones, and which, containing as it does the higher branches of the animal kingdom, required much care in the collating and correcting. Moreover, we are glad to find that the editor has avoided the insertion of passages that might be attributed either to egotism or envy in the late author; for it is lamentable that the jostlings of scientific men, when sometimes engaged upon the same bone, should be continued in perpetual raspings.

The volumes contain more than 900 pages and are profusely illustrated; and the subjects are arranged in consecutive order. The work is divided into four parts: the first part contains the nature and arrangement of the British strata, with remarks on the contained fossils and their mode of occurrence as regards petrifaction, silicification, &c., with hints for collecting and preserving different fossils, more especially the vertebrate forms. The second part is devoted to fossil botany, and is considerably enlarged and improved, giving a general history of the structure and affinities of the mineralized remains of the vegetable kingdom, as well as interesting deductions respecting the successive floras. The third part comprises fossil zoology, and occupies thirteen chapters, treating successively of the Zoophytes, Echinodermata, Foraminifera, Testacea, Cephalopoda, Articulata, Fishes, Reptiles, Birds, and Mammalia. The geological distribution of each group is given, as well as the principal British localities from whence their remains have been obtained.

At p. 217 of the first volume we find the Bryozoa arranged under the Zoophytes, contrary to the present received opinion that they ought to be classed near the Mollusca, although it is fairly stated at p. 265 that they are of a much higher order of organization than the Anthozoa. By some inadvertence at p. 430 the genus *Sphærulites* is arranged with the univalve Mollusca, instead of among the Bivalves and near the Chamidæ, to which the recent researches of Mr. Woodward have proved its affinity. In the second volume (from the Cephalopoda to Mammalia) the editor has used every endeavour to render this portion as complete as possible by citing the latest information, and has also freely inserted many useful and good references to the different sections treated of, especially among the reptiles and mammals. The subject of foot-prints is copiously treated, and with regard to the controversy respecting the origin of the so-called Ornithoidichnites, the editor has judiciously avoided referring them positively to birds. In the section treating of the Batrachia is the following interesting paragraph (p. 748) respecting the geological distribution of certain genera allied to the Perennibranchiata :—"The Labyrinthodont reptiles have been regarded as characteristic of the Permian and Triassic epochs, their remains being found in Germany and England in rocks of that age. The commencement of the existence of this family of sauroid-batrachians, however, is of great antiquity, since their relics also occur in the formations of the Carboniferous epoch. The *Archegosaurus*, a batrachian but slightly removed from the true Labyrinthodont type, has left its well-characterized remains in the coal of Germany; the *Parabatrachus*, in that of Scotland; and the allied *Dendrerpeton*, in the Nova Scotian coal-field. This last-mentioned great carboniferous formation has, however, afforded fossil evidence of the existence of the true Labyrinthodonts in the coal-period; for some cranial bones, imbedded in a mass of Pictou coal, lately sent to England by Mr. J. W. Dawson, and the subject of a paper by Prof. Owen, read before the Geological Society, were demonstrated by that distinguished palæontologist to have close affinity with the corresponding parts of the skull of the Triassic genera *Capitosaurus* and *Metopias*."

The fourth part contains general instructions for the collection of rocks and fossils, and notes of excursions, in illustration of the mode of investigating geological phænomena.

In recommending these volumes to the general reader, we feel assured that the editor has efficiently laboured in rendering his portion of the work as complete a compendium as possible of the palæontological history of the organic beings of which it treats, and in adapting it to the requirements of the geological student of the present time.

Genera Plantarum Floræ Germanicæ iconibus et descriptionibus illustrata. Fasc. 27. Auctore R. Caspary.

We are glad to announce the receipt of this part of the valuable series of plates commenced many years since by the lamented T. F. L. Nees von Esenbeck, and continued by several eminent botanists. So long an interval had elapsed since the publication of Fasc. 25, which contains the illustrations of twenty genera of Dipsaceæ, Stellatæ, Gentianaceæ, &c., edited by Dr. Schnizlein; and Fasc. 26, consisting of twenty genera of Umbelliferæ published by Prof. Bischoff, that we had begun to fear that there would be no continuation of the work. Our gratification is therefore the greater to find that it is really to be continued. The recently published part is from the pen and pencil of our correspondent Dr. Robert Caspary, of whose qualifications for such an undertaking we had the opportunity of forming an opinion during his residence in England. We are glad to add, that this Fasciculus well deserves to form a portion of the valuable work with which it is connected. It contains plates and descriptions of fourteen genera of Cruciferæ, two of Papaveraceæ and the genus *Caltha*. These are illustrated in a rather more complete manner than was adopted in the earlier parts of the work.

Concerning the other two fasciculi mentioned above, it is hardly necessary to say that they are creditable to the eminent men whose names are associated with them.

We cannot conclude without specially directing the attention of our botanical readers to this work, as having the unusual properties of cheapness combined with excellence. It is quite essential to every student of European plants, and by far the greater number of the genera illustrated in it are natives of Britain.

The Microscope and its Application to Clinical Medicine. By LIONEL BEALE, M.B. 8vo. pp. 282.

The Microscope; its History, Construction, and Applications. By JABEZ HOGG, M.R.C.S. 8vo. pp. 434.

The former of these works, as is implied in its title, scarcely comes within our range of subjects. Inasmuch, however, as it treats of the method of using the microscope, the means of examining and preserving objects, &c., we can recommend it as containing a tolerably satisfactory account of the present state of knowledge upon these subjects. It contains upwards of 200 woodcuts, and will form a useful handbook to those members of the medical profession who have not sufficient time to procure the information from the original sources; for it contains nothing new. We must observe, that in regard to the history, &c. of one or two points, it is in error.

Mr. Hogg's book is of a different kind. It is intended for a popular work, and forms one of the series of the "Illustrated London Library."

It may be said to consist of two parts: a series of quotations, in brackets, from various authors, in regard to microscopy and natural history, and a number of annotations, with poetical abstracts by the author, and is illustrated with numerous woodcuts. The quotations embody a considerable amount of information upon natural history and microscopy, for there is about as much of one as of the other; whilst the remarks of the author exhibit complete ignorance of both these subjects, as well as a total deficiency of classical lore. Moreover, the whole is written in a remarkably loose and clumsy style, well calculated to disgust an educated mind with the use of the microscope and microscopic observers.

Thus, we are told, that "the *Eunotia* is of the *Navicula* species." That "the scientific name by which the yeast-plant is known is *Fermentum cervisiæ*, or *Torula cervisiæ*." That "the leathery *boletus* is merely an enormous aggregation of the vegetable mould-plant or *mucor*." That "the disease known as *ring-worm*, infesting the heads of children, is one out of forty-eight different species of this fungi." One figure shows "the zones of annual growth, termed the medullary rays." Again, we have an account of the "*Bryozoa Bowerbankia*;" with abstracts from Quekett's *Historical Catalogue*. Also a host of misspelt words; and these not occurring accidentally, but frequently repeated: thus, *Astatia, Plurosigma, Volvox globata, Saccina ventriculi*, &c. The author has also an insuperable difficulty in the distinction of the singular from the plural. Thus, we have "*Torulæ diabetica*;" "the *Entozoa folliculorum* is," &c.; "*Vibrio spirilla* or *trembling animalculæ* appear," &c. The words *animalculæ* and *spiculæ* are constantly used. The author's knowledge of chemistry is also extremely small, for we are told that the "invaluable agent, *Formic acid* or *Chloroform*, was first discovered in, and produced from, the *Formic ant*;" and that the "contents of the cells of the yeast-plant resemble fat or oil, a protenic substance."

In short, the work is evidently written by one who has amused himself with the examination of mounted microscopic objects, but who can lay no claims to the character of a man of science, and who is very ill-calculated to write a popular work. The book is just that which we should have expected from one of those uneducated men, highly useful in their way, who obtain their livelihood by preparing and mounting microscopic objects; but it is a discreditable production from the pen of a member of the learned profession to which the author belongs. The part of the publishers has been well performed, and many of the woodcuts are very beautifully executed.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 6, 1854.—Thomas Graham, Esq., V.P., in the Chair.

"On a peculiar Arrangement of the Sanguiferous System in *Terebratula* and certain other Brachiopoda." By W. B. Carpenter, M.D., F.R.S.

In a memoir "On the Minute Structure of Shell," read before the Royal Society January 17, 1843, (and subsequently embodied in a "Report" on the same subject, prepared at the request of the British Association for the Advancement of Science, and published in its Transactions for 1844,) I first announced the fact, that the 'punctations' which had been previously noticed on the exterior of many Brachiopodous shells, both recent and fossil, are really the orifices of *tubular perforations*, which pass directly through each valve, from one of its surfaces to the other (fig. 1).

Having subsequently obtained specimens of *Terebratulæ* in which the soft parts of the animals had been preserved, in connection with their shells, I ascertained that these passages are occupied in the living state by membranous cæca, *closed externally*, but opening on the *internal* surface of the shell, and filled with minute cells of a brownish hue. Recollecting that Professor Owen, in his account of dissections of some species of *Terebratula* and *Orbicula* (Transactions of the Zoological Society, vol. i.), had spoken of an unusual adhesion of the mantle to the shell in these Bivalves, it occurred to me that this adhesion might be due to a continuity between the mantle and these cæcal tubuli; and I carefully sought for evidence of such a structure. In this, however, I was entirely unsuccessful; for the mantle, when stripped from the shell, presented no appearance whatever of having transmitted any such prolongations into its substance; on the contrary, it was evidently continued over the mouths of the cæca with which it was in apposition; and I frequently found its external surface (*that* in contact with the shell) covered *in patches* with cells exactly resembling in size and aspect those contained within the cæca. I was equally unsuccessful in the attempt to trace any other connection between these cæca and the soft parts of the animal; so that, although their importance in its œconomy scarcely admitted of doubt, the nature of their function remained entirely unknown. The idea that they had any connection with the formation of the *shell* itself, seemed to be completely negatived by the fact, that in a large proportion of the group of BRACHIOPODA, no such perforations exist; notwithstanding that their shells, in every other feature of minute structure, are exactly accordant with that of *Terebratula.*—The foregoing results were communicated to the British Scientific Association in 1847, and were embodied in the Second Part of my "Report" published in its Transactions for that year.

The physiological importance of the characters of 'perforation' or 'non-perforation' has become continually more obvious, as the principles on which the subdivision of the group of Brachiopoda should be founded, have been gradually settled by those who have concerned themselves with its systematic arrangement; and in particular, the *universal presence* of the perforations in the shells of the family *Terebratulidæ*, contrasted with their equally universal absence in those of the family *Rhynchonellidæ*, unequivocally marked its relation to the general conformation of the *animals* of these subdivisions.

Having been requested by Mr. Davidson to undertake a more detailed investigation than I had yet made, into the minute structure of the shells of Brachiopoda, for the sake of throwing still further light upon the classification of the group, I applied myself afresh to the solution of the problem, and believing that I have succeeded in ascertaining the import of this curious feature in the organization of Terebratula and its allies, I beg to offer an account of my results to the Royal Society.

The membrane which is commonly spoken of as 'the mantle,' and which may be stripped from the shell by the use of sufficient force to overcome its adhesions, must, I maintain, be considered as really its *inner layer* only; for I find that an outer layer exists, so intimately incorporated with the shell as not to be separable from it without the removal of its calcareous component by maceration in dilute acid. When thus detached, this outer layer is found to be continuous with the membrane lining the perforations in the shell (fig. 1 *b*); so that their tubular cæca are, in fact, prolongations of the *real* external surface of the mantle. The adhesion of the *inner* to the *outer*

Fig. 1.

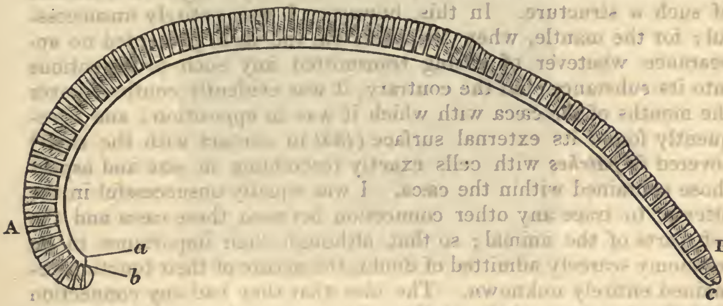
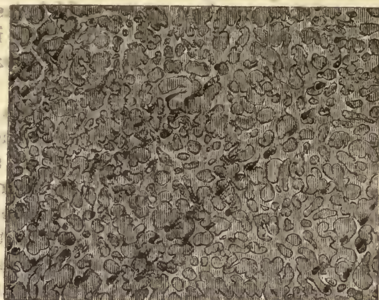


Diagram of the intra-palleal sinus-system of *Terebratula*, with its cæcal prolongations into the shell;—A, B, section of valve; *a*, inner layer of mantle, *b*, outer layer in contact with the shell, and giving off cæca; *c*, continuity of the two at margin of valve.

layer (which Professor Owen, not being aware of the existence of an outer layer, interpreted as an adhesion of the *mantle* to the *shell*) does not extend to the whole of the contiguous surfaces, but is limited to certain bands or spots,—the two layers of membrane, in the intervals between these, being separated by a set of irregular spaces, freely communicating with one another, and with the cavities of the cæca, so as to form a rude network. This arrangement is peculiarly well marked in *Terebratula caput-serpentis*, as shown in the figure (fig. 2); and to those who are familiar with the condition of the circulating apparatus in the inferior Mollusca, it is scarcely possible not to recognize in it a 'sinus-system,' corresponding to that which is formed in the Tunicata by the partial adhesion of the second and third tunics to each other.

Considered under this point of view, the cæcal structure (as was first suggested to me by my friend Mr. T. H. Huxley) bears a close resemblance to the vascular prolongations, which, in many Ascidians, pass from the sinus-system into the substance of the 'test;' the chief difference lying in this,—that whilst each of the vascular prolongations into the 'test' of the Ascidians contains both an *afferent* and an *efferent* canal,—no such distinction ordinarily manifests itself in these prolongations of the intra-palleal sinus-system of *Terebratula*, although I have met with indications of it in *Crania*. Their cæcal character, however, is by no means opposed to the views I am now giving of their physiological nature; for it has been shown by M. de Quatrefages, that the prolongations of the 'general cavity of the body,' which pass into the branchiæ and other appendages of Annelida, transmitting to them its nutritive fluid for aëration, are always cæcal, notwithstanding that they are sometimes distributed as minutely as blood-vessels*.

Fig. 2.



Sinus-system of *Terebratula caput-serpentis* (as shown by the grinding away of the shell, without detaching the mantle), being a network of canals formed by the adhesion of the two layers of the mantle at certain spots, leaving passages around them.

On this interpretation, the cells which are found within the cæca, and in the spaces between the contiguous surfaces of the two layers of the mantle, are to be regarded as *blood-corpuscles*, and they correspond in size and appearance (so far as can be determined by specimens preserved in spirits) with the blood-corpuscles of Ascidian and Lamellibranchiate Mollusks.

The sinus-system from which this collection of cæca proceeds, appears to be altogether distinct from the vascular apparatus of the (so-called) 'mantle,' (that is, according to my interpretation, *of the inner layer* of the mantle) which has been described by Professor Owen; but it probably communicates with the 'common sinus' at the back part of the visceral chamber, which is stated by Professor Owen to receive the blood, not only from the palleal sinuses of the dorsal and ventral valves, but also from "other sinuses that there fill, line, and seem to form, the visceral or peritoneal cavity†."

It cannot be deemed improbable, then, that the apparatus in question is *branchial* in its nature; and that it is designed to provide for certain tribes a more special means of aërating the blood, than is afforded by that distribution of blood to the general surface of the mantle, which is common to the entire group. This view of its respiratory office is confirmed by an observation communicated to me by Professor Quekett; viz. that the discoidal opercula which cover the external orifices of the cæca, and which, though adherent to the periostracum, are not structurally continuous with it, present appearances in young shells, which seem indicative of the existence of

* Ann. des Sci. Nat., 3e sér., Zool., tom. xviii. p. 307.

† See Mr. Davidson's Monograph on the "British Fossil Brachiopoda," published by the Palæontographical Society, vol. i. p. 15.

a fringe of cilia round each, designed to produce currents of water over the extremities of the cæca.

The resemblance which these cæcal prolongations of the sinus-system into the shell of the *Terebratula* bear to the vascular prolongations of the sinus-system into the test of certain *Ascidians*, is not without its parallel in another group, which (as pointed out by Mr. Hancock, Ann. of Nat. Hist. vol. v. p. 198) is intimately related to that of Brachiopoda,—namely, the *Bryozoa*. The stony walls of the 'cells' which invest the soft bodies of many species of *Eschara*, *Lepralia*, &c., are marked, like the shells of Terebratulæ, with punctations, which are really the orifices of short passages extending into them from their internal cavity, as sections of these structures demonstrate. These passages I have found to be occupied by prolongations of the visceral sac, which is the only representative of a circulating system among these animals; and they thus convey the nutrient fluid which this contains, into the substance of the framework formed by the calcified tunics of these animals.

I need not here enlarge upon the additional value which these structural and physiological considerations afford, to the character of "perforation" or "non-perforation" in the shells of Brachiopoda. The importance of this character in systematic arrangement will plainly appear, I think, from the details which I have published in the Introduction to Mr. Davidson's Monograph already referred to.

March 30, 1854.—Thomas Bell, Esq., V.P., in the Chair.

"On the Structure and Affinities of *Trigonocarpon* (a fossil fruit of the Coal-measures)." By Joseph D. Hooker, M.D., F.R.S.

Having been for some time engaged in examining the structure and affinities of some fossil fruits of the coal formation, included under the name *Trigonocarpon*, and the progress which I am enabled to make being extremely slow (owing to the difficulty of procuring good specimens), I am induced to lay before the Royal Society such results as I have arrived at, for publication in their Proceedings (if thought worthy of that honour). The details and illustrations of the subject will, when complete, be offered to the Geological Society of London.

My attention has for many years been directed to the genus *Trigonocarpon*; as, from the period of my earliest acquaintance with the flora of the carboniferous epoch, I have felt assured, that botanically, this was the most interesting and important fossil which it contained in any great abundance, and that until the affinities of this were determined, the real nature of the flora in question could never be regarded as even approximately ascertained.

In the first place, *Trigonocarpon* is so abundant throughout the coal-measures, that in certain localities some species may be procured by the bushel; nor is there any part of the formation in which they do not occur, except the underclays and limestone. The sandstone, ironstones, shales, and coal itself, all contain them.

Secondly. The symmetry in form and size which many of them display, the regularity of the sculpturing on their surfaces, and various other points, suggested their belonging to a class of highly organized vegetables.

Thirdly. The fact of our being wholly unacquainted with the organs of fructification belonging to the exogenous vegetation, which also abounds in the coal formation, coupled with the assumed highly organized nature of *Trigonocarpon*, favoured the assumption that these might throw light upon one another, and seemed to afford a legitimate basis upon which to proceed, should I ever procure specimens of *Trigonocarpon* displaying structure, which I had long hoped to do.

It is, however, only since my return from India that I have been so fortunate as to obtain good specimens, and for these I am indebted to my friend Mr. Binney of Manchester, who has himself thrown much light upon the vegetation of the coal epoch, and whose exertions indeed have alone enabled me to prosecute the subject; since he has not only placed his whole collection of Trigonocarpons at my disposal, but has shared with me the trouble and expense of their preparation for study. All the specimens were found imbedded in a very tough and hard black-band or clay ironstone, full of fragments of vegetable matter, and which appears originally to have been a fine tenacious clay.

The individual Trigonocarpons are exposed by breaking this rock, and are invariably so intimately adherent to the matrix as to be fractured with it. A great many of these lumps of ironstone, containing partially exposed Trigonocarpons, have been sliced by a lapidary in the usual manner, and excessively thin sections taken on slips of glass. The sections were made necessarily very much at random, but as nearly as possible parallel, or at right angles to the long diameter of the fruit. Five of the specimens thus operated upon have proved instructive, presenting the same appearances, and all being intelligible, and referable to one highly developed type of plants. As, however, the term 'highly developed' may appear ambiguous, especially with reference to a higher or lower degree in the scale of vegetable life, I may mention that by this term I mean to imply that there are in the fruit of *Trigonocarpon* extensive modifications of elementary organs, for the purpose of their adaptation to special functions, and that these modifications are as great, and the adaptation as special, as any to be found amongst analogous fruits in the existing vegetable world.

Thus, I find that the integuments of the fruit of *Trigonocarpon* are each of them a special highly organized structure; they are modifications of the several coats of one ovule, and indeed of the same number of integuments as now prevail in the ovules of living plants.

The number, structure and superposition of these, are strongly indicative of the Trigonocarpons having belonged to that large section of existing coniferous plants, which bear fleshy, solitary fruits, and not cones; and they so strongly resemble the various parts of the fruit of the Chinese genus *Salisburia*, that, in the present state of our knowledge, it appears legitimate to assume their relationship to it.

In all the five specimens alluded to, there are more or less perfect evidences of four distinct integuments, and of a large cavity, which is in all filled with carbonate of lime and magnesia; these minerals, I presume, having replaced the albumen and embryo of the seed.

The general form of the perfect fruit is an elongated ovoid (rather larger than a hazel nut), of which the broader or lower end presents the point of attachment, while the upper or smaller end is produced into a straight, conical, truncated rostrum or beak, which is perforated by a straight longitudinal canal. The exterior integument is very thick and cellular, and was no doubt once fleshy; it alone is produced beyond the seed and forms the beak; its apex I assume to have been that of the primine of the ovule, and its cavity the exostome. The second coat appears to have been much thinner, but hard and woody or bony; it is impervious at the apex; is also ovoid, and sessile by its broad base within the outer integument, with which it is perhaps adherent everywhere except at the apex. This is marked by three angles or ridges, and being that alone which (owing to its hard nature) commonly remains in the fossil state, has suggested the name of *Trigonocarpon*. Within this are the third and fourth coats, both of which are very delicate membranes; one appears to have been in close apposition with the inner wall of the second integument, and the other to have surrounded the albumen. These are now separated both from one another, and from the inner wall of the cavity, by the shrinking of the contents of the latter, and the subsequent infiltration of water charged with mineral matter. I may remark, however, that these two membranes may be due to the separation of one into two plates, in which case the original one was formed of several layers of cells. Hitherto I have not been able to trace any organized structure within the cavity of the fruit, and its real nature therefore remains doubtful. It is only from the strong resemblance, in structure, appearance and superposition, which these integuments present to those of Taxoid Coniferæ, that I assume their probable relationship. *Salisburia*, especially, has the same ovoid fruit, sessile by its broader end, and its outer coat is perfectly analogous, being thick, fleshy, and perforated at its apex by a longitudinal canal (the exostome of the ovule); within this is a perfectly similar, woody, two- or three-angled, impervious integument, forming the nut. This again is lined with one very delicate membrane, and contains a mass of albumen covered with a second similar membrane. A marked analogy is presented to the European botanist by the fruit of the Yew, which has the same integuments though somewhat modified; the outer, fleshy coat in the Yew is however a cup-shaped receptacle, and not drawn up over the nut so as to leave only a small canal at the top, as in *Salisburia* and *Trigonocarpon*. The nut also does not adhere to the fleshy cup except below its middle. The internal structure is the same in all three.

Such are the main facts which I have been able satisfactorily to establish. There are many others yet to be worked out, especially those connected with the individual tissues of which those bodies are composed; and it is particularly to be borne in mind that the disco-

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very of some structure indicative of albumen or embryo, is absolutely essential to the complete establishment of the affinity I have suggested.

It must not be overlooked, that the characters through which I have attempted to establish an affinity between *Trigonocarpon* and Coniferæ are equally common to the fruits of Cycadeæ; and in connexion with this subject I may remark, that M. Brongniart* has referred the genus *Noggerathia*, which is also found in the coal-measures, to that natural order, together with some associated organs which are probably Trigonocarpons in a mutilated state. The leaves of *Noggerathia* are, however, alone known, and Dr. Lindley, when figuring those of one species (Lindley and Hutton, Fossil Flora, 28, 29), pointed out their great resemblance to those of *Salisburia*, thus affording collateral evidence of the view I have been led to adopt from an examination of the fruit alone.

May 11, 1854.—The Earl of Rosse, President, in the Chair.

"On the relation of the Angular Aperture of the Object-Glasses of Compound Microscopes to their penetrating power and to Oblique Light." By J. W. Griffith, M.D., F.L.S.

The explanation given by Dr. Goring and others of the advantage of increased angular aperture in microscopic objective-glasses appears to the author to be correct, as applied to the case of opake objects, and accordingly his remarks in the present communication have reference to transparent objects only.

It is known that delicate markings on a transparent object, such as the valve of a *Gyrosigma*, may be rendered more distinctly visible by using an object-glass of large aperture, by bringing the mirror to one side, and by placing a central stop in the object-glass or the condenser or in both; the increased distinctness produced in these several ways being due to the illumination of the object by oblique light. Experiment also shows that the degree of obliquity of the light requisite varies with the delicacy or fineness of the markings, being greater as these are more delicate; so that the finest markings require the most oblique light which can possibly be obtained to render them evident, and the angular aperture of the object-glass must necessarily be proportionately large, otherwise none of these oblique rays could enter it.

If the parts of an object which refract the light are large in proportion to the power of the object-glass and of irregular form, they will refract a certain number of rays, so that these cannot enter the object-glass; hence certain parts will become dark, and will map out, as it were, in the image formed of the object, the structural peculiarities of the same. But if the parts are minute, of a curved form and approximatively symmetrical, they will act upon the light transmitted through them in the manner of lenses, and their luminous or dark appearance will vary according to the relation of the foci of these to that of the object-glass. Thus the parts of an object may appear

* Annales des Sciences Naturelles, 2nd Series, vol. v. p. 52.

dark and defined, from the refraction of the light out of the field of the microscope; also, from the concentration or dispersion of portions of the light by these parts, all the rays being admitted by the object-glass, or entering the field.

Another condition affecting distinctness consists in the relation which the luminousness or darkness of an object bears to that of the field or back ground upon which it is apparently situated.

The refraction of the light out of the field of the microscope or beyond the angle of aperture of the object-glass is the ordinary cause of the outlines of objects becoming visible; and in these cases, an increase of the angular aperture of the object-glass will impair their distinctness, because it will allow of the admission of those rays which would otherwise have been refracted from the field, and the margins will become more luminous and less contrasted with the luminous field.

The cause of the distinctness of an object by refraction when all or nearly all the rays enter the field of the microscope, may be investigated in a drop of oil immersed in water, or in a drop of milk, as illuminated by light reflected from an ordinary mirror. The refractive power of the globules is so great and their form such, that each acts as a minute spherical lens; and the parts within the margin will appear light or dark according to the relation of the focus of the little lens to that of the object-glass. Under an object-glass of small aperture and moderate power the outline will appear black, because the marginal rays do not enter the object-glass. If the object-glass be of sufficient aperture to admit these marginal rays, the black margin will disappear, and the little lens will only be distinguishable by the above focal relation. Its appearance under oblique light (thrown from all sides, as when the condenser and a central stop are used) will vary; but taking the case of extreme obliquity of the rays, the lens will only be visible by a luminous margin from reflexion, giving it a very beautiful annular appearance. Hence it is more distinct by direct, or slightly oblique, than by very oblique light.

But in certain objects, the irregularities of structure are of such extreme minuteness, or the difference of the refractive power of the various portions of the structure is so slight, that the course of the rays is but little altered by refraction on passing through them, and, under ordinary illumination, all the rays will enter the object-glass; neither are the rays accumulated into little cones or parcels, of sufficient intensity to map out the little light or dark spots in the field of the microscope, according to the relation of their foci with that of the object-glass.

Let us take the instance of an object with minute depressions on the surface, as the valve of a *Gyrosigma*. These are so minute, that when the light reflected from the ordinary mirror is used, the rays passing through the depressed and the undepressed portions, are not sufficiently refracted to cause either set to be excluded from the object-glass, consequently both sets will enter it. The slightly oblique and converging rays passing through a portion of the valve become separated into two sets, one passing through the thinner depressed portions, the other through the thicker and undepressed portions: still both sets enter the object-glass. But on transmitting oblique light through the object, one set of the rays will be refracted so as not to enter the object-glass, whilst the other set will gain admission; thus the two parts, which have differently refracted the rays, will become distinct. If the markings were more delicate, or if the difference between the refractive power of the two portions of the valve were less, both sets would enter the object-glass. But on rendering the light still more oblique, one set would be again excluded by being refracted out of the field. Hence it is evident why the angular aperture of the object-glass must be larger as the markings are finer, or the difference between the refractive power of the two portions of tissue is less; because the obliquity of the light requisite will be very great to cause the exclusion of one set of the rays, and the other set will be too oblique to enter the object-glass unless it be of correspondingly large aperture. This is the explanation of the advantage of oblique light. It has no peculiar power of rendering objects distinct, as has sometimes been believed, and the following experiment, supposed to show such peculiar power, is really to be explained on different grounds. A piece of net, or some similar texture, is placed behind a hole made in a window-shutter, and when thus viewed, the fibres are not well seen; but when the texture is moved on one side, they become very distinctly visible, and this has been erroneously attributed to the illumination by oblique light; whereas the increased distinctness in the lateral position is owing principally to the circumstance that the object is then viewed on a dark instead of a white ground as in the first instance; although it is also true that in this position the oblique rays, being reflected in large numbers from the fibres into the eye, contribute to the distinct vision of the object when viewed as it then is upon a dark ground.

The most difficult point has been to explain, how an object-glass of large angular aperture will render markings evident, which were not visible under an object-glass of smaller aperture; because it would naturally be imagined that the larger aperture would admit both sets of rays, one of which was excluded by the object-glass of smaller aperture. The difficulty vanishes when it is recollected that the additional rays admitted by the object-glass of larger aperture are more oblique; hence one set of these rays will be refracted from the field of the microscope, whilst the other set will enter the object-glass and will illuminate the more highly refractive parts of the object; thus the two kinds of differently refractive structure become distinctly separated, one appearing dark, the other luminous; in fact, by means of the additional rays admitted by the larger aperture we illuminate more highly one part of the object whilst the illumination of the other is not increased. In short, the object is illuminated, first, by rays corresponding to those admitted by an object-glass of small aperture; and, secondly, by the additional rays admitted by the object-glass of larger aperture. The first set not being sufficiently oblique, no part of them is refracted beyond the angular aperture of the object-glass; the second, being more oblique, are refracted out of the field by certain parts of the object and not by others, and thus contribute to render its different parts distinguishable by contrast of darkness and illumination. The first set of rays, by illuminating all parts of the object, tend to diminish this contrast, and consequently do not add to but impair the discriminative power of the object-glass for the fine markings of transparent objects, and accordingly these are rendered more distinctly visible by intercepting the less oblique rays by means of a central stop.

It has been here assumed that the oblique light requisite for the display of the markings upon objects is separated into two sets of rays by refraction; but the author observes that it might be questioned whether they are not separated by reflexion. There can be no doubt that the latter is not generally the case; perhaps the most important reason which may be assigned for this is, the considerable comparative breadth of the luminous portions of the valve of the *Gyrosigma* for instance. On transmitting unilateral light obliquely through the valve of an *Isthmia,* in which the depressions are so large, in such manner that part of it is reflected by portions of them, it is easily seen how small the amount of reflected light is; and this because the surface of the depressions is curved, and thus the portions inclined at the requisite angle for reflexion are also very small. As the amount of light reflected is so small in this case, it would be inappreciable in that of the *Gyrosigma*, in which the depressions are so exceedingly minute. In fact, attention to this point affords a ready means of distinguishing whether an object is illuminated by reflexion or refraction.

The author next considers the relation of the *penetrating* power of an object-glass to its *defining* power. Penetrating power depends upon angular aperture, and consequently on oblique light. The question whether there be any essential difference between penetrating and defining power is best answered by experiment. If we take a fragment of the valve of an *Isthmia* and examine it under a high power of small aperture, all the parts are very distinctly seen by the ordinary light of the mirror; and the various depths of shadow of the different parts of the depressions and the undepressed portions render these also clearly distinguishable; and when an object-glass of very large aperture is used, the distinctness is rather impaired than improved. But if we examine a fragment of the valve of a *Gyrosigma,* and this requires an object-glass of large aperture to render the markings visible, no distinction of the various parts of the depressions and the undepressed portions is visible; all we see is, that the depressions as a whole are dark and the undepressed portions are luminous. Hence the *Isthmia* requires defining power, whilst the *Gyrosigma* requires penetrating power or large angle of aperture to exhibit the markings; yet the structures differ only in size. And there can be no doubt that if we could examine the valve of the *Gyrosigma* under a power as high relatively to the size of the depressions, as that under which we can examine the *Isthmia,* the same relations being preserved between the angle of aperture of the object-glass and the angular inclination of the refracted rays, the various parts of the depressed and undepressed portions would be equally recognizable in both cases.

This is also true of fine lines scratched or etched on glass; for although the coarser lines upon glass micrometers are well seen with an object-glass of small aperture with good defining power and direct light, yet the finest lines upon Nobert's test-slide require penetrating power in the object-glass, and oblique light. Large angular aperture or *penetrating* power is but a very imperfect substitute for *defining* power—an important point which the author believes has not hitherto been noticed, and to which he would invite the earnest attention of object-glass makers.

The author concludes by observing that his remarks have been principally confined to one class of objects requiring penetrating power, viz. the valves of the Diatomaceæ. This has been done advisedly, because the scales of insects, which may be regarded as forming the type of the other class, involve considerations of a mixed kind, which would have tended to confuse the subject. The longitudinal ridges upon the scales of insects, in their relation to penetration, may be viewed as representing the undepressed portions of the valves of the Diatomaceæ; and the same explanation will apply to the visibility of both under various conditions. The transverse lines seen upon the scales are not indications of true structure; but their origin, as also that of the lines seen upon the valves of the Diatomaceæ, from circular or angular depressions, does not come within the conditions involved in the principle which it has been the object here to elucidate. It will suffice to say that the true structures producing the appearance of transverse markings upon the scales of insects are best resolved by small angular aperture and good definition.

It has been assumed also, that the markings upon the valves of the Diatomaceæ arise from depressions. This can be proved to be the case in the larger ones (*Isthmia*, &c.); and there is sufficient evidence to render it at least highly probable in the remainder. But this is an unessential point as regards the principle, and therefore it has not been dwelt upon.

ZOOLOGICAL SOCIETY.

February 10, 1852.—W. Yarrell, Esq., in the Chair.

Monograph of the Family Branchipodidæ, a family of Crustaceans belonging to the Division Entomostraca, with a description of a new genus and species of the family, and two new species belonging to the family Limnadiadæ. By W. Baird, M.D., F.L.S. &c.

Next to the *Apodidæ*, the largest species of *Entomostraca* belong to the family *Branchipodidæ*. This family contains perhaps the most beautiful animals of the division, elegant in form and graceful in movement. The species are, geographically, widely extended, but those as yet described are few in number.

The Family may be thus characterized.

Order Phyllopoda.

Family Branchipodidæ.

Pedes branchiales, paribus undecim ad novemdecim. Antennæ dissimiles, paribus duobus; par inferior in mare prehensilis. Oculi duo, pedunculati. Corpus cylindricum, nudum, clypeo nullo obtectum.

The feet are all branchial, being formed entirely for breathing with, and consist of 11 pairs, each pair gradually enlarging in size as they descend. They are in constant motion, and when so, present a very beautiful wavy appearance. Like the *Apodidæ* the animals of this family swim upon their backs. The body consists of a considerable number of segments, and is quite naked, having neither a shield-shaped carapace like the *Apodidæ*, nor a bivalve-shell-shaped carapace like the other families of the Order *Phyllopoda*. The antennæ are dissimilar in appearance in the male and female. The superior pair in both sexes are slender and filiform, but the inferior pair are much larger in the male than in the female, and serve the purpose of prehensile organs. The eyes are two in number, compound, oval-shaped, and are placed upon considerable-sized peduncles. Like the *Apodidæ*, the young *Branchipodidæ* have only one eye, which disappears in the process of moulting, but leaves a mark behind which remains visible in the adult.

The species included in this family are referable to five genera.

Genus Branchipus, Schæffer.

Corpus molle, cylindricum, segmentum caudale pinnis duabus ciliatis instructum. Pedes undecim. Antennæ inferiores maris magnæ, bi-articulatæ, cornibus similes, appendicibus duabus filiformibus, antenniformibus, armatæ.

The body is soft, cylindrical in shape, and is composed of twenty-two segments. The head consists of two and the thorax of eleven, each of which gives attachment to a pair of branchial feet. The abdomen consists of nine, the caudal segment dividing into two broad flat appendages of some length, and plumose on their edges. The inferior antennæ, or "cephalic horns," in the male are large organs; they are composed of two articulations, which being cylindrical and curved at the apex give an appearance of a pair of horns, and they have springing from near their base a filiform appendage closely resembling in appearance the superior antennæ. The structure of these inferior antennæ, or cephalic horns as they are generally termed, and the filiform appendage at their base, which are frequently described as an additional pair of antennæ, sufficiently distinguish the genus.

Only two species of *Branchipus* have as yet been described.

1. Branchipus pisciformis, Schæffer. *Antennis inferioribus maris magnis, compressis, apice bifurcatis; appendicibus anten-niformibus filiformibus prælongis; fronte prolongato, bisulco.* Long. ½ poll.

Syn. *Apus pisciformis*, Schæffer, Der Fisch-form. Kiefenfuss, etc. t. 5. f. 1–11 (1752).

Cancer stagnalis, Linnæus, Syst. Nat. edit. 10. 634 (1758); Faun. Suec. ed. 2. 497. No. 2043 (1761); Fabricius, Ent. Syst. ii. 518. No. 11; Mantiss. i. 335. No. 10; Müller, Zool. Dan. Prodrom. 2351; O. Fabricius, Faun. Grœnland. 247. No. 224.

Branchipus pisciformis, Schæffer, Element. Entomol. t. 29. f. 6, 7 (1766).

Gammarus stagnalis, Fabricius, Syst. Entom. 419. No. 5.

Cancer (*Gammarellus*) *stagnalis*, Herbst, Krabben und Krebse, ii. 121. No. 66. t. 35. f. 8–10 (1796).

Branchiopoda stagnalis, Lamarck, Syst. An. s. Vert. 161; Latreille, Hist. Nat. Crust. iv. 319. t. 36, 37; Gen. Crust. i. 22; Bosc, Man. d'Hist. Nat. Crust. ii. 234.

Branchipus stagnalis, Latreille, Enc. Méth. t. 336. f. 14–16; Règne Anim. iv. 174; Leach, Dict. Sc. Nat. xiv. 542; Edin. Encyc. vii. 384; Desmarest, Cons. gen. Crust. 389; Lamarck, Hist. An. s. Vert. v. 133; M. Edwards, Hist. Nat. Crust. iii. 367; Règn. An. ed. Crochart, t. 74. f. 2.

Branchipus Schæfferi, Fischer de Waldheim, Bull. Soc. Imp. Moscou, vii. (1834); Thompson, Zool. Research. fasc. v. t. 3. f. 1–3 (1834).

Branchipus melanurus? Koch, Deutsch. Crust. H. 35. t. 2.

Ino stagnalis? Oken, Lehrb. der Naturg. iii. 399.

Larva aquatica, Linn. Faun. Suec. ed. 1. 358. No. 1357.

Hab. In vicinitate urbis Ratisbonæ; *Schæffer*. In vicinitate urbis Paris; *M. Edwards*.

This species according to Schæffer's description is half an inch long, about the thickness of a straw, and semipellucid. The male is generally of a pale red or flesh colour, though sometimes varying between vermilion and orange. The female is of a dull green, with the ovaries generally of a bright blue. The inferior antennæ of the male are large organs, somewhat flattened in shape, broad at the base, toothed at about two-thirds of their length on the external edge, and becoming narrower near the extremity, which presents an appearance as if somewhat bifurcated. Those of the female are much shorter, cylindrical, and pointed at the extremity. The two antenniform appendages arising from near the base of these organs in the male are of considerable length, longer than the antennæ themselves, and filiform. The front of the head is prolonged into a prominence which is cleft down the centre and forked. The feet are long, composed of three joints, all of which are nearly of equal size, and have their edges beset with numerous short hairs or setæ, which when magnified are finely plumose. The caudal fins are of considerable size, flat and plumose. The male organs are slender and rather long.

2. Branchipus spinosus, M. Edwards. *Antennis inferioribus maris magnis, cylindricis, apice acuminatis; appendicibus antenniformibus curtis, crassis; abdominis segmentis infra spiniferis.*

Long. 1 poll. 2 lin.

Branchipus spinosus, M. Edwards, Hist. Nat. Crust. iii. 367.

Hab. In lacu salino "Hadjibé," in vicinitate urbis Odessæ; *M. Nordmann.*

This species, which was discovered by Professor Nordmann in a salt lake near Odessa, is upwards of an inch in length. The inferior antennæ of the male are large, cylindrical, the terminal articulation being sharp at the point. They possess no tooth or process, and the antenniform appendages are very short compared with those of the preceding species, and of a considerable degree of thickness. The front of the head has no prolongation. The feet are short. The segments of the abdomen are armed underneath with sharp spines, and the caudal fins are short and plumose. The male organs are short and obtuse.

Genus Streptocephalus.

Corpus cylindricum, segmentum caudale pinnis duabus ciliatis instructum; pedes undecim; antennæ inferiores maris triarticulatæ, valde tortuosæ, ad apicem in ramos graciles divisæ, appendicibus antenniformibus armatæ.

In the structure of the body, abdomen, and feet, this genus resembles entirely the preceding. The inferior antennæ, or cephalic horns, in the male, however, are very different in structure; they are longer in proportion than the corresponding organs in the *Branchipus*, consist of three articulations, and are singularly twisted, and bent as it were into elbows. The terminal joint divides at the apex into two branches. They are inhabitants of fresh water. Only two species have as yet been described, and I now add a third to the number.

1. Streptocephalus torvicornis, Waga. *Antennis inferioribus maris validis, ramis terminalibus elongatis, serratis, interno longiore, processu triangulari brevi armato, appendicibus antenniformibus elongatis filiformibus; fronte prolongato, acuminato; ovario externo conico.*

Long. maris 1 poll., fœminæ circa 14 lin.

Branchipus torvicornis, Waga, Ann. Soc. Ent. de France, xi. 261. t. 11. f. 1–4.

Hab. In vicinitate urbis "Warsaw;" *Krynicki.*

This species, which was discovered by M. Krynicki in a muddy stagnant piece of water near the town of Warsaw, is upwards of an inch in length, the female being longer than the male. The inferior antennæ or cephalic horns of the male are very large, when extended equalling in length the whole body. The basal joint is strong, and broad at its junction with the head; the second is short, and the third is divided at the apex into two branches, which are long, slender and serrated on their inner edges, the internal one being the longer, bent into the form of a hook, and having on its external edge a process of a triangular form and acuminated at the point. The first and second joints are armed with several minute teeth, and the antenniform appendages are straight, slender, but somewhat stouter than the superior antennæ. The front of the head is prolonged into a prominence which is pointed. The inferior antennæ in the female are flat, and obtusely rounded at the extremity. The ovarian bag is conical in shape and of a blue colour. The caudal fins are of considerable size and plumose on their edges.

2. Streptocephalus cafer, Lovén. *Antennis inferioribus maris longis, articulo basali intus appendice lacinulata brevi prædito, ramo terminali interno longo, flexuoso, inermi; fronte prolongato, in rostrum lunatum producto; ovario externo caligæformi.*

Long. 15 millim.

Branchipus cafer, Lovén, Kongl. Wet. Akad. Handl. 1845, 433. t. 5. f. 1–20.

Hab. In paludibus terræ Cafrorum Natalensium; *Wahlberg.*

This species was discovered by M. Wahlberg in some pools of fresh water in Port Natal, and is about 15 millimetres in length. The inferior antennæ or cephalic horns in the male are long stout organs and flexuose in shape. The basal joint is rather short, rounded, and is furnished at its base on the internal edge with a short appendage of a lanceolate form and toothed on its edge externally. The third joint divides at the apex into two branches, the internal one being long, slender and flexuose, the external being club-shaped and forked at the extremity, dividing into two other slender branches of unequal length. The antenniform appendages are filiform and flexuose. The front of the head is prolonged into a narrow deflected beak, which is forked at its extremity. The male organs are long and slender; they are composed of four articulations, the last of which is much the longest, is curved, and armed on each side with a numerous row of teeth and spines.

In the female the cephalic horns are broad, thick, and furnished with a sharp hooked point at the extremities. The caudal fins are of considerable size and finely plumose. The oviferous sac is long and narrow, and resembles very much in shape a long stocking or boot. The ova are of a rosy colour.

3. Streptocephalus similis, Baird. *Antennis inferioribus maris longis, cylindricis, appendice lunulata destitutis, ramis terminalibus præcedenti similibus, appendicibus antenniformibus filiformibus elongatis; fronte prolongato, in rostrum bilobatum producto; ovario externo conico.*

Long. maris 8 lin., fœm. 6 lin.

Hab. In insula "St. Domingo," in India Occidentali. Collegit M. Sallé. Mus. Brit.

This species, which was found by M. Sallé in the island of St. Domingo in the West Indies, is of a slender and cylindrical form. The male is about $\frac{5}{8}$ths of an inch in length, and the female half an inch. The inferior antennæ or cephalic horns in the male are large and tortuous; they are composed of three joints; the first or basal joint is the largest, is cylindrical, and extends for some distance straight forwards; the second, smaller than the basal, is also cylindrical, curves slightly at first, then bends suddenly backwards upon itself; the third or terminal joint bends as suddenly forwards and terminates in a club-shaped extremity, which divides into two branches, one longer than the other, terminating in a long filiform process; the other flatter, shorter, and dividing into two shorter filiform processes of unequal length. The antenniform appendage is long and cylindrical, rather stout, and springs from close to the extremity of basal joint. The basal joint is destitute of the lanceolate, toothed appendage on internal edge, which we see in the preceding species. The superior antennæ are long and slender, and consist of two joints, the basal one much shorter than the second. The male organs are rather long, cylindrical, and of a horny texture. The front of the head is prolonged into a beak, which is flat, rather broad and slightly lobed at the extremity. Feet short. Abdomen slender. Caudal appendages of moderate length, and beset on each side with numerous short and plumose setæ.

The cephalic horns in the female are short, thick, and terminate in a short spine at the extremity. The ovarian bag is conical, acute, and the ova are of an ochreous colour.

The chief differences between this species and *S. cafer* consist, in the male, in the shape of the front of the head, the organs of generation, and in the inferior antennæ having no lamina with teeth on the basal joint; in the female, in the shape of the external ovary.

Genus Chirocephalus, Prevost.

Corpus molle, cylindricum; segmentum caudale pinnis duabus ciliatis instructum; pedes undecim; antennæ inferiores maris validæ, biarticulatæ, appendicibus digitiformibus flabelliformibusque armatæ.

This genus closely resembles the two preceding in the shape and form of the body, having the same number of articulations, possessing the same number of feet, and having similar caudal fins. It is in the structure of the inferior antennæ or cephalic horns in the male, that the important difference between the two genera exists. These antennæ are very large, and are composed of two joints. At the base of the first joint a complicated apparatus arises, which when unfolded presents a very curious appearance. This consists of a long, flat, curved, very flexible body, somewhat tapering and toothed on its edges, and composed of numerous short articulations, which the animal can fold up upon itself like a ribbon. Springing from its external edge near the base are four rather long and flexible appendages strongly toothed on their internal edge, somewhat resembling long fingers, and in addition to these a large membranous triangular-shaped body, toothed on its edges all round, which when extended nearly covers the finger-like bodies, and can be folded and unfolded like a fan. When the animal is at rest these organs are folded up underneath the head in the same manner as a butterfly folds its proboscis, but when in pursuit of the female they become extended at full length and present a very beautiful appearance.

Five species of this genus have now been described.

1. Chirocephalus diaphanus, Prevost. *Antennis inferioribus maris validis, cylindricis, apice acuminatis, processu dentato ad basin articuli secundi armatis; fronte rotundato.*

Long. maris 14 lin., fœminæ 1 poll.

Pro Synonymis vide "Baird's Nat. Hist. of the British Entomostraca, Ray Society, 1850."

Hab. In Anglia, Gallia, prope Genevam, &c. &c.

This species, which occurs in many places in England, as well as in France, Switzerland, &c., is very elegant in form, and (the male more especially) very beautiful in colour. It is upwards of an inch in length, slender, of a cylindrical form, and nearly transparent. In the male the inferior antennæ or cephalic horns are of a beautiful translucent bluish green colour, tipped at the extremity with a fine red hue. The caudal fins are of a bright red. The female has a strip of blue along the whole length of the back, and the ovarian bag when full of ova is conical in shape and of a reddish brown. The inferior antennæ of the male are very strong organs, divided into two joints; the basal joint is thick and fleshy, and the terminal joint is cylindrical and curved in the form of a horn, having at the base where it joins the first joint a flat plate attached to it, beset with several stout teeth. The apparatus which we find at the base of the first joint, consisting of the long, flat, somewhat tapering body with its digitiform and fan-shaped appendages, is of a very delicate transparent bluish green colour. The antennæ of the female are short, stout, pointed at the extremity, flexible, and slightly curved downwards.

2. Chirocephalus lacunæ, Guérin. *Antennis inferioribus maris validis, valde arcuatis, articulo basali magno, dentato, terminali cylindrico, ad apicem sinuato.*

Long. maris et fœminæ 12–15 millim.

Branchipus lacunæ, Guérin, Iconog. Règn. Anim. Crustacés, 39. t. 33. f. 4, 4 *a*.

Hab. In stagnis prope "Fontainebleau;" *M. Guérin.*

This species, which is briefly described by M. Guérin in the 'Iconographie du Règne Animal,' is found in little pools of water near Fontainebleau. It is transparent, but is smaller than the preceding species, and is distinguished from it by the shape of the inferior antennæ or cephalic horns in the male. These organs are of two joints; the basal one large, and armed on its internal edge with several stout teeth or lobes; the second much smaller, cylindrical, bent suddenly back upon the first, and sinuated, or as it were slightly toothed at the apex. The long ribbon-like appendage which springs from the base of the first joint appears to have only two very short processes attached to it, instead of the four long finger-like bodies, and the fan-shaped body is not represented at all; but this part of the head is not sufficiently described by M. Guérin to enable me to satisfactorily ascertain its exact structure.

3. Chirocephalus claviger, Fischer. *Antennis inferioribus maris validis, articulo basali magno, terminali parvo, ad basin dentato, ad apicem clavato; antennis superioribus quadri-articulatis; fronte rotundato.*

Long. 8–10 lin.

Branchipus claviger, Seb. Fischer, Middendorff's Sibirische Reise, ii. Wirbellose, 149. t. 7. f. 1–11 (1851).

Hab. In fluvio Taimyr, in Siberia; *Middendorff.*

This species, which is about 8 or 10 lines long, was discovered by M. Middendorff in a pool of water by the river Taimyr in Siberia. The inferior antennæ of the male are strong organs; the basal joint being stout and fleshy and the terminal narrow, provided with about a dozen small teeth at its base, and ending in a club-shaped extremity. The digitiform appendages are more numerous apparently than in *C. diaphanus.* They arise from the extremity of the long riband-like appendage, instead of from its base, and each of them has several teeth on the sides and apex. In the female these antennæ are small, narrow and sharp-pointed. The superior antennæ are divided into four articulations.

4. Chirocephalus birostratus, Fischer. *Antennis inferioribus maris validis, articulo basali magno, terminali mediocri, prope basin processu elongato armato, ad apicem uncinato.*

Long. 10–12 lin.

Branchipus birostratus, Seb. Fischer, Middendorff's Sibirische Reise, ii. t. 7. f. 12–16 (1851).

Hab. Prope urbem "Charkow" in Russia; *Fischer.*

This species is about 10 or 12 lines long, and was found by Fischer in the neighbourhood of the town of Charkow, in Russia. The inferior antennæ of the male are strong organs, the basal joint stout and fleshy, the terminal of moderate size, having, springing from near its base, a somewhat elongated process armed with sharp teeth at its extremity, and ending in a sort of hooked point. The riband-like process appears similar to that of *C. diaphanus.*

5. Chirocephalus Middendorffianus, Fischer. *Antennis inferioribus maris validis, articulo basali magno, longissimo, numerose dentato, terminali cylindrico, acuto; antennis superioribus quadri-articulatis; fronte quadrangulari.*

Long. 7–9 lin.

Branchipus Middendorffianus, Seb. Fischer, Middendorff's Sibirische Reise, ii. 153. t. 7. f. 17–23 (1851).

Hab. In fluviis "Taimyr et Boganida" in Siberia; prope "Tri-Ostrowa" in Lapponia; *Middendorff.*

This species, which is only from 7 to 9 lines in length, was found by Middendorff in pools on the banks of the rivers Taimyr and Boganida in Siberia, and in Lapland near Tri-Ostrowa. The inferior antennæ in the male are stout organs, the basal joint being very long and fleshy and armed along the inner edge with a long row of many teeth, the terminal being cylindrical in shape and pointed at the extremity. The superior antennæ are four-jointed, and the front of the head is of a quadrangular shape. The ovarian sac in the female is long and rather slender, and appears to be notched at the base.

Genus Artemia, Leach.

Corpus molle, gracile; segmentum caudale pinnis nullis instructum; pedes undecim; antennæ inferiores maris magnæ, biarticulatæ, compressæ, appendicibus nullis armatæ.

Syn. *Cancer,* Linnæus.—*Gammarus,* Fabricius.—*Eulimene,* Latreille et auctorum.—*Artemia,* Leach et auctorum.—*Branchipus,* Latreille, Fischer, &c.—*Artemisus,* Lamarck.—*Artemis,* Thompson.

The body in this genus consists of the same number of segments as in the three preceding, is soft and without covering, but is more slender in shape, and has the caudal segment simply bilobed at the extremity, instead of being armed with two large plumose fins. The inferior antennæ in the male are large, flat-shaped, broad, and divided into two articulations. The basal joint has neither the antenniform appendage of *Branchipus* and *Streptocephalus,* nor the complicated digitiform and fan-shaped apparatus of *Chirocephalus.* They inhabit salt water, frequently even in water which is very highly charged with salt. They swim upon their backs.

The genus *Eulimene* was founded by Latreille in 1817, in Cuv. Règn. An. 1st edit. iii. 68; that of *Artemia* by Leach in 1819, in the Dict. Sc. Nat. xiv. The term *Eulimene,* however, had been previously used by Peron for a genus of *Acalepha,* and though the name *Artemia* is liable to objections from its construction (Artemia for Artemis), I prefer adopting it to burdening the nomenclature with another synonym.

Five species have been described.

1. Artemia salina, Leach. *Antennis inferioribus maris validis, compressis, articulo secundo lato apice acuminato, basali unidentato; segmento caudali setigero; ovario quadrilaterali.*

Long. 6 lin.

Pro Synonymis vide "Baird's British Entomostraca," et adde:—

Eulimene albida, Latreille, Nouv. Dict. d'Hist. Nat. x. 535; Cuv. Règn. An. 2nd edit. iv. 178; Desmarest, Cons. gen. Crust. 394; Risso, Hist. Nat. Eur. Mérid. v. 165; Lamarck, Hist. Nat. An. s. Vert. 2nd edit. v. 199 (note); M. Edwards, Hist. Nat. Crust. iii. 371; White, Catalogue of Crustacea, Brit. Mus.

Artemia Eulimene, Leach, Dict. Sc. Nat. xiv. 543.

Hab. In salinis ad "Lymington," in Anglia; prope "Montpellier," in Gallia; in Mediterraneo, prope "Nice," &c.

This species, which seems to have been first observed by M. Schlosser, in the salt-pans at Lymington, is nearly white, slender, and about half an inch in length. The abdomen is long, fully as long as the body, and the caudal segment is simply divided into two small lobes, which give origin to several short setæ. The inferior antennæ in the male are divided into two articulations, the basal one of which has on its inner edge at about half of its length, a short, stout, conical tooth. The terminal joint is broad, bends nearly at a right angle about the middle of its length, and terminates in a sharp point. In the female these organs resemble closely those of the preceding genus. The ovarian bag is large, of a quadrilateral shape, somewhat pointed at the two sides, and opens at both sides to allow the ova to escape.

The genus *Eulimene* was founded by Latreille to receive a small crustacean which was found by M. Cuvier amongst some marine animals which he had received from Nice. The chief character by which he distinguished the genus was the extreme shortness of the abdomen, which he considered terminated almost immediately after the last pair of feet in a swollen, semiglobular lobe filled with a blackish matter, and having springing from it a long thread-like body, of a dark colour also, and which he conjectured might be an oviduct. In the British Museum are many specimens of this little animal, received by Dr. Leach from M. Cuvier, and labelled by Dr. Leach himself, "*Artemia Eulimene*, from Nice, given by M. Cuvier." From a careful examination of this species I consider it specifically identical with the *Cancer salinus* of Linnæus, the *Artemia salina* of Leach. The specimens in the Museum are all females, and upon comparing them with specimens of *Artemia salina* from Lymington, no difference is perceptible, except that the specimens from Nice are rather whiter in colour and have the ovarian bag and abdomen of a darker hue. It is undoubtedly this dark-coloured ovarian bag that was mistaken by Latreille for the termination of the body, and the "long filament like an oviduct" which springs from it, is in reality the abdomen. The difference in colour evidently depends upon the food of the animal, the alimentary canal of the specimens from Nice being filled with a dark-coloured matter, thus giving the abdomen a blackish hue, while those from Lymington have the canal filled with matter of a brownish tint. In the second edition of the 'Règne Animal,' in his notice of the *Artemia salina*, Latreille says, it is a species, "sur lequel nous n'avons encore que des renseignements très imparfaits." From this it would appear that he had never seen that species, and as most probably the specimens he had received from Cuvier were a little injured from having been preserved in spirits, it is not at all surprising that he did not observe the identity of the two.

2. Artemia Milhausenii, Fischer. *Antennis inferioribus maris gracilibus, articulo secundo angusto; segmentis duobus cephalicis longis, segmento caudali bilobato, non setigero.*

Long. 5 lin.

Branchipus Milhausenii, Fischer, Bull. de la Soc. Imp. Nat. Moscou, vii. 1834.

Artemia Mulhausenii, M. Edwards, Hist. Nat. Crust. iii. 370.

Artemia salina, Rathke, Faun. der Krym. 395. t. 6. f. 14–21.

Hab. In lacu salino "Loak" in Crimea; *M. Milhausen.*

This species, which was found by M. Milhausen in the salt-water lake of Loak in the Crimea, is about 5 lines in length and of a brown colour. The inferior antennæ of the male are much more slender than in the preceding species. The basal joint has no tooth and the terminal joint is cylindrical and pointed. The superior antennæ, according to Fischer, have the first joint very short and of an obconical form, and the two cephalic segments are considerably elongated. The abdomen is slender, shorter than the body, and is terminated by a simple bilobed process not furnished with setæ. The feet are rather long, and the terminal joint is armed with long filaments.

In the month of July these animals abound in great numbers; they fill the lake and give the water a brick-red colour.

3. Artemia Guildingii, Thompson. *Species hæc, reperta in India Occidentali, delineata est a Domino Thompson in* 'Zoological Researches,' *sed non descripta, necnon satis accurate delineata est.*

Artemis Guildingi, Thompson, Zool. Research. Fasc. v. t. 1. f. 11.

Hab. In insula "St. Vincent's," in India Occidentali; *Rev. L. Guilding.*

This species is figured by Mr. Thompson, but not sufficiently described to enable me to give a good diagnosis of it. It was found at St. Vincent's in the West Indies by the Rev. Lansdowne Guilding, by whom its natural history was intended to have been more fully detailed. The body seems to be thick and the abdomen shorter than the body and stout. The caudal segment does not appear to be lobed nor setigerous. The cephalic segment is conical in shape, and the superior antennæ, according to Mr. Thompson's figure, consist each of four joints. The ovarian sac consists, according to the same authority, of two articulations.

4. Artemia arietina, Fischer. *Antennis inferioribus maris validis, articulo secundo latissimo, basali unidentato; antennis superioribus apice furcatis, setigeris; segmento caudali bilobato, lobis setigeris.*

Long. 4–6 lin.

Artemia arietina, Fischer, Middendorff's Sibirische Reise, ii. 156. t. 7. f. 31–35 (1851).

Hab. In vicinitate urbis Odessæ; *Middendorff.*

This species, which was found by Middendorff in the neighbourhood of the town of Odessa, is about from 4 to 6 lines in length. It approaches very near to the *Artemia salina*. The inferior antennæ in the male have the second joint very broad and flat and sharp-pointed. The superior antennæ are forked at the extremity, the forks unequal, each having two terminal setæ. The eye is very large and the caudal segment is bilobed, each lobe terminating in three pretty long setæ.

5. Artemia Koppeniana, Fischer. *Antennis duabus ut in præcedente; segmento caudali non lobato nec setigero.*

Long. $2\frac{1}{4}$–3 lin.

Artemia Koppeniana, Fischer, Middendorff's Sibirische Reise, ii. 157. t. 7. f. 36–37 (1851).

Hab. In Russia Australi; *Koppen.*

This species was found in Southern Russia by M. Koppen, and is only from $2\frac{1}{4}$ to 3 lines in length. Its principal difference consists in the form of the caudal segment, which is not lobed at the extremity, but is simply squared off and has no setæ springing from it.

Genus Polyartemia, Fischer.

Corpus molle, gracile; segmentum caudale pinnis nullis instructum; pedes branchiales, paribus novemdecim. Antennæ inferiores maris bi-articulatæ, articuli terminales in ramos duos divisi et dentibus numerosis instructi; articuli basales appendicibus tenuibus armati.

Polyartemia, Fischer, Middendorff's Sibirische Reise, ii. 154 (1851).

This genus was founded by Sebastian Fischer to receive a species of the family *Branchipodidæ*, which differs in some respects from any of the genera of the family. It is furnished with appendages to the male inferior antennæ, which are two-jointed, approaching in this respect to the genus *Chirocephalus*—and it is destitute of caudal fins, resembling in this structure the genus *Artemia*—but the number of feet is nineteen pairs, and the male inferior antennæ have each of the terminal joints divided into two broad, flat branches, the one overlying the other like the branches of a pair of scissors. These branches are furnished on their edges with three or four rows of sharp teeth. The basal joint has a rounded process at about half its length armed with short setæ. The appendages attached to these organs are conical in form, thin, and apparently not provided with digitiform or flabelliform appendages. The abdominal portion of the body is shorter in proportion than in any of the other genera, and the ovarian sac of the female is moderately large and lies close upon the abdomen, seeming when viewed from above to be amalgamated with it. The male organ is cylindrical, four-jointed, and is contained in a sheath which is serrated on one side.

Polyartemia forcipata, Fischer, Middendorff's Sibirische Reise, ii. 154. t. 7. f. 24–28.

As this is the only species yet known, the generic characters given above will suffice.

Hab. In fluviis "Trundra, Taimyr et Boganida" in Siberia; et prope "Tri-Ostrowa" in Lapponia; *Middendorff.*

Species hujus familiæ, incertæ sedis aut quæ dubiæ sunt—

Genus Branchipus?

1. *Branchipus ferox*, M. Edwards, Hist. Nat. Crust. iii. 369.

This species, according to M. Milne-Edwards, has neither the antenniform appendage attached to the inferior antennæ of the male of *Branchipus*, nor the complicated apparatus of *Chirocephalus*. They are pointed at the extremity, and thus differ also from these organs in *Streptocephalus*. The description given of this species by M. Edwards is so short, that it is difficult to say to what genus it may belong. His description is as follows:—"Cornes céphaliques sans appendice près du côté interne de leur base, pointues au bout et sans dent sur le bord externe. Abdomen lisse, nageoires caudales longues et étroites. Longueur environ 15 lignes. Habite les eaux douces aux environs d'Odessa."

2. *Cancer paludosus*, Müller, Zool. Dan. ii. 10. t. 48. f. 1–8; Herbst, Krabben, ii. 118. t. 35. f. 3–5.

Most authors have assumed this species to be the same as the *Chirocephalus diaphanus*. As M. Milne-Edwards very properly observes, however, the figure of this species given by Müller shows no appearance of the complicated apparatus belonging to the male antennæ of *Chirocephalus*. There does not appear either to be any antenniform appendage belonging to them, as in the genus *Branchipus*, and the structure of the antennæ themselves removes it also from the genus *Streptocephalus*.

3. Some fragments of a species of Branchipode were brought by Sir John Richardson from Cape Krusenstern in N. America, collected there by Mr. J. Rae in August 1849, along with the *Apus glacialis*. They consist of portions of two males and two females. The male antennæ are two-jointed; the basal joint is thick, and has at its lower part near its junction with the second a row of small teeth; the second joint is cylindrical and pointed. The female horns or antennæ are flat apparently, and have a short hooked spine at the extremity. The caudal fins are rather long and fringed with long cilia. In some respects this species resembles the figure of the *Cancer paludosus* of Müller, but the fragments are too much decayed in the spirits to enable me further to describe it. It does not appear to have either antenniform appendages or any apparatus attached to the antennæ of the male.

Should these three species prove to be distinct, they may form another genus of this family, characterized by the want of these appendages and the toothed or serrated basal joint of the male cephalic horns.

Genus Streptocephalus?

4. A figure of a species of Branchipode was exhibited at a meeting of the Zoological Society by Dr. Nicholson in February 1851. The figure was not sufficiently accurately made to enable the species or genus to be made out. In all probability, however, it may prove to be a species of *Streptocephalus*. It is a native of India and inhabits freshwater ponds.

Genus Artemia?

M. Audouin, in the Ann. de la Soc. Ent. de la France, v. Bull. 61, 1836, mentions a species of *Artemia* closely allied to *Art. salina*, as inhabiting the salt lakes of Egypt. In the Ann. des Sc. Nat. 2nd ser. vi. 230, he again mentions the fact, that numbers of *Artemiæ* have been found in the "lacs de natron" in Egypt; but no further description has ever been given of them.

Family Limnadiadæ.

Genus Limnadia.

Sp. Limnadia antillarum, nov. sp.

Carapace valves of a rounded oval shape, and of a transparent whitish colour; prominent on dorsal margin where the muscular attachment of the body takes place, sloping from thence rather suddenly towards anterior extremity where it forms a somewhat blunt point, and more gradually to posterior extremity, which, as well as ventral margin, is rounded. Antennules bluntly serrated or crenulated on their upper edge, rather shorter than the peduncles of large antennæ, which are stout and not half the length of the body. They consist of nine articulations, each having one or two long plumose setæ springing from the under edge, and one short stout spine at each joint on the upper edge. Caudal lamellæ of considerable length, and beset on upper edge with long plumose setæ to within a short distance of the tip, which is somewhat curved, sharp-pointed and slightly serrated on upper edge. Feet 18 pairs.

The structure of the carapace is the same as in *Limnadia Hermanni*, the surface being covered with minute dots or puncturations.

This species differs from the two others in the shape of the carapace and in having the setæ of antennæ and tail plumose.

Hab. St. Domingo, West Indies; *M. Sallé*. Mus. Brit.

Genus Estheria.

Sp. Estheria Dallasii, nov. sp.

Carapace valves shortly obovate and flat, upper margin from the beaks to two-thirds of its length almost straight; anterior extremity rather broader than posterior. Beaks prominent and situated near anterior extremity. The shell is of a light horny colour and very thin and translucent. Ribs elevated, smooth and numerous, about 20 in number. The intermediate spaces are concave and are covered all over with rough-looking spots of an irregular size and appearance, approaching somewhat in structure to that of *brasiliensis*. It differs from that species however in size and in being of a more rounded oval shape.

Hab. Brazil? I am indebted for this species to Mr. Dallas, who found it in a collection of insects chiefly from Brazil. Mus. Brit.

BOTANICAL SOCIETY OF EDINBURGH.

June 8, 1854.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "On the Plants of the Coal Epoch, and on the general Structure of Coal," by Professor Balfour.

After alluding to the importance of studying carefully the Fossil Flora, Dr. Balfour proceeded to make remarks on the structure of the plants connected with the Coal epoch. He particularly noticed the occurrence of scalariform, pitted, and punctated vessels. He was disposed to think that porous vessels had been in some instances mistaken for true punctated woody tissue, which is characterized by the presence of a circle and a dot in the centre. The presence of *Sigillariæ* and *Stigmariæ* in coal, and the conversion of their outer portion into carbonaceous matter, clearly showed that these plants were concerned in the formation of this material. He did not agree with those who supposed that coniferous wood alone formed coal, nor with those who thought that certain rings which appeared on sections of coal parallel to the plane of stratification were the ends of woody tubes. Various plants appear to have joined to form coal, which may account for the differences in the appearance of different parts of the same bed. Specimens were shown of Parrot coal enclosing numerous thin seams of Cherry coal. The extensive fern vegetation of the carboniferous epoch was probably connected with a paucity of other species, and seems to indicate a uniformity of temperature throughout a large area. Many plants, however, which are considered as Ferns, or allied to Ferns, may prove to be Gymnosperms.

True punctated coniferous structure may be seen occasionally in coal, but it must be borne in mind that this tissue occurs in other plants, such as *Winteraceæ*, and that tissue very much resembling it, and apt to be confounded with it, has also been detected in many other orders. Much is still wanting to enable a fossil botanist to speak decidedly in regard to the true nature of many of the coal plants. In many coals evident sporangia have been detected in large quantities. These resemble the spore-cases of Lycopods. In Fordel coal these sporangia are in vast abundance, and they are associated with Middletonite.

The varieties of coal are very numerous. There is a gradual passage from Anthracite to Household and Parrot Coal; and the limit between coal and what is called bituminous shale is by no means definite. Judging by chemical products, as well as by microscopical and other characters, there seems no reason for separating Boghead or Torbane, Capeldrae, Methil, and other brown Parrot coals from the category of true coals. Dr. Fyfe has instituted careful analyses, by which he showed that Boghead Gas Coal and Boghead Household Coal yield the usual coal products, viz. ammoniacal liquor, tar, naphtha, benzole, naphthaline, grease oil, pitch oil, paraffine and pitch. As to bitumen, a matter soluble in naphtha, this exists in very small quantity in coals, and is less abundant in Torbane coal than in English caking coal. Dr. Fyfe states that in—

	Per cent.
Capeldrae coal there is of matter soluble in naphtha .	0·0
Torbane black coal	1·2
Torbane white coal	1·4
Lesmahagow	2·33

While in English caking coal it is 4·2, 5·8, and even 8 per cent.

According to Dr. Fyfe, the following are some of the results as regards volatile matter and coke :—

	Volatile matter per cent.	Coke.
Lancashire coal	26·6	73·4
Boghead coal	69·0	31·0
Wemyss, Capeldrae, Methil		33·41
Methil, upper part of seam	70·5	
Methil, lower part of seam	37·7	

While in Boghead coal the quantity of carbon is small, the quantity of hydrogen is large, and hence there is a small proportion only of fixed carbon left. There is a difference in the quantity of coke according as the coal is heated slowly or rapidly; when the heating is rapid the quantity of coke is smaller. The quantity of white ash left by many coals is very large. This is particularly the case in Lochgelly, Capeldrae, Wemyss, and Torbane coals.

On reviewing all that had been recently done in the examination of coal, Dr. Balfour is disposed to think that there is still a great want of information on the subject, and he particularly alluded to the fact that no chemist had given an analysis of the reddish-brown or yellow matter which is met with in coal, more particularly in Boghead gas coal, and that until this was done it was impossible to decide as to its bituminoid or resinous nature.

Professor Fleming entered at length upon the subject of the formation of coal, and alluded particularly to the differences often observable in strata of the same bed, which he thought indicated a difference either in the materials of which they had been formed, or in the manner in which the deposit had taken place. He heartily concurred in Professor Balfour's views.

Professor Edward Forbes stated that although he had not hitherto taken part in the investigation that had recently occupied so much attention in Edinburgh, he felt that it was one of great importance. He thought a mistake had occurred in regarding coal as a mineral rather than as a rock, and showed that we ought not to confine our ideas of coal to the deposits of the carboniferous system. He particularly alluded to the cretaceous and to other beds of coal found in various parts of the world. He thought Dr. Fleming's views to be nearer the truth than any that had as yet come under his notice. We are very much in the dark as to the real character of many of the fossil plants, and more so in regard to those which have been converted into coal, even if it were necessary to assume that that material was entirely of vegetable origin.

2. "Notice of new localities for rare Plants in the neighbourhood of Edinburgh," by Professor Balfour.

LINNÆAN SOCIETY.

December 20, 1853.—Thomas Bell, Esq., President, in the Chair.

Read, a "Notice regarding a Weevil of the Vine and its Parasite." By John Curtis, Esq., F.L.S. &c.

Numerous insects have long since been noticed as injurious to vines in the South of Europe, and their history and œconomy have been ably discussed by Baron Walckenaer and M. Audouin. Among the Beetles is a weevil, named by Fabricius *Attelabus Betuleti* (*Rhynchites* of Schönherr and other authors), which occasionally produces very extensive mischief to the vines of Burgundy, while in England its attacks are limited to the birch. During a residence at Genoa in June last, Mr. Curtis was obligingly taken to the Botanic Garden by M. Mussino to see alive the *Chrysomela Americana*, L., which inhabits a species of lavender, and his attention was called to the vines against the walls, which were attacked by the mildew, so widely spread during the past summer through Médoc and the wine-growing districts of France and Italy, and especially in Tuscany and Piedmont. While examining this mildew, he perceived many of the leaves of the vine rolled up like cigars; but the elaborate memoir of M. Debey on *Attelabus Betulæ*, L., renders it unnecessary to enter into detail on the wonderful mode in which these little animals generally cut and roll the leaves with mathematical precision. It is necessary, however, to state that the female weevil cuts the leaf through across the diameter, without dividing the midrib, then deposits an egg or two upon the upper surface, and subsequently rolls up the lower portion, leaving the upper part untouched, so that it remains green, and the leaf does not fall off for a considerable period, often probably until the tree sheds its leaves. In her mode of manipulation, however, the *Attelabus Betuleti* seems to differ from the *A. Betulæ* and most other weevils, inasmuch as the author observed, on cutting transversely, that the entire leaf appeared to be rolled up, from the base to the tip.

Mr. Curtis's principal object, however, in bringing the subject before the Society, was to call attention to a memoir by Prof. Filippi of Turin, published in the 'Nuovi Annali delle Scienze Naturali di Bologna' for January and February 1852, entitled "Storia Genetica di un Insetto Parasito delle Uova del *Rhynchites Betuleti*," a notice of which is given in the 'Annals of Natural History' for June of the same year.

Read also "Remarks on the so-called Eye-spot of the *Infusoria* and Microscopic *Algæ*." By Arthur Henfrey, Esq., F.R.S., F.L.S. &c.

Mr. Henfrey states, that in the course of an extensive series of observations on the microscopic Algæ, especially in investigations of the effect of reagents upon the tissues and contents of the cells, he has frequently been completely baffled by the uncertainty which presented itself as to the real existence of colours exhibited by objects. The decomposition of light taking place in these minute bodies under high magnifying powers is such, that even with lenses most carefully corrected and fully sufficient for all general purposes of investigation, we are left altogether in doubt as to whether or not the phænomena of colour arise from refraction. He uses lenses made by Ross about eight years since, a quarter and an eighth of an inch, the latter of excellent defining power, and is convinced that these are not inferior to any glasses in use on the continent. But with them, particularly the latter, delicate membranes seen edgeways exhibit a blue tint, under certain circumstances, often giving rise to a difficulty in arriving at a decided opinion in questions connected with cellulose, when using the sulphuric acid and iodine test. Many phænomena might be cited in reference to this subject, but the main point to which he wishes to direct attention is, the doubt existing in his mind as to the nature of the red spot described by Ehrenberg as an 'eye' in the Infusoria. He has observed this object chiefly in the unicellular *Algæ* and zoospores, and was first led to suspect that the red colour depended on unequal refraction, in the cells of *Chlamydomonas Pulvisculus*. In these he has frequently found several red spots on one individual cell, which however could not all be brought into focus at once, and he has decidedly observed, that when these spots were brought into clear and well-defined focus, they appeared as bright colourless granules. Frequently no red spot at all could be found.

The idea suggested by this was further confirmed by noticing the similar variations of colour according to form in a granule (nucleolus ?), in a half-decomposed, colourless, diseased cell.

Finally, he had recently found that he could bring out the crimson colour most beautifully in the central spot or 'hilum' of starch granules. When the lens is a little too far away from the object, the hilum appears like a minute black spot; then, carrying the lens a little nearer, it comes out as a beautiful crimson spot exactly like an 'eye-spot' in every respect. Adjusting the focus exactly, by bringing down the lens a little more, the hilum is seen as a well-defined spot of a brighter character than the rest of the starch-grain, but altogether devoid of any prismatic colour.

Although dwelling but briefly on this question here, Mr. Henfrey states that he has had it under consideration for some time, and he thinks it desirable to make known his supposition now, in order that other microscopists working with different lenses may direct their attention to the point, and furnish the results obtained with them, since almost all high objectives differ slightly in their correction.

Read further, "Notes on the Natural Order *Crescentiaceæ*." By Berthold Seemann, Esq., Ph.D., F.L.S. &c.

The author cites first the opinions in relation to the proper position of the genus *Crescentia* and its allies in the natural system successively entertained by De Jussieu, Endlicher and DeCandolle, the latter of whom associated them with *Bignoniaceæ*. Gardner first pointed out their claims to be regarded as a distinct natural order allied to the family last named, and Prof. Lindley adopted this view and first gave a diagnosis of the order, taken however only from a single species, *Crescentia Cujete*, L., for which reason Dr. Seemann proposes the following amended character.

CRESCENTIACEÆ.

Frutices vel arbores, glabræ v. glabratæ; caule ramisque plùs minùsve angulatis. *Folia* alterna, fasciculata, v. opposita, petiolata v. subsessilia, nunc simplicia, sæpissimè integerrima, nunc composita, 3-foliolata, v. pari- v. impari-pinnata. *Stipulæ* nullæ, v. interdum e gemmæ axillaris foliis primariis spuriæ. *Flores* hermaphroditi, subregulares, v. irregulares, terminales v. axillares, v. sæpissimè ex trunco aut basi ramulorum orti. *Calyx* liber, gamophyllus, persistens, 5-merus, v. varius, deciduus, spathaceus, v. bipartitus. *Corolla* hypogyna, gamopetala, subcampanulata, infundibuliformis, v. hypocraterimorpha; limbo 5-lobo, subæquali v. subbilabiato; lobis per æstivationem duplicato-plicatis v. subplicato-imbricatis. *Stamina* 4, cum rudimento quinti, corollæ tubo inserta, ejusdem laciniis alterna, exserta v. inclusa. *Filamenta* simplicia. *Antheræ* biloculares. *Discus* hypogynus glandulosus, ovarii basin cingens, sæpè obsoletus. *Ovarium* liberum, 1-, 2-, v. rariùs 4- v. pluriloculare. *Ovula* indefinita. *Stylus* terminalis, simplex. *Stigma* bilobum, v. bilamellatum. *Fructus* baccatus 1-, 2-, v. rariùs 4- v. plurilocularis. *Semina* plurima, aptera. *Albumen* nullum. *Embryo* rectus, v. subcurvatus.

Crescentiaceæ thus defined inhabit chiefly the tropical and subtropical regions of America and Africa: they are not found in Europe or Australia, and only one species is met with in Asia. Several species are cultivated, and have become naturalized in different parts of the Old World; none possess any poisonous qualities. As far as at present known, the Order is composed of about thirty species, distributed under nine genera.

Dr. Seemann next adverts to the genus *Oxycladus*, described by Mr. Miers in the twenty-first volume of the Society's 'Transactions' and referred by that gentleman to *Bignoniaceæ*, of which he regards *Crescentiaceæ* as one division, while he forms another division of the genus *Oxycladus*. Dr. Seemann, however, states his opinion that *Oxycladus* has nothing to do with *Bignoniaceæ*, even in the widest sense, but belongs to *Myoporaceæ*, being allied to *Stenochilus*, R. Br., and *Bontia*, L.

In conclusion, the author states that he distributes the true *Crescentiaceæ* into two sectional subdivisions, as follows:—

1. Tanæcieæ. Calyce persistente, regulari, 5-fido—*Colea, Periblema, Phyllarthron, Tanæcium, Tripinnaria, Sotor* (?).
2. Crescentieæ. Calyce deciduo, irregulari, spathaceo v. bipartito—*Parmentiera, Crescentia, Kigelia.*

He adds that all the plants belonging to the Order have a tendency to form winged petioli; and thinks it not improbable that the simple-leaved species may hereafter be looked upon as plants with abortive leaflets and highly-developed phyllodia. The ovary too, he remarks, in all *Crescentiaceæ*, is unilocular, with a truly parietal placentation; and it is only when the placentæ meet, as they generally do when the fruit approaches maturity, that the placentation appears to be axile, and the fruit two- or more celled.

MISCELLANEOUS.

On the Development of Cœnurus cerebralis. By Prof. Van Beneden. Extracts from letters to M. de Quatrefages.

The following is the result of the experiments on *Cœnurus*. You know that M. Küchenmeister had a dog which had been fed with *Cœnuri* at the beginning of March in the present year, and which had been passing *proglottides*. This dog was killed on the 24th

May, and M. Küchenmeister forwarded some of the Tænias of the *Cœnurus* to Louvain, Copenhagen, and Giessen. They arrived at Louvain alive on the 27th May. They were immersed in the white of an egg. I kept them alive for eight days, by renewing the white of egg every day.

On the day of their arrival, at nine o'clock in the morning, half a proglottis was given to each of two young sheep, about two months old, and in the afternoon each of them took an entire proglottis. On the 3rd June, one of them, marked No. 1, swallowed another proglottis.

The first symptoms of vertigo made their appearance on the 13th June; on the morning of the 15th, I was told that the one marked No. 2 was dying. Its head was burning hot, its eyes red, its legs bent under its body; it beat with its head against the railings, and turned it constantly in one direction. It was then killed.

The upper and lower surfaces of the two hemispheres of the brain presented very irregular grooves, which might be taken for the deserted tubes of certain Annelida; these have been already mentioned by M. Küchenmeister. There were about a dozen of them. At the end of these tubes there were the same number of *Cœnuri*, almost all lodged in the cortical substance of the brain. Some of them were removed with the membranes of the brain. They were nearly of the same size, about three or four millimetres in diameter. These *Cœnuri* as yet only consisted of a simple milk-white vesicle filled with fluid. The heads (*scolex*) were not yet to be seen. It is the *hexacanthous* embryo (*proscolex*) a little more developed than at its exit from the egg.

These observations agree exactly with those of M. Küchenmeister.

In the muscles, and especially in the diaphragm, I afterwards found some yellowish-white bodies, which may easily be distinguished by the naked eye amongst the red muscular fibres. These, as M. Küchenmeister has stated, are only strayed individuals, which are never further developed.

The second sheep (No. 1) was killed on the 29th June. It presented nearly the same symptoms as the former. For the last few days of its existence, the right fore-leg was always bent, and in walking it could not support itself upon its hoofs.

In removing the brain from the cranium, a *Cœnurus* of the size of a small nut fell upon the dissecting-table. Two other *Cœnuri*, of the same size, were found in the right hemisphere, one above, the other behind; and in separating the hemispheres of the cerebellum, I found two others touching the quadrigeminal tubercles. The left lobe of the cerebellum also contained one. Eight were found in all. These *Cœnuri* were nearly all of the same size, except two or three which were scarcely larger than a cherry-stone.

Through the walls of the larger ones, the naked eye could distinguish some little whitish flakes,—the indications of so many heads (*scolex*). The smaller ones had no appearance of heads, nor of the place from which they were to rise.

The *Cœnuri* were enclosed in a membrane of recent formation, produced by the inflammation of the neighbouring surfaces. This membrane is formed of fibro-plastic tissue, or of embryonal cellular tissue, covered with a multitude of elementary granulations.

At this period of their development, these worms are very curious. The scoleces were beginning to be formed; but, as I expected, they had as yet neither hooks nor suckers. The head, with its suckers and hooks, would only have begun to show itself in eight days afterwards.

In drawing one of these worms from its cavity and bringing it immediately upon the object-slide of the microscope, one is astonished at the great contractility of its walls. Its surface becomes wrinkled, its edges fringed, and the worm performs tolerably extended motions, which explain its action upon the cerebral mass; the substance of the brain in fact yields to the pressure of the parasite. Cells are distinctly seen in the walls of the vesicle, and it is to their contraction that its movements are due.

Beneath the walls of the vesicular worm, vessels are to be seen very distinctly, which anastomose like a capillary network; they correspond with the ordinary secretory apparatus of the Cestoid and Trematode worms.

When a scolex is about to be formed in the parent vesicle, the surface of the vesicle becomes wrinkled in a certain spot; these wrinkles become circular; the centre is then depressed, an eminence appears in the centre of the depression, and the future scolex is seen. Round the circular wrinkles, moreover, calcareous corpuscles may already be seen, similar to those which incrust the body of the scolex, but which do not exist on the hexacanthous embryo or proscolex.

M. Eschricht writes to me as follows from Copenhagen, under date the 20th June:—

"The *Cœnurus-Tœnia* taken from the dog on the 24th May at Bautzen, arrived at Copenhagen on the forenoon of the 26th, so that they could be swallowed by three sheep, within forty-eight hours of their removal from the intestines of the dog. One of the sheep has not been affected by them, but the other two were taken ill on the fifteenth and sixteenth days. They kept their heads turned to the right, and one could not rest except on the left side, without being seized with violent spasms. The inflammation of the brain was very distinct, the eyes very red. They both died on the fourth day, and I found a large quantity of small vesicles (2 or 3 mill. in diameter) in the pia mater and in the cortical substance. In the muscles in general, and in the walls of the heart, as well as beneath the skin, there were also vesicles full of a yellowish matter, which are probably, as supposed by MM. Küchenmeister and Harchner, aborted individuals."

I have also received intelligence from Giessen. M. Leuckart has observed the symptoms to rise in the same period, and has found the *Cœnuri* in the same state of development.

To those who can believe that the preceding results are mere coincidences, I may observe, that the *Cœnurus* is so far from being common here, that I waited three years before I was able to obtain one for my collection; and that as I can say beforehand I shall find *Cœnuri* of such a size and of such a degree of development, the question of coincidence is set at rest. It might as well be said, that the plants we gather do not arise from the seeds which have been put into the earth.—*Comptes Rendus,* July 3, 1854, p. 46.

THECACERA PENNIGERA.

To the Editors of the Annals of Natural History.

Weymouth, August 13, 1854.

GENTLEMEN,—I have the pleasure of announcing the capture by myself of two specimens of what I consider, without the slightest doubt, to be *Thecacera pennigera* of Montagu: see Brit. Moll. iii. p. 575. The only difference I can at present detect is in the number of appendages surrounding the vent. Montagu makes them five in number, whilst I make them three. I feel considerable doubt in any way questioning the accuracy of such an extraordinarily accurate observer as Montagu. I have placed the specimens in far more able hands than mine for description. The first specimen lived in my dredging vessel, in a bottle of salt water, for six weeks. It is a very lively animal, and fond of swimming foot upwards on the top of the water. This was obtained on the 31st July last. The second specimen I caught yesterday, whilst fishing in ten fathoms water, gravelly bottom, in company with Mr. H. Adams and two other friends; this was dispatched by post. I yesterday obtained, for the first time *this season, Antiopa cristata*; they were, however, small.

I am, Gentlemen, yours truly,

WILLIAM THOMPSON.

P.S.—Since writing the above, I have received a communication from Mr. Albany Hancock, to whom I had sent the specimen obtained on the 31st July, and who fully concurs with me as to its being the true *Thecacera pennigera*.

ATHYRIUM RHÆTICUM.

To the Editors of the Annals of Natural History.

British Museum, 28th August 1854.

GENTLEMEN,—The year before last I gathered at Eridge, near Tunbridge Wells, on a bit of ground from which trees had been recently removed, some plants of *Athyrium Filix-fœmina* with the erect habit, curled pinnules, and apparently linear frond, which are given by Mr. Moore, in the 2nd edition of his 'Handbook of British Ferns,' as the characteristics of *A. rhæticum*; I have since noticed in Scotland that plants of this species, growing on walls where they are exposed to the sun, frequently assume a similar habit; and on recently visiting a part of Tilgate Forest, where I had, two years since, gathered abundance of the normal state of *A. Filix-fœmina,* together with most luxuriant specimens of *Polypodium Phegopteris,* I found (the trees having been cleared away in the mean time) only the *rhæ-*

ticum form of *Athyrium,* and some much-dwarfed *P. Phegopteris*: the *Athyrium* had all the characters of *A. rhæticum* most thoroughly developed, and yet I cannot but think that the same plants were the normal state of *A. Filix-fœmina* two years back; the pinnules of *P. Phegopteris,* even, had a strong inclination to curl. These observations induce me to believe that *A. rhæticum* and *A. Filix-fœmina* are identical, the differences between them depending only on the external conditions under which the plants grow,—the influence of the sun inducing the erect rigid habit in the fronds and pinnæ, and the curling in the pinnules of *A. rhæticum*; and shade and moisture causing the lax, drooping, dilate frond and flat pinnules observable in *A. Filix-fœmina.*

I trouble you with these remarks in the hope that, should you insert them in the 'Annals,' some of your readers may be able to confirm my observations.

I am, Sir, yours very obediently,
S. O. Gray.

On the occurrence of Larvæ of Sarcophaga *in the Human Eye and Nose.* By Dr. E. Grube.

Several cases of the occurrence of the larvæ of insects in the human eye have been noticed, but the species or even the genus to which they belonged has never yet been ascertained. Thus a communication of Cabrira's, in Von Siebold's Report upon the progress of Helminthology in 1848, mentions that a man who had slept in the open air was attacked by pain in the left eye on the following day. A small red spot was observed on the sclerotic coat, and on rubbing with the upper eyelid, small white worms appeared upon the cornea and the rest of the eyeball; about forty of them were removed. They were of the thickness of a hair, half a line long, and had a small black head. Ormond also observed two cases of inflammation of the eye in which several small larvæ of Dipterous insects made their appearance.

I have to communicate an analogous circumstance observed by Dr. Schnee of Gorigoutzk, in which the specific determination of the insect was possible. Two boys, one four, the other twelve years old, who had slept in the open field during some hot weather, felt, on awaking, a smarting pain in the inner angle of the eye, which gradually increased with violent inflammation, until at last the affected eye lost all power of sight. On examination, Dr. Schnee found in the angle of the eye a mass of maggots, which had destroyed the conjunctiva and the cellular tissue, and penetrated so deeply into the orbit that the hinder end was completely imbedded between the orbit and the eye-ball, although the length of the body is stated at 9 lines. After all the larvæ had been removed (there were about twelve or fifteen of them), the internal muscles of the eye were seen as completely freed of cellular tissue as if they had been prepared.

In drawing the larvæ out with forceps, most of them were so injured that they did not assume the pupa state; some acquired this form, and of these I have the flies before me. They belong to the genus *Sarcophaga*, and are either the *S. ruralis* or *S. latifrons*, Fallen *.

Dr. Schnee adds, that he has met with similar but smaller larvæ in the nose of a Jewess, who experienced indescribable pain in that part; he was unable, however, to extract them uninjured, so that they did not attain the pupa state.

According to Ruthe †, the larva of *Sarcophaga latifrons* has repeatedly been extracted from ulcers of the ear.—*Archiv für Naturgeschichte*, xix. p. 282.

METEOROLOGICAL OBSERVATIONS FOR JULY 1854.

Chiswick.—July 1. Heavy rain : overcast. 2. Very fine : slight rain. 3. Slight rain : fine. 4. Densely clouded. 5. Showery. 6. Very fine : heavy showers. 7. Overcast : heavy showers. 8. Rain : very fine : clear. 9. Very fine : cloudy. 10. Showery : heavy rain at night. 11. Cloudy. 12. Drizzly : densely overcast. 13. Very fine. 14. Overcast : clear. 15. Densely clouded : very fine. 16. Very fine. 17. Rain : very fine. 18—21. Very fine : air very dry. 22. Quite cloudless. 23. Clear and calm. 24. Sultry : lightning at night. 25. Very hot : lightning at night. 26. Slight haze : cloudy : rain. 27. Easterly haze : rain. 28. Clear and fine. 29. Slight fog : cloudy. 30. Very fine : thunder-storm 2 to 5 P.M. 31. Uniformly overcast : heavy thunder clouds.

Mean temperature of the month	61°·59
Mean temperature of July 1853	61 ·94
Mean temperature of July for the last twenty-eight years...	63 ·17
Average amount of rain in July	2·42 inches.

Boston.—July 1. Cloudy : rain A.M. 2. Cloudy. 3. Cloudy : rain P.M. 4. Fine : rain P.M. 5. Fine. 6, 7. Cloudy. 8. Cloudy : rain A.M. 9. Cloudy. 10. Cloudy : rain A.M. and P.M. 11. Cloudy. 12. Rain A.M. and P.M. 13. Cloudy. 14, 15. Cloudy : rain A.M. and P.M. 16. Fine. 17. Cloudy : rain A.M. and P.M. 18. Cloudy : rain A.M. 19, 20. Cloudy. 21. Fine : thermometer 84° 5 P.M. 22—24. Fine. 25—29. Cloudy. 30. Fine. 31. Cloudy : rain A.M. and P.M.

Sandwick Manse, Orkney.—July 1. Cloudy A.M. and P.M. 2. Cloudy A.M. : showers P.M. 3. Cloudy A.M. : rain P.M. 4. Rain A.M. : fog P.M. 5. Cloudy A.M. : hazy P.M. 6. Bright A.M. : rain P.M. 7. Clear A.M. : clear, fine P.M. 8. Bright, fine A.M. : cloudy P.M. 9. Drizzle A.M. : cloudy P.M. 10. Bright A.M. : cloudy P.M. 11. Cloudy A.M. and P.M. 12. Drizzle A.M. and P.M. 13. Rain A.M. : damp P.M. 14. Damp A.M. and P.M. 15. Rain A.M. : clear, fine P.M. 16. Cloudy A.M. : cloudy, fine P.M. 17. Damp A.M. : clear, fine P.M. 18. Clear, fine A.M. : fine, fog P.M. 19. Hazy A.M. : cloudy P.M. 20, 21. Clear, fine A.M. and P.M. 22. Showers A.M. : clear P.M. 23, 24. Cloudy A.M. and P.M. 25. Drizzle A.M. : cloudy P.M. 26. Showers A.M. : clear, fine P.M. 27. Clear A.M. : cloudy, fine P.M. 28. Clear, fine A.M. and P.M. 29. Clear, fine A.M. : cloudy, fine P.M. 30. Cloudy A.M. : fog P.M. 31. Fog A.M. and P.M.

Mean temperature of July for twenty-seven previous years .	55°·08
Mean temperature of this month	55 ·25
Mean temperature of July 1853	58 ·15
Average quantity of rain in July for fourteen previous years .	2·40 inches.

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* Dr. Grube states that he is unable to determine to which of these species his specimens belong, but gives a detailed description of them, with some critical remarks on the descriptions of other authors.

† Troschel and Ruthe, 'Handb. der Zoologie.'

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London*; *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1854. July.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·918	29·878	29·40	29·87	29·87	64	49	59	52	51½	w.	nw.	calm	·02	·35	....
2.	29·949	29·876	29·46	29·81	29·72	69	55	64	55	51½	sw.	s.	se.	·02	....	....
☽ 3.	29·805	29·620	29·30	29·63	29·48	72	56	66	55	52	sw.	ssw.	e.	·02	....	·06
4.	29·620	29·556	29·08	29·33	29·41	69	46	62	55½	53½	sw.	sw.	nne.	·01	·08	·41
5.	29·702	29·662	29·18	29·45	29·63	67	47	62	57	55	sw.	sw.	e.	·06	·01	·05
6.	29·725	29·695	29·24	29·74	29·76	67	41	67	59	54	sw.	sw.	nw.	·07		
7.	29·743	29·722	29·30	29·74	29·91	66	51	65	57	54	s.	sw.	e.	·15	....	1·01
8.	29·750	29·721	29·30	29·94	29·93	72	45	60	57½	53½	e.	nw.	n.	·05	·09	....
9.	29·773	29·723	29·28	29·99	30·04	72	49	64	53	50½	w.	nw.	n.	·02	....	....
○ 10.	29·909	29·861	29·44	30·02	30·01	67	51	56	52	50½	n.	n.	nw.	·40	....	....
11.	29·905	29·864	29·46	29·97	29·98	66	50	58	54	50	nw.	nw.	nw.	·01	·17	·03
12.	29·851	29·790	29·38	29·89	29·82	60	46	53	51½	53	n.	n.	wnw.	·17	·23	·01
13.	29·854	29·774	29·42	29·72	29·66	68	49	61	54	54½	sw.	wnw.	wsw.	....	·07	·15
14.	29·924	29·749	29·30	29·61	29·63	65	56	64	54½	54½	sw.	ssw.	w.	·02	....	·01
15.	30·096	29·769	29·33	29·73	29·87	72	47	68	54½	55½	nw.	sw.	calm	....	·03	·51
16.	30·122	29·981	29·60	29·93	29·87	77	52	62	55½	55	sw.	s.	ese.	....	....	....
☾ 17.	30·058	29·965	29·56	29·89	29·92	71	48	66·5	57½	57	sw.	ssw.	calm	·02	....	·03
18.	30·012	29·979	29·50	29·94	29·89	76	46	68	63	55	sw.	calm	ese.	....	·21	....
19.	29·980	29·960	29·45	29·75	29·73	72	43	68	55	56	sw.	s.	sse.	....	....	....
20.	30·084	30·066	29·60	29·91	29·97	80	48	70	63½	57½	sw.	wnw.	sse.	....	....	....
21.	30·173	30·163	29·67	30·02	29·99	83	46	64	58	55	sw.	calm	ese.	....	....	....
22.	30·204	30·148	29·63	29·68	29·94	84	45	67·5	58	55	sw.	ssw.	ssw.	....	....	·10
23.	30·159	30·052	29·60	29·95	30·00	89	56	70	60½	55	s.	calm	wsw.	....	....	·08
24.	30·103	30·051	29·60	30·08	30·09	85	57	70	59	55	se.	ne.	w.	....	....	....
● 25.	30·054	30·040	29·54	30·11	30·20	89	58	71	55	55	e.	nnw.	nw.	....	....	·03
26.	30·103	30·052	29·65	30·21	30·22	75	55	63	55½	54½	e.	ne.	nw.	·52	....	·04
27.	30·152	30·078	29·65	30·22	30·25	67	51	66	55½	52½	se.	ne.	n.	·02	....	....
28.	30·200	30·182	29·76	30·26	30·18	71	38	63	56½	52½	se.	nne.	ese.	....	....	....
29.	30·183	30·045	29·74	30·11	29·98	76	54	66	59	57	s.	calm	ese.	....	....	....
30.	29·969	29·816	29·50	29·85	29·77	82	56	73	59	55	s.	sse.	ese.	·46	....	....
31.	29·803	29·654	29·27	29·67	29·71	76	59	72	57½	56	sw.	sw.	e.	·36	....	....
Mean.	29·964	29·886	29·46	29·871	29·884	73·19	50·00	64·8	56·43	54·08				2·40	1·24	2·52

THE ANNALS

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

[With three Plates.]

[Continued from p. 57.]

Structure of the Branchiæ in the Lamellibranchiate Mollusks.

THE *mist* upon this branch of natural history which has survived the brightening science of a bright century may indeed refuse to be dissipated even by the achromatic microscope—the potent wand of the modern observer. That which the calm eye discerns with clearness, and the understanding interprets with confidence, though amplified many hundred diameters, is as likely to be an immutable objective truth as any "instance" within the sphere of the unassisted vision. Faith in the verity of microscopic facts is a fundamental article in the scientific creed of every living philosopher. The sphere of the naked vision is exhausted: another is opened by the microscope. Minute descriptions of subtle and complex structures, rendered possible only through its instrumentality, will prove of as great service in the hands of the future lawgivers of science, as the grosser narratives of the fathers of anatomy have already proved in the founding of the temple in which the high priests of natural theology now chant her service.

The branchial structures of the Mollusca have never yet been unravelled. The problem, though not impracticable, still awaits solution. The system of the gills is a conspicuous element in the molluscean organism. In apparent size they are considerable.

If function were expressed in numeric amount by the dimensions of the organs, the physiologist would assign to this class of animals a high degree of respiration. Minute structure is a factor in the estimate. The gills of the Lamellibranchiate mollusk are singularly and peculiarly formed: they admit of comparison in structural characters with no other organ found amongst Invertebrate animals. The *meaning* of a part is an inference of the intellect. When exact, it is founded upon a correct appreciation of structure. A 'law' is upraised upon the basis of particulars. Let the following difficult inquiry be conducted in rigid compliance with this *regulus philosophandi*. Though abundant, the elder literature upon this subject has bequeathed little that is accurate and true. Baer* alludes in a special manner to the pectinated character of the branchiæ in the Lamellibranchiata; he illustrates his description by the gills of *Mytilus*. Meckel † depicts and describes in general terms a comb-like structure in the gills of *Spondylus, Pecten,* and *Arca*. Cuvier's figures and descriptions ‡ delineate the same formation. In his valuable notes, Siebold § describes the branchiæ in *Pectunculus, Mytilus, Arca, Pecten, Avicula,* and *Lithodomus* as consisting of a system of parallel vessels. In the text of his work, however, Siebold, like Mr. Hancock, speaks of the trellis-like network of the branchial structures. Among the older authors by whom allusion is made to the pectinated arrangement of the branchial vessels, the names of Bojanus, Treviranus, and Poli may be enumerated.

The contributions of Mr. Hancock upon this subject are the most recent, special, and distinguished ‖. By this observer three types of structure are recognized. They are thus defined in his own language:—"There appear to be *three distinct modifications* of gill-structure in the Lamellibranchiata. In the first the laminæ forming the gill-plate are composed of filaments either free or only slightly united at distant intervals, as in *Anomia* and *Mytilus*; in the second they are formed by a *simple vascular network,* as in *Mya, Pholas,* &c.; and in the third the laminæ of the gill-plate are complicated by the *addition of transverse plicæ composed of minute reticulations of vessels,* as in *Chamostrea, Myochama, Cochlodesma,* &c. Other modifications may exist,

* Meckel, Arch. 1830, p. 340.

† Syst. der Vergleich. Anat. vi. p. 60.

‡ Règne Animal, nouvelle edit., Mollusques, pl. 74. fig. 2 *a*.

§ Anatomy of the Invertebrata, translated by Burnett, p. 211.

‖ The excellent papers of Messrs. Alder and Hancock, to which repeated reference is made in the text, will be found in various Numbers of the 'Annals and Magazine of Natural History' for the years 1852 and 1853. To the attentive perusal of these valuable essays the student of the subject is earnestly advised.

but these are all that have come under my observation *." In each of these "modifications" one common character is said to prevail—the vessels *reticulate*—in the first only "slightly," in the others more "minutely." Such is the structural law of the branchiæ of the Lamellibranchiates as expounded by Mr. Hancock. It is at direct variance with the prevalent and accepted definition. Dr. Sharpey says—"Each gill (of *Mytilus*) or leaf consists of two layers, which are made up of vessels set very close to one another like the teeth of a comb or like parallel bars, &c.†" "These bars are connected laterally with the adjacent ones of the same layer at short intervals by round projections on their sides," &c.‡

Here this accurate observer conspicuously indicates the difference between the solid projections interposed between the vascular bands, tying them together into a horizontal lamina, and the "transverse plicæ" of Mr. Hancock, which transform a matchless system of parallel bars into one of "minute reticulation" (Hancock), which neither the eye nor the understanding can unravel. M. Deshayes § stands in this anomalous position :—he has figured accurately what he has interpreted wrongly. Albeit to this author merit is due. He has pointed out clearly by the pencil—what really exists in nature; what he himself misunderstood; what neither Dr. Sharpey nor Mr. Hancock seem at any time to have recognized—a structure without which the gill of the Lamellibranch could not architecturally be what it is; a marvellously woven fabric, refined in the utmost degree in its mechanism, adapted with incomparable skill to the purpose in view —a structure which no observer either anterior or posterior to the time of M. Deshayes has even suspected to exist—that apparatus of transverse scaffolding (Pl. VI. fig. 1 *c*, *c*, *d*) situated between the lamellæ of the gill, crossing at right angles the axes of the interlamellar water-tubes, *j*, *j* (of the existence of which M. Deshayes had not the slightest knowledge), and doubtfully described by him as the true *blood-channels* of the branchiæ! M. Deshayes mistook the laminæ formed by the real branchial vessels for "*membranous* layers or laminæ, *within the substance of which the branchial vessels* are arranged with great regularity." His *eye* caught with correctness nearly *all the parts* of this exquisite apparatus; his reasoning then enveloped them in

* Annals and Magazine of Natural History for April 1853.

† Art. "Cilia," Cyclop. of Anat. and Phys.

‡ This concise description is rendered still clearer by the original figures which accompany the famed article of Dr. Sharpey, to which I have adverted in the text.

§ See art. "Conchifera," Cyclop. of Anat. and Phys.

confusion*. Nothing less than a *rediscovery* of these skeletal parts, by which the branchial vessels are maintained *in situ* and the whole tubular system preserved in shape, could suffice to render complete and consistent the demonstration of the anatomy of the Lamellibranchiate gills.

With the eye stedfastly fixed on these parts, it is surprising that M. Deshayes could see in them no meaning, could read in them no purpose. In defining the outline and office of the interlamellar water-tubes, it is matter of wonder that Mr. Hancock did not suspect the mechanical *necessity* for a supporting apparatus such as this, without which the water-tubes could not sustain their patency or their form. Such is the history of progress in all the manifold paths of scientific observation. Discovery must literally be *prefigured* in the intellect of the thinking observer. In the absence of the foreshadowing conception, wondrous things in nature rendered manifest by accident are vacantly gazed at, left unfathomed, and then forgotten, or mentioned only as incidents or episodes in the drama. The merit which belongs to rediscovery is too often withheld from its author. It is morally, in equity, not less worthy of honour than the first discovery.

The law was formerly stated that the blood-channels in the gills of the Lamellibranchiate mollusks occur always in every species in form of straight, parallel, independent, non-communicating tubes, supported on the two opposite sides by hyaline cartilages, generally membraniform and semicylindrically curved (Pl. VI. figs. 6 & 6^2; and Pl. VII. fig. 15). These blood-channels never reticulate. At the free border of the gill the afferent channel returns into the efferent in a looping manner (Pl. VI. fig. 1 *e, f*). The efferent like the afferent channel preserves its individuality from one border of the lamella to the other (*m, e*). The blood-current, therefore, preserves unmixedly its singularity and independence from the beginning to the end of its branchial orbit (Pl. VIII. figs. 23 & 24). This is a striking and remarkable characteristic. It is a molluscan peculiarity. Its prevalence in this class is universal. It stands in contrast with the crustacean. The network plan is here the type. In some species of Annelids the branchial vessels observe a straight, parallel, looping mode of division. In the Annelid the blood is coloured and non-corpuscular. In the mollusk it is replete with globules. The blood-globules travel through the branchial 'bars' in a single series, or two abreast. In the crustacean the blood-channels are imparietal sinuses. In the mollusk each

* The reader is requested to refer to fig. 352, article "Conchifera," in the first volume of the 'Cyclopædia of Anatomy and Physiology.'

vessel is elaborately carved and wonderfully protected (Pl. VI. figs. 6 & 6^2). The difference is as essential in kind as it is conspicuous: it may serve hereafter to establish the true direction of equivocal affinities. Subtle analogies, like deeply hidden differences concealed amid the profoundest recesses of the organism, are often more conclusive in disputative questions of specific and generic relationships, than diversities or resemblances graven prominently in the manner of the outward form.

In now entering upon the narrative of the minute structure of the gills in the conchiferous mollusks, it must be premised that illustrative types only can be comprehended in the story. Specific varieties and modifications must be left to the specific inquiries of individual observers. There prevails, however, such a remarkable uniformity in the architectural principle on which the breathing organs in all Lamellibranchiate mollusks are constructed, that departures from the central plan never involve a change of type. Such variations are apparent, not radical. Though a concise description, aided by illustrations, may enable the author to convey a readily intelligible statement of these parts, the reader must not infer that his task has been easy or his labour light. He has traversed dark and tangled controversies. For long he could pilot his course by the magnetism of no clearly-defined principle. Evidence conflicted, assertions bewildered; the subject was intricate, the clue of *principle* was wanting. He would fain trust that the history which he is about to write will transform a pre-existing chaos into the cultivated scene of exact demonstration.

The minute structure of the gills in the Conchifera may be conveniently described under the heads severally of the constituent parts of which they are formed.

1. The parallel bars or vessels forming the lamellæ.

2. The borders of the lamellæ, (*a*) attached, (*b*) free.

3. The transverse connective parts—intervascular, or intervectal.

4. The interlamellar water-tubes and the *intra-tubular framework* of support.

5. The ciliary system of the gills.

1. In the Acephalous mollusk the branchial vessel is sculptured upon one essential plan. All deviations from this plan are inessential varieties. So singularly do these blood-canals differ from ordinary blood-vessels, that they will be henceforth described under the name of "*branchial bars.*" The word 'bar' implies, first, straightness, and secondly, rigidity, two properties which belong to the branchial bars. The word 'bar' involves the idea of separateness, individuality and independence—characters which apply to the branchial bars. Rigid bars arranged

in parallel directions on the same horizontal plane would form a *stratum of bars*—such is the branchial lamella. Disposed on two coincident planes, one above the other, two parallel lamellæ would result. Between parallelly-arranged rigid bars the *inter-spaces* would be parallel and equal—such are the *intervectal** water-passages of the branchiæ. If traversed by cross threads at frequent intervals, a long fissure would assume the form of oblong foramina (Pl. VI. fig. 1 *g*, fig. 2 *e*). Such sometimes are the varieties which occur in the intervectal passages. If the parallel lamellæ be tied together at regular points by bands running with the bars, the space between the lamellæ would be divided into tubes. Thus are formed the interlamellar water-tubes (figs. 7, 9). The picture is faithful to nature. It mirrors the reality of a complex apparatus. It represents in simple outline the machinery of the branchiæ in the bivalve mollusk.

The details are now neither intricate nor unintelligible, because the *constructive idea* is clear to the intellect. In all investigations a tangibly-grasped *mental* picture must forerun the clear perception of the outward reality.

A branchial bar is a *tube* whose sides are comparatively rigid, and whose diameter is uniform (Pl. VI. fig. 6 *a, a*). It is clothed externally by a membrane, the continuation of the mantle, of which the epithelium is evolved at certain regular lines into cilia-bearing scales (*b*). The opposed sides of each bar are formed of, and supported by, cartilages (*a, a*). If these two cartilages were far removed apart, the blood-channel would be broad and flat (Pl. VII. fig. 15 *b, b, b*). These cartilages are slender in the extreme in texture; they are membraniform and exquisitely hyaline; curved at the edges, they assume the figure of a hollow semicylinder; they possess just enough rigidity to preserve the straightness of the bar; they are *continuous* throughout the whole length of the bar (Pl. VIII. fig. 17). Being placed on the opposed horizontal sides of the bars (not on the upper and under aspects), they must necessarily circumscribe a tubular channel of unbroken continuity. The sides are not perforated by openings of any description. If the transverse structures (Pl. VIII. fig. 22 *a*), afterwards to be described, be *vessels* or blood-channels, as conceived by Mr. Hancock and some of the elder anatomists, the bore of such channels cannot communicate with that of the parallel bars. The transverse parts must therefore, if they be blood-channels at all, constitute an independent system. But they are *not* so. They are con-

* From the Latin *vectis*, a bar. Since it is proposed to distinguish the branchial blood-channels under the name of bars, it is only consistent to mark the spaces between them as *intervectal*, rather than as intervascular.

nective fibrous structures (Pl. VIII. fig. 19). In almost all species of bivalve mollusks, the branchial bars more or less closely approach the cylindrical in figure. To this rule of structure those of the common Mussel form a remarkable exception: they are here blade-shaped (figs. 17 & 20). The section of the bar is frequently oval. In the genera *Cardium, Unio, Ostrea,* &c. this form is exemplified. The subcylindrical canal, circumscribed by the hyaline cartilages just described, is the true blood-channel*. All naturalists have conjectured this fact; the existence is now only for the first time *proved.* The cartilages bounding these channels are now first announced. They do not enclose the whole circumference of the vessel: they form a third of the opposite halves (Pl. VI. fig. 6^2). The rows of cilia correspond with their edges: the intervals between these edges are membranous. The real osmotic movement of the gases concerned in respiration is limited to these intervals. Along these intervals, extending with beautiful regularity from one end of the bar to the other, there travels a cilia-driven current. In *Mytilus* the bars appear to swell (Pl. VIII. fig. 17 *o, o, o*) at the points at which they are joined together by the transverse structures. The real blood-channel does not bulge. The cartilages of the bars at the base of the lamella are lost in and identified with that embracing the trunk common to the whole series (*c, c*). Traced carefully to the proximal border, they will be observed to have this disposition: the cartilages of contiguous sides of *adjoining* bars form one piece, being so bent as to become continuous at the proximal border of the lamella. The bars are thus held firmly *in situ* and in relative connexion.

At this point it becomes extremely interesting to inquire, whether the *lamella* is composed of a single series (Pl. VI. fig. 4), laid side by side, of parallel bars, or of a double series arranged in two separate planes? (fig. 5). The answer to this question will implicate an important point of function. It is difficult to convey clearly the idea of a double series of bars constituting a *single* lamella. This undoubtedly is the disposi-

* A very recent study of the minute structure of the gills in the Tunicates and Ascidians has enabled me to resolve completely the homology of the *branchial bars* in the bivalve mollusks, to explain demonstratively why it is that in the gills of some Acephalans the blood-conduits are placed like membranous channels between *alternate bars* (as is shown in Pl. VII. fig. 15, *b, b, b*), and that in others the blood-canal (as in Pl. VIII. fig. 22) occupies the *axis* of each bar. Though there exist in the gills of the Tunicata a system of large *transverse* trunks, with which the *parallel* ultimate blood-channels (the homologues of the "bars" in the Acephala) openly communicate, in *a supplementary note on this subject* in the next paper, it will be shown that the ultimate elements of the branchiæ in Tunicata and Acephala are really arranged on the same type.

tion of the branchial bars in some species of Acephala. If a "bar" be bent once upon itself (fig. 3), and if then one limb only be rested upon a flat surface, the other limb will be on the same vertical plane, but on a different horizontal plane. If a second, then a third bar, and so on, be placed in coincident directions, the limbs will form two horizontal series or laminæ, between which a free undivided horizontal space will exist (*e, f*); but there will also exist vertical spaces between each two adjoining bars having the same vertical planes. In words this arrangement is complex, in illustration simple. Now it may at first be supposed that of mechanical necessity this must be the order in which the bars are arranged in all the examples of double gills* (Pl. VI. figs. 1 & 7), as it is really that in which the afferent and efferent limbs of the same looped bar are disposed in all instances, without exception, of *single* (Pl. VI. fig. 2) gills. But it is truly the case only in a very few genera. It is so in the Mytilidæ (Pl. VIII. fig. 24). It follows that under the latter circumstances the interlamellar water-tubes must be bounded by two concentric walls (Pl. VI. fig. 5), each wall being composed of a single horizontal series of bars. Of this disposition another apparent example is afforded in the Ostreadæ; if the disposition of the loops at the free margin *only* be considered. In nearly *all* other genera, known to the author, the limbs of the same looped bar are placed on the same horizontal plane (Pl. VI. fig. 7 *f*). The plane of the loop notwithstanding at the distal border of the lamella is not horizontal, but vertical. It results that each lamella is composed of a single series of bars, though the contiguous limbs alternate in function, one conveying a centripetal, the other a centrifugal current (Pl. VII. figs. 9 & 11). But it must be remembered that a single lamella (*a* or *b*, Pl. VII. fig. 11) of a double gill is not the exact equivalent of an entire single gill (fig. 14). In *all* single gills the limbs of the same bar rest on vertical planes; those of a single lamella of a double gill are placed on the same horizontal plane (fig. 12). In the single gill the physical conditions are more favourable to the complete aëration of the blood. The water-currents are different, not the same. It will greatly facilitate the comprehension of the preceding history if now *the minute anatomy of the free or distal borders of the branchial lamella be carefully and accurately studied.*

The structure of the extreme free edge of the lamella furnishes a ready key which unlocks at once the whole mystery of the branchial apparatus; and yet this wondrous part of the organ

* The meaning attached in these papers to the *double* as opposed to the *single* gill is afterwards explained.

has never arrested the curiosity of the anatomist. In *Mytilus* and in *Mytilus* only, Dr. Sharpey figures correctly the manner in which, at the distal margin of the lamella, the bars of the upper become continuous with those of the lower lamella. In *Mytilus* the structure of the gill is almost unique (Pl. VIII. fig. 17). The order which obtains in nearly all other genera could not be deduced from the anatomy of the Mytilidan gill. It is a singular exception. It is the rare exception only that Dr. Sharpey has pictured. The *rule* of structure remained really to be discovered. If the blunt and acute edges of the penknife-shaped branchial bar (fig. 20) carry each a blood-channel, then each *gill* in *Mytilus* will be a double gill, for the upper and lower are identically formed. If, on the contrary, the blood-channel exists only at the blunt edge (*a*) of the blade, the current travelling peripherally along the bars of the upper lamella (A, fig. 17) must turn round (as shown in fig. 24 *d, d*) at the free margin through the loop and move centrally along the bars of the lower lamella (B, fig. 17). In the latter case the gill would be single, in the former double. The bars of the upper lamella when the gill is single carry currents moving in the same direction (Pl. VI. fig. 2; Pl. VII. fig. 14) from one border of the gill-plate to the other; those of the lower, oppositely tending currents (Pl. VIII. fig. 23 *e, f*). This point is the wonder-striking feature of the branchial enginery. No writer has ever given to it a single thought. It deserves to be further elucidated. In *Pholas* (Pl. VI. figs. 1 & 2), *Gastrochæna, Mya, Tellina, Mactra, Cypræa, Cardium* (Pl. VII. figs. 13 & 14), *Ostrea* (Pl. VIII. fig. 21), and probably in many other genera, the inner gill is *double* and the outer is *single*. The Pandoridæ and Lucinidæ are families in which the outer gill is altogether suppressed. In *Solen, Pecten, Unio, Venus, Kellia, Arca,* &c., the two gills on both sides are equal in size and *double* in structure.

Every gill-plate, whether single or double, is composed of two lamellæ, between which the excurrent water-tubes (see large arrows in Pl. VII. fig. 13, Pl. VI. fig. 1, and figs. 7 & 8) are situated. In the example of the double gill *each lamella* is the scene of a double system of opposed currents of blood, since the two limbs of the same looped bar lie on the same horizontal plane in the same lamella (Pl. VII. fig. 9 *c*). The adjoining limbs are thus alternately afferent and efferent, or venous and arterial. *Each lamella* then of every double gill is a complete and independent gill. Its system of circulation is distinct, and totally unconnected with that of the other lamella. Nevertheless, a single lamella of a double gill is not identical in anatomical characters, or structurally, or perhaps officially, equivalent to an entire single gill. As formerly intimated in the example of a single gill, the limbs of the same looped bar, respectively venous and arterial, are placed on different horizontal planes (Pl. VII. fig. 14), the planes of the *loops* (*a*) at the free margin being vertical, and not horizontal as they are in general in the double gill (Pl. VI. fig. 1; Pl. VII. figs. 9 & 11). The single gill, like the double, is composed of two lamellar planes (fig. 14 *b*, *c*) bounding intermediate water-tubes. But in the single gill each lamella is single in function, since it consists of the afferent or efferent limbs separately and exclusively of the looped bars. In either lamella therefore the adjacent bars belong to separate and independent loops. The component bars of the lamellæ in all single gills are separated from one another by intervectal water-fissures (Pl. VII. fig. 15 *c*, *c*, *c*). In the double gills in which the two limbs of the same loop lie adjoined on the same horizontal plane, such limbs are united together by a *continuous membrane* (Pl. VI. fig. 5). In such case the intervectal water-fissures exist only between the limbs of different contiguous loops, not between those of the same looped bar. By this arrangement the volume of water which traverses the gill at any given time is reduced by exactly one-half. The functional value of the organ therefore sinks in the same degree. A *double* gill (Pl. VII. figs. 13, 9 & 11; Pl. VI. fig. 1) in structure is not necessarily twofold in physiological import. In official activity it exceeds little the single gill. In the latter the blood is more intimately brought into contact with the respiratory medium, and this medium is more readily and rapidly renewed. To the single gill (Pl. VI. fig. 2; Pl. VII. fig. 14) conchologists have applied the term *supplementary*. It is difficult to understand in what sense this term should be received. In *structure* the single gill is *not* supplementary. It is a perfect and complete organ. No constituent element is deficient or suppressed. In function it is complete. It is not a supernumerary organ. Both these designations are significant of what is untrue. It is as much an integer of the organism as the upper or inner gill. A *law* hitherto undiscovered does, however, affect the presence and dimensions of the outer or single gill which does not influence the inner or double gill. If, as in the Pandoridæ, Lucinidæ, and some other families, there exist only one gill, it is invariably the single or out-gill that is wanting. The principle of suppression or non-development affects exclusively the latter. When only one gill exists, that is, one on either side of the foot and body, it is always *double* in structure. It contains the same number of bars and loops as any other double gill. It is quite erroneous to conceive that in such a case the absent or suppressed gill has been fused into and identified with the present solitary gill. The latter is the same in essential structure as if the single gill were present.

In *Pholadomya* and *Anatina*, Professor Owen describes the two branchial lamellæ of either side as having been united to form a single gill*. Valenciennes states that the solitary gill of the family Lucinidæ resembles that of *Anodonta*; it is larger, and formed of thicker and more prominent pectinations. *Lucina Jamaicensis, L. tigrina, L. columbella,* and *L. lactea,* are examples in which only a single branchial organ exists on either side. The solitary gill differs from the ordinary double gill only in *apparent* characters. The free border is composed only of two rows of loops; but these loops are soldered together by an obvious longitudinal band or cord, running in shape of a deep water-groove from one end to the other of the free margin (Pl. VI. fig. 3 *b*). It is this character which occasions the appearance of doubleness and fusion. In the solitary gill of the Pandoridæ and Lucinidæ, the pectinations† of the lamellæ are coarse and large to the naked eye. This circumstance is due to the greater size in these cases of the interlamellar water-tubes. It is repeated, that the vascular elements, in the solitary gills, are the same in number and disposition with those of any other double gill. If, in the example of the solitary gill, the outer single gill were really organically united to the inner double gill, an organ should result consisting at the free border of *three* rows of vascular loops, *two* distinct systems of parallel interlamellar water-tubes, *four* separate lamellæ, *three* layers of afferent and *three* of efferent bars! Such, of mechanical necessity, should be the anatomical characters of a gill which owed its formation to the union of one already double to another struck on the single plan. Such a monstrosity is not illustrated in nature. It is a fabulous branchia, born of hypothesis. But it *may appear* quite reasonable to explain the anomaly of a solitary gill, on the supposition that it is the natural and necessary product of the fusion of two *single* gills. A glance at the illustrations depictive of the type of the latter, will at once convince the mechanician that two single gills could not in any manner be fused in order to make a double gill,—such a double gill, that is, duplex in mechanism, twofold in function, as actually exists in the real animal. Let two single gills be brought together (Pl. VI. figs. 7 & 8),—the water-movement and the ciliary action would cease at once on the two adjoined, apposed faces. Thus the power of each would be reduced by one-half. Two singles united make a single! Such is the clumsiness of human handi-

* Forbes and Hanley, British Mollusca, vol. ii. p. 42.

† It should be distinctly understood, that the word '*pectinations*' is not synonymous with an ultimate branchial bar, but with that *set* of bars which form an interlamellar water-tube.

craft: attempting to mimic nature, it is lost in caricature. Nature does not reach her ends by the "fusion" of organs. An existing organ is *modified* to fulfil a collateral purpose. A solitary gill has its own peculiar characters. The component vessels remaining unchanged in number and arrangement, a solitary organ is rendered equivalent to a double one, by augmenting the dimensions of the passages and tubes in such a manner, that the aërating element brought into relation with the blood can be increased almost to any amount. *Function* is thus intensified, while structure remains analtered.

The *loops of the vascular bars*, as they project at the free margin of the lamellæ, are differently joined and variously figured and sculptured in different genera, and frequently in different species of the same genus. In *Pholas* (Pl. VI. figs. 1 & 4), the free border of the double or inner gill presents two rows of loops (*e, f*). The plane on which the loops of the upper lamella rest is horizontal, coinciding with the *length*, as opposed to the breadth, of the gill. Those belonging to the lower lamella of the same gill, form a row on a plane an eighth of an inch below the former. Between these two projecting scalloped edges, a groove (fig. 3 *b*) runs from one end of the gill to the other. The cilia which fringe this groove (Pl. VIII. fig. 24 *h*; Pl. VII. fig. 10, *a, b*) are very much larger in all species than those which are distributed over the bars at the plane faces of the gills. They excite a vigorous current, bearing towards the mouth. Those of the flat surface (Pl. VIII. fig. 20; Pl. VI. fig. 6 *b, b*) raise streams, tending towards the free border of the gill. Both are subservient to alimentation and respiration. In *Pholas*, then, the double gill (Pl. VI. fig. 1) is composed only of two lamellæ, like the single gill (Pl. VI. fig. 2); but in the former, each lamella is composed of two orders of bars, in the latter of one order only. The two limbs (fig. 4 *b, b, c, c*) of each looped bar in the former are placed on the *same* side of the intermediate water-tube: the afferent and efferent limbs of the same bars (fig. 2 *h, f*), in the instance of the single gill, are so *opened* or separated at the free margin as to form respectively the *opposite* walls of the included water-tube. The vascular *loops* at the margin of the double gill in nearly all genera are disposed flatwise (Pl. VI. fig. 1 *e, f*; Pl. VIII. fig. 21 *c, b*; Pl. VII. fig. 9 *a, b*, fig. 11 *a, b*), so that all the loops of the same lamella form one horizontal plane. Those of the single gill (Pl. VII. fig. 14 *a*; Pl. VI. fig. 2) are placed vertically, so that the plane of each loop is separated from, though parallel with, that of the adjoining loops. In the double gills of the Cardiadæ an exception occurs, and probably in other families. The loops at the distal margin are disposed here on vertical planes (Pl. VII. fig. 14 *a*); but though standing vertically, they do not enclose two systems of interlamellar water-tubes, but only *one*. The *mechanical* problem presented by the gills of *Cardium* proved extremely difficult of solution. *When understood*, it challenged any living mechanism for beauty and perfection. In *Mytilus* the loops of the two lamellæ are soldered into union at the free borders: they stand vertically (Pl. VIII. figs. 17 & 24): they circumscribe a deep intermediate gutter. In *Solen* (Pl. VIII. fig. 23) the loops expand. In *Venus* they also somewhat exceed in diameter that of the bars, of which they are *the bend*. In *Mytilus*, the inner and outer gills exhibit the same formation. In the Ostreadæ (Pl. VIII. fig. 21), the loops at the margins of the gills are so closely packed together horizontally, as to appear like a continuous membrane bounding an angular groove. Numerous other varieties in the mere shape and size of the loops occur in different families of Bivalves—the *type* of structure never changes.

The proximal or attached border (Pl. VI. figs. 1 & 2 *a*, *b*) of the gills occurs under many varieties of anatomical plan. *Pholas* exemplifies one type. The two lamellæ* are attached to the pallial tunic. All the vascular bars terminate in a common trunk (Pl. VI. fig. 2 *a*, *b*) which runs at right angles to their axes, and parallel with the length of the entire gill. There are two of these trunks, one afferent, the other efferent. They occupy respectively the proximal margins (Pl. VI. fig. 1 *a*, *b*) of the two lamellæ of which each gill is composed. In *Pholas* these trunks are supported by the framework of *solid* structure (*c c* and *d d*) which occupies the interlamellar spaces. In *Solen* (Pl. VIII. fig. 23 *a*) and *Mytilus* (fig. 17 A) another plan of formation is observed. Here the proximal border of the superior lamella of the upper gill, and inferior lamella of the under gill, are *unattached*, floating in the mantual cavity. In such instances the interlamellar framework is wanting. The vascular bars at this border, for some distance up the breadth of the gill, are tied together by means of a *continuous* membrane (*e*, *e*). Here the interlamellar scaffolding, and the water-tubes which the former assist to form, exist only where the two lamellæ are adherent; viz. over the two-thirds of the breadth of the gill nearest the free border.

* It should be clearly explained that the word *lamella*, as applied to the gill of the Acephalan Mollusk, should signify, *one* of the two plates of which the gill, whether double or single, is composed. The gill is the whole organ. In those instances in which (as shown in fig. 5, Pl. VI.) the bars stand vertically on the same lamella, then of course each lamella would be composed of two plates, or finer lamellæ. I am not quite certain that such an arrangement exists in nature. In several genera—in *Cardium* especially—when care is taken to avoid *pressure* upon the margin, such is the true position of the loops, if not of the bars proceeding backwards from them.

Intervectal and Interlamellar Framework of Connective Structures.

These structures constitute the true skeleton by which is sustained the vascular fabric of the gill. Of the latter, they determine the shape and the form. They preserve the blood-carrying bars in position. They hold apart the component lamellæ of the gills. They thus *form* the interlamellar tubes, since without these structures the lamellæ would fall together into contact and obliterate the tubes. Messrs. Alder and Hancock recognized the tubes, but overlooked the framework system by which they were constructed *. M. Deshayes has *figured* this framework (Pl. VI. fig. 1 *c, c, c* & *d,* fig. 2 *i,* and fig. 8 *d, d*) apparatus in a conchiferous (*Pecten* or *Arca*?) mollusk. Not a sentence is written descriptive of its characters, or interpretative of its meaning †. Attention was drawn to it by no allusion whatever, direct or incidental. Philippi ‡ has this observation with respect to the branchiæ of *Solenomya,* which probably refers to the interlamellar structures in question:—"Branchiæ duo non quatuor, non lamelliformes, sed pectinatæ vel potius pennam exacte referentes, lamellis transversis perpendicularibus, carina media corpori per totam longitudinem adnatæ, versus apicem *ope ligamenti.*" Ill-defined reference to the same parts is made by Carus, Blainville, Garner, and others. To be known descriptively, and comprehended physiologically, they remained really to be rediscovered,—to be read by a *new* eye, from

* It is very probable, from the following passage, that Messrs. Alder and Hancock have mistaken the thick solid cords which at short intervals cross the *tubes,* for real blood-channels: "The laminæ forming the walls of these tubes were now examined through the microscope, when the whole was observed to present a regularly *reticulated* structure composed of blood-vessels; *those passing transversely being the stronger and more prominent.*"—Annals and Magazine of Natural History, paper on Currents in *Pholas* and *Mya,*" 1852.

† The following is the only passage which occurs in the excellent article (Conchifera, Cyclop. Anat. Phys.) of M. Deshayes having reference to the structure of the gills:—"In the greater number of genera, the branchiæ are formed of two membranous layers or laminæ (*a, b,* fig. 352), within the substance of which the branchial vessels descend with great regularity. In several genera, as the *Archidæ* and *Pecten,* the branchial vessels, instead of being connected parallel to one another *within the thickness of a common membrane,* continue unconnected their entire length, and they are thus formed of a great number of extremely delicate filaments, attached by the base within the membranous pedicle on which the branchial veins pursue their way towards the auricle." Nothing is said of the distinct and independent structures which separate the laminæ. The condition, namely the *separation* of the laminæ—upon which depends the existence of the interlamellar water-tubes—is here *accidentally* stated; but neither the existence nor the meaning of such parts seem in the slightest degree to have been imagined by M. Deshayes.

‡ Moll. Sicil. i. p. 16.

a *new* point of view. The author believes that the following is the first systematic exposition on record of the anatomy and significance of the *non*-vascular elements of the lamellibranchiate gill.

They are classifiable under two heads. Those parts which are placed between (Pl. VI. fig. 1 *g*, fig. 2 *e*, fig. 8 *d*; Pl. VIII. fig. 19 *c, c, c*) the parallel bars (*the intervectal*), uniting them into the form of a leaf, constitute a separate order. Those, *secondly*, stronger, coarser, in some genera very conspicuous, in others very concealed, which separate the lamellæ, forming and bounding the excurrent interlamellar water-tubes, to which in many species the ova adhere, the basis of the whole gill, the wonder of the whole enginery, the last of the branchial constituents to be described and understood, are really a distinct and unknown class of structures.

The first class vary the apparent anatomy of the gill more than the second. They cut the fissural spaces (Pl. VI. fig. 7 *d*) between the individual bars, or individual loops, into oval stigmata (fig. 5 *d*), elliptical perforations, or lengthened parallelograms (Pl. VII. fig. 12 *d*). In the absence of them, as in *Thracia* (Pl. VII. fig. 15), the intervectal water-fissures are continuous from the free margin of the gill to the proximal. In *Mytilus* (Pl. VIII. fig. 17 *o, o, o*) they appear under the character of fleshy nodules; in *Cardium* (Pl. VII. fig. 12 *c, c, c*) they are almost invisible; in the Veneridæ they consist of a flattened bundle of slender threads, running from bar to bar at equal intervals; in *Pholas* they assume almost a membranous form (Pl. VI. fig. 4*e*), perforated at regular distances by oval holes; they exist only between alternate loops. In a physiological sense, the highest value attaches to these intervectal parts. They determine the dimensions of the water-stigmata. If they are small, the water of respiration is very much subdivided; if large, the lamella is readily traversed by the aërating element. In calculating the quantum of respiration in the Conchifera, *two factors* demand to be estimated: first, the amount of blood entering the breathing organ; secondly, the volume of water by which, in a given time, it is capable of being traversed. The latter will depend upon the dimensions of the water-passages.

The intervectal connective structures have been mistaken for half a century by the best observers for *vessels, blood-canals crossing the bars*,—deceiving the observers into the idea that each lamella in the lamellibranchiate gill is really composed of a *network of blood-vessels*. This idea as regards the Acephala involves a fundamental error; it envelopes everything in unresolvable confusion. The orbit of the branchial circulation cannot be explained. It contradicts the anatomical arrangement conspicuous in other parts. A consistent sentiment cannot be shaped of this most perfect mechanism. They are *not* blood-channels. They are elastic, fibrous structures, enacting a purely ligamentous part. They derive their supply of blood from that of the branchial bars. Their office is mechanical, not chemical.

The *intra-tubular structures* (Pl. VI. fig. 1 *k, k, k*, fig. 8 *d, d*; Pl. VIII. fig. 21 *f*, &c.) are neither less remarkable nor less important. Upon this interlamellar framework depend the whole characters of the gill. They hold the lamellæ apart at *definite* distances. They unite closely together the loops of these lamellæ at the free margin (Pl. VI. fig. 7 *a, b*); thus they *close up* cæcally the tubes at this border of the gill *. This single point of structure is the pivot whereon turns the action of the gill. If the tubes at this extremity were open (as suppositionally at Pl. VII. figs. 9 & 11), it is hydraulically certain that the water would take this course to pass from the extra- to the intra-branchial cavity; none would pass between the bars which contain the blood; the function of respiration could not proceed; and this calamity, further, would ensue—no food could be carried to the mouth. Men do not value health until it is lost! Spectators see not, *feel* not, the perfection, the unimprovableness of organic mechanism until an element is ideally removed—until some deviation from nature's method of working is *supposed*! The *argumentum ad absurdum* startles by the bungle and foolery which it is sure to introduce; *then* philosophers realize the inimitableness of her certainty and refinement.

As the proximal borders of the lamellæ (Pl. VI. fig. 1 *a, b*) are separated by the whole diameter of the water-tubes, and as the distal margins are fused together, it follows that these tubes, like rivers, are small and shallow at their commencement, deep and broad at their termination. This arrangement favours their *suctorial* action. The water, as first explained by Mr. Hancock, is undoubtedly *drawn into* (properly *pushed* into) these tubes through the lamellar stigmata (Pl. VIII. fig. 17 *f, f, f*) from the pallial cavity. The water is discharged from the tubes by ciliary agency, which is constant (arrows in Pl. VII. figs. 9, 11, 13 & 14). They are thus constantly being emptied. If they were not refilled from without, they would become *vacuous*. During the action of the gill, there is momentarily generated a tendency to a *vacuum*. The pressure that is on the tubular side of the

* In the accompanying illustrations, in several instances (Pl. VII. fig. 9 & 11, Pl. VIII. fig. 21), these tubes are represented as if they were *open* at this margin of the gill. This method of illustration was adopted only for the sake of clearness, and in order that the disposition of the loops and bars of each lamella may be readily understood. In all cases, without a single exception, the tubes are *closed* at this border of the gill by the apposition of the loops of the two constituent lamellæ.

lamella is diminished; on the other it remains the same as long as the animal continues in the water. It is hydraulically inevitable, even *without* the assisting agency of cilia, that the water must transude the lamella by way of its intervectal fissures and perforations. This mechanism could neither be conceived nor explained before the nature and office of the interlamellar framework were brought under clear demonstration. It is important to understand, that that surface of the lamellæ which faces the intermediate tubes, namely the *internal* walls (Pl. VI. fig. 8 *e*) of the water-tubes themselves, is far less richly ciliated than the external surface. The excurrent movement of the respiratory water is much aided by the action of the connective structures of the bars and tubes. The intervectal pieces—those which pass crosswise from bar to bar by approximating the latter—are capable of stopping up the intervectal stigmata,—of suspending, therefore, the act of respiration. Thus is prevented the passage of irritating substances through the branchial lamella. The alternate movements of the shutting and opening of the bars is as important to the sieving operation of the gill, its prehensile function, as the cilia themselves. The transverse intervectal pieces (Pl. VII. fig. 12 *c, c, c*; Pl. VIII. fig. 19 *c, c, c*) consist of irritable and contractile tissue. They are capable, in part, of voluntary contraction. Thus, although the chemical act of breathing is in itself uncontrollable, it may be interrupted by the exercise of those connected parts which are subject to the will.

The skeleton of *solid* pieces (Pl. VI. fig. 8 *d, d,* fig. 1 *c, d,* fig. 2 *i, j,* &c.) by which the *tubes* and the *lamellæ* are supported and held apart, exists probably in the branchiæ of *every lamellibranchiate mollusk*. It constitutes a framework system, though anatomically distinct from, having a mechanical action concurrent with, the intervectal. At the free border this interlamellar substance is thin, slender, and difficultly detected by the eye, admitting of the falling together of the lamellæ and of the closing of the tubes. At the opposite attached border, the interlamellar substance is much thicker, coarser, and more conspicuous (Pl. VI. fig. 1 *k, k, k*); the parts being quite apparent *through* the lamellæ. Here, therefore, the lamellæ are further separated, and the tubes of the greatest diameter. This framework consists of two distinct pieces,—those, first, which run parallel with the vascular bars (Pl. VI. fig. 1 *c*, fig. 2 *i*); and, secondly, those which transversely connect these longitudinal pieces (fig. 1 *d*, fig. 2 *j, j*). The former limit the breadth of the interlamellar water-tubes. The tubes are capacious when the lamellæ are far apart, small when they are near each other. As the exterior appearance of "pectinations" in the gill is due to the presence of these tubes, the pectinations are obvious, as in *Cardium, Solen, Pecten, Thracia*, &c., when the tubes are large, invisible to the naked eye when they are small. The *cross pieces* tie together the longitudinal at regular intervals. The latter run with the tubes, and *divide them* from one another, the former cross them. If the transverse pieces were so thick and large as to fill up the tube, and interrupt its continuity, the ex-currents of water of course would be arrested, and the function of the gill would be suspended. It is far otherwise. They traverse the tubes in form of cords. Their extremities are attached to the opposed points on the horizontal sides,—to those very lines along the sides of the tubes at which the chemical act of breathing is passive. From this arrangement there flows this most beautiful result: the water, having permeated the lamella and gained the *interior* of the tubes, in its course towards the ex-current siphon, *is made to keep continually in contact with the branchial bars*. By this simple arrangement, the *two* sides, in fact the four sides, of each individual blood-carrying bar are *persistently* embraced by a moving current of the respiratory element! If the cross cords did not exist, every drop of water which entered the tube would collect at the most depending side, and flow out as *a useless and unused stream*. In the œconomics of nature, the subtlest œconomist may well marvel at her care!

The long pieces of this interlamellar framework are capable of shortening the length of the water-tubes, the cross pieces of diminishing their diameters. These actions impel, interrupt, facilitate, &c. the breath-giving currents. While they complicate the branchial machinery, they double the certainty of the process; they provide against accidents; they preserve in the required position the slender, tender, beautiful parts of which the apparatus is composed.

Endless diversities occur, in different species and genera, in the size, the figure, the visibleness, &c. of this interlamellar framework. In no single instance is there observable the slightest departure in *principle* of structure, in intention, in purpose, from the typal plan unfolded in the preceding description.

The *cilia-bearing epithelium* (Pl. VI. fig. 6 *b*) of the branchial lamellæ in the conchiferous bivalves is well known. It has been well described by trustworthy observers, from Leeuwenhoek to Quekett. The cilia in all cases are distributed in rows on the bars (Pl. VII. fig. 15; Pl. VIII. figs. 20 & 22). There are two rows on each external hemi-cylinder of each bar. On the *external* aspect of each bar, therefore, there are four lines of cilia (Pl. VII. fig. 10 *b, a*). They drive two currents in intersecting directions. On the interna aspect of each bar, that namely which faces the

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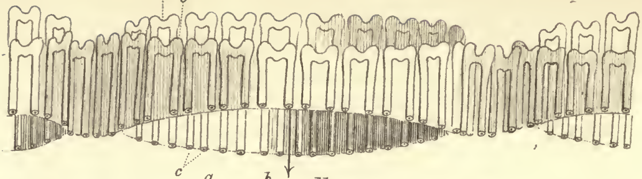

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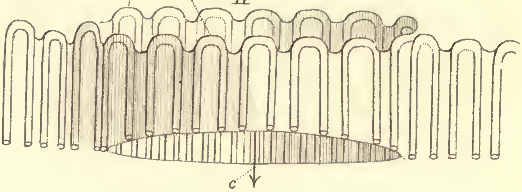

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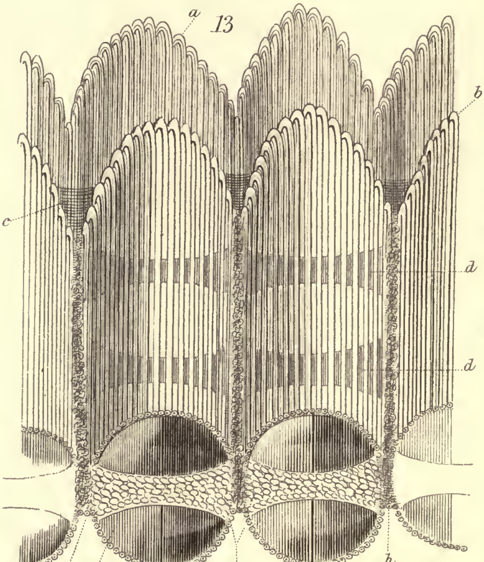

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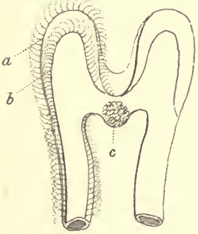

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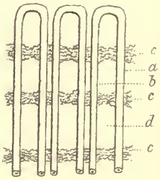

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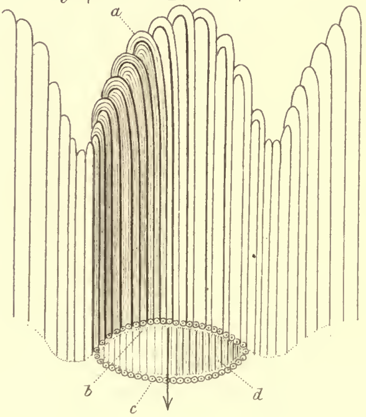

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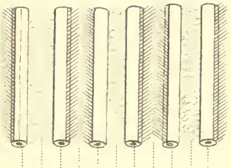

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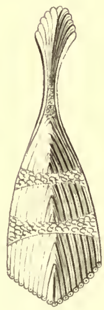
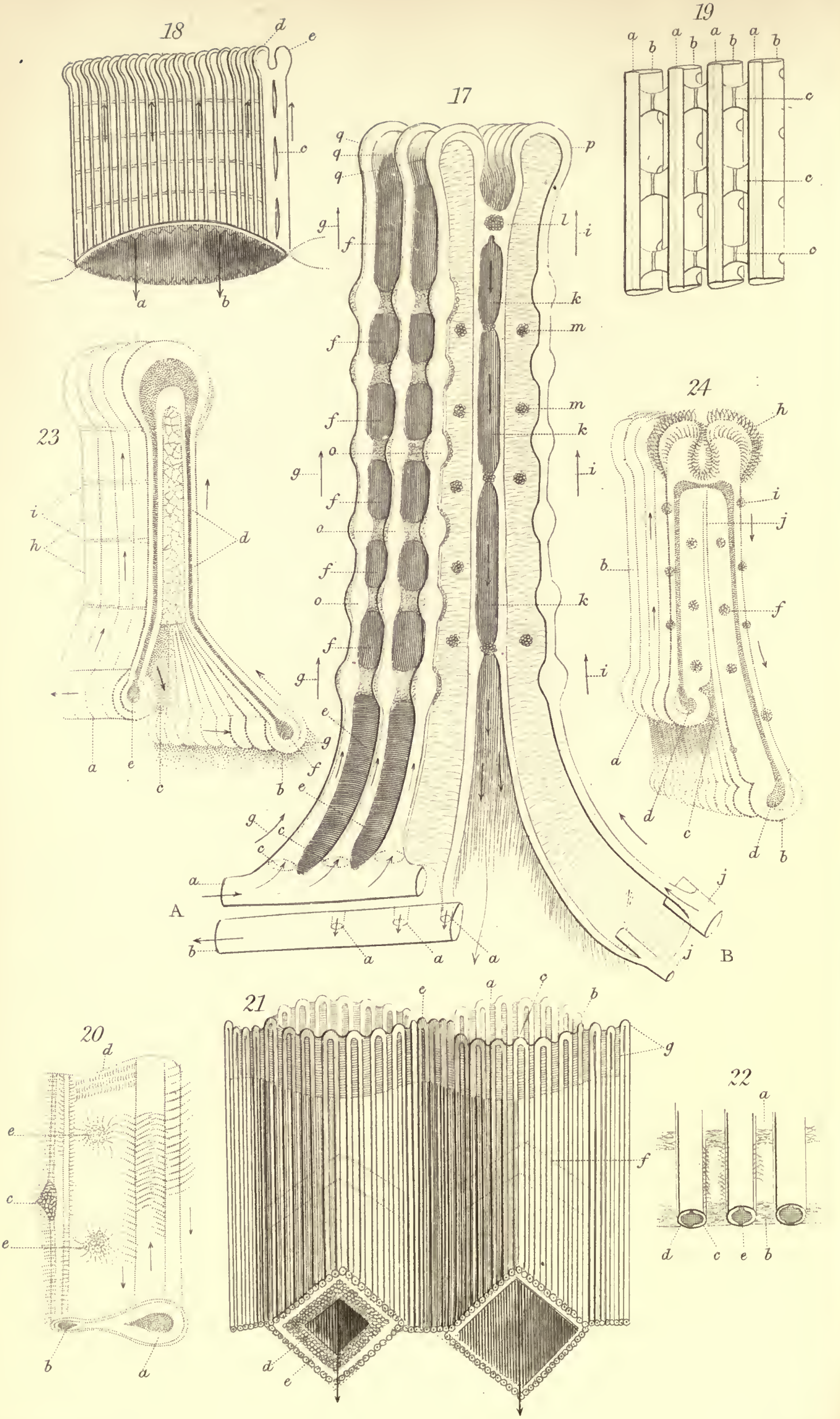


T. Williams, del. ad nat.

J. Basire, sc.



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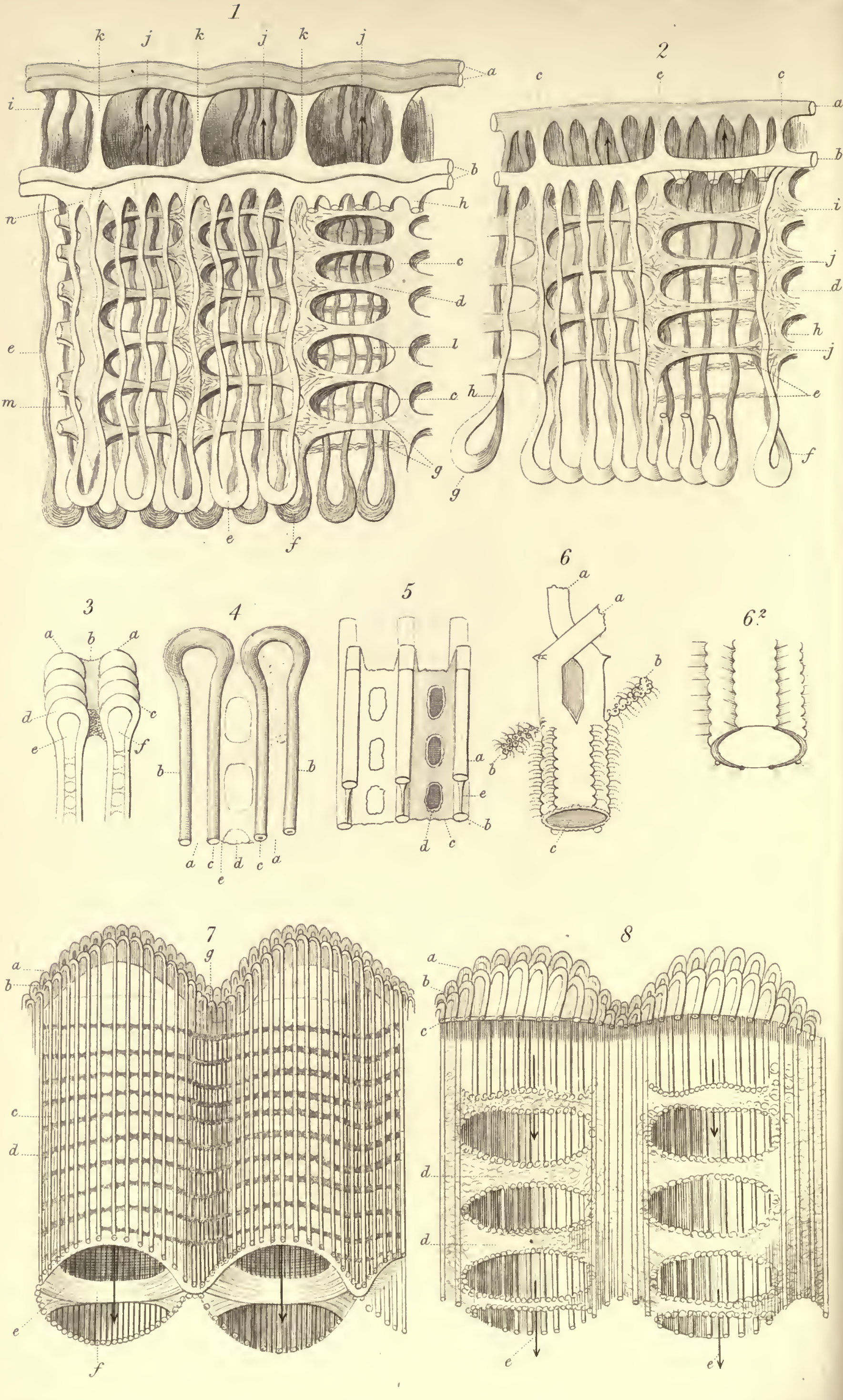


T. Williams, del. ad nat.

J. Basire sc.

interlamellar water-tubes, these rows of cilia are single on the opposite sides. The excurrent streams are consequently driven by a power which is one-half in amount of that by which the water is propelled through the lamellæ into the tubes. No cilia are detectable on the supporting framework between the lamellæ. The current raised by the cilia which are distributed on the external surface of the lamellæ tends in the direction of the free border; that excited by the internally-placed cilia bears towards the proximal border, coinciding with the outlet of the interlamellar tubes. It is a true ciliary current; but it is reinforced, quickened from time to time, by the contractile, voluntary action of the musculo-fibrous parts which constitute the intervectal and interlamellar framework. The cilia which fringe the free border of the gill propel the water in the direction of the mouth, at right angles, consequently, with that raised by those covering the flat surfaces of the gill. It is an alimentary, not a respiratory current. It is powerful enough to bear on its waves pellets of food for the mouth. The true aërating currents travel along the *naked* lines between the rows of cilia. These are the ultimate scene of the respiratory process.

Thus ends an imperfect sketch. It is but a rude outline of a beautiful picture. Much is left to the industry of observers coming after the author. Magnetic thoughts, indicating the pole of truth, have been but hastily projected. May they stimulate others to a truth-admiring repetition of his labours!

EXPLANATION OF PLATES VI. VII. AND VIII.

PLATE VI.

Fig. 1. Complete view of the *double* gill of *Pholas candida.* The attached border is held upwards as it were. *a, b,* are the large afferent and efferent trunks (of which there is a *set* in the border of each lamella) communicating with the parallel vessels, as shown at (*n*) and (*h*); *c, c, c,* mark the longitudinal pieces of the intra-tubular framework of solid structures; *k, k, k,* show the mode in which these longitudinal pieces form and bound the interlamellar water-tubes (*j, j, j*); *d, d, d,* are the transverse pieces of the framework on which the lamellæ (*m, c*) of parallel vessels rest, and by which the latter are held apart, and which cross at right angles the axes of the interlamellar water-tubes; *e, f,* denote the *two* series of loops of which the free border of this *double* gill is composed; they lie on two distinct planes one above the other; they are shown *as if they were few in number and far between*; they exist in nature in innumerable multitudes and packed with dense closeness. *m, n,* represent the course of the bars in the upper lamella; *e, i,* that of the lower. The arrows at the base of the gill emerge out of the interlamellar water-passages. *g,* intervascular *fibrous connecting* pieces.

Fig. 2. Is a view of a small portion of the entire *single* or *supplementary* (sic) gill in *Pholas candida.* *a, b,* afferent and efferent trunks giving and receiving the blood of *two separate lamellæ,* not that of the *same* lamella as in the case of the double gill; *h, h,* bars of the upper lamella; *f,* those of the lower; *e,* connecting fibrous threads tying together the bars; *d,* the bars of the lower lamella, *i, j*; *c, c,* the interlamellar framework as explained in the double gill. *g & f,* show the *single* row of loops of which the free margin of this single gill is composed: but here the *plane of each loop* is placed *vertically,* not *horizontally* as in the double gill.

Fig. 3. A diagram representing the arrangement of the loops, *a, a, c, d,* at the free margin of the gill in some species; *b,* is the water-channel conveying a current towards the mouth. The loops are placed on vertical planes. Each lamella in this case is composed of afferent or efferent vessels *exclusively.*

Fig. 4. Two loops from the free margin of the double gill of *Pholas,* showing the mode in which the *continuous* membrane, *a, a,* which in some bivalves, if not in *Pholas,* really forms the blood-channel. In such cases the bars, *b, b, c, c,* would be *solid.* The water-stigmata (intervectal orifices), *d,* are in such instances present only between alternate pairs of bars.

Fig. 5. Plan representing the manner in which the bars, *a & b,* of two separate lamellæ placed on the *same* vertical planes, but different horizontal planes, are tied together by vertical partitional perforated membranes (*e*); *d,* shows the water-orifices in that connecting structure (*e*) which unites the bars of the same lamella *horizontally.*

Fig. 6—6^2. Minute anatomy of the branchial bars in those cases in which the hyaline cartilages, *a, a,* are so closely approached as to form the boundary of the channel (*c*); *b, b,* pieces of the cilia-bearing epithelium stripped off.

Fig. 7. View of a piece of the entire gill of *Thracia convexa.* The free, distal margin is turned upwards. *a, b,* the double rows of *vertically disposed* loops of which this margin is made up; *g,* the contraction which occurs between the interlamellar water-tubes (*e*); *f,* one of the transverse pieces of the interlamellar framework in view, crossing the water-tube, indicated by the arrow.

Fig. 8. The same cut horizontally along the length of the bars. The free edge (*b, c*) of the upper lamella is left. *d, d,* show the mode in which the transverse pieces of the intra-tubular framework lie between the lamellæ, *a, b,* which constitute the walls of those tubes; *e, e,* arrows denoting the direction of the water-currents in the tubes.

Plate VII.

Fig. 9. A small piece of the free edge of the double gill of *Venus striatula.* *a, b,* loops of the bars of the two component lamellæ lying horizontally; the loops lobed (fig. 10) as they are in *Mytilus.* *c,* the afferent and efferent bars of a single loop. The arrow descends from the interlamellar water-tubes.

Fig. 10. One of the loops from fig. 9, enlarged, representing the lines and disposition of the vibratile cilia, *a, b* : *c,* is a fleshy nodule tying the loop to its neighbour.

Fig. 11. The free margin of the gill of a minute freshwater bivalve. It is produced with a view to illustrate the *continuous* membrane which in some cases ties the branchial bars together at the *free* border of the gill. *a, b,* the loops of the two lamellæ are shown as if they were separated by the intervening tube (*c*), but in *nature* the lamellæ are fused together at the free border, and the intermediate tubes are cæcal.

Fig. 12. A few looped bars from the preceding, magnified, showing the delicate transverse threads, *c, c, c,* which cross the branchial bars at distant intervals. They lie on the *inside* or *tubular* aspect of the lamellæ, and sometimes supersede the intra-tubular framework. The open spaces (*d*) between these cross threads are the "intervectal" water-orifices. *a, b,* are either vascular bars, or two rigid sides bounding an intermediate membranous channel, which then is the blood-channel.

Fig. 13. A small portion from the distal edge of the double or upper gill of *Cardium*. *a, b,* the upper and lower loops of which this border is composed. The planes of the loops have a vertical position in relation, that is, to the plane of the whole gill. *c,* the fleshy or membranous structure which unites the loops. It belongs probably to the intra-tubular apparatus, *d, d.* Although in *this* double gill, as in *all* double acephalan gills, the free edge is double, the interlamellar water-tubes *f,* and arrows *g,* are *single.* The double row of loops runs into one at a little distance from the margin, in order to form *one* system of tubes. This union of the bars is shown at *i* and *e*. *h,* indicates the fleshy structures,—a part of the intra-tubular cross bars by which the *lobes* or "pectinations" of the gill are held together.

Fig. 14. A portion of the free margin of the inferior or *single* gill of *Cardium.* This figure exhibits perfectly the manner in which the limbs (*b*)—(which, arranged in a linear series, form the upper wall of the tube (*d*), or the upper *lamella* of the gill)—of the *same* system of loops pass, by looping *vertically,* as shown at *a,* into those of the lower wall of the tubes, or, which is the same thing, into the lower *lamella* of the gill.

Fig. 15. Shows the *alternate mode* by which the membranous blood-channels (*b, b, b*) are formed by the *solid* bars (*a, a, a, a*) of contiguous, but distinct loops. In such a case, which is the normal type in the branchiæ of all Tunicata, the cilia are disposed in lines *only* on that side of each *bar* which is nearest to the *water-fissures* (*c*). These fissures, in such examples, are not crossed by transverse connecting threads.

Fig. 16. Represents one of the lobes, or tubular pectinations, from the single gill of *Cardium,* cut longitudinally, illustrating the mode in which the water-tubes are formed.

Plate VIII.

Fig. 17. The "bars" from the gill of *Mytilus,* followed throughout the whole of their minute anatomy. *a, b,* are the afferent and efferent blood-trunks, running along the attached margin of the upper lamella A. This border of the gill in *Mytilus* is represented as including *two* trunks, on the theory, as yet not quite proved, that the *two* edges, *c* and *c,* would then be the beginning of the blood-channel along the *blunt* edge, and *a, a, a,* would mark the termination of that, travelling along the acute margin of *the same* penknife-shaped process. *j, j,* are the corresponding trunks at the proximal border of the inferior lamella; *e, e,* mark the *continuous* membrane by which, in this gill, the bars are tied together at the proximal border, so that no water can pass between the bars; *f, f, f, f,* are open orifices between the fleshy nodules, *o, o, o, o,* by which the aërating water enters from without into the interlamellar water-tubes; *q, q, q,* are the superior *lobes* of the *single* loop, of which the free margin of the gill in *Mytilus* is composed; *p,* is the lower lobe. The deep groove between these lobes is the great alimentary water-channel, bearing a current moving in the direction of the mouth. *l,* is a fleshy nodule, by which the loops are united into a series; *k, k, k,* are *horizontal* water-passages; *m, m,* fleshy nodules, which connect the contiguous bars. The system of arrows, *g, g, g,* indicate the direction of the great respiratory current, along the upper surface of the lamella; *i, i, i,* the lower: *both* having the same direction—towards the free margin of the gill.

Fig. 18. Is a transverse section of one tube from the gill of *Mytilus,* exhibiting the mode in which the laminæ *separate,* in order to form a tube (*a, b*).

Fig. 19. Four bars from the same gill, illustrating further the *vertical* parallel planes on which the penknife-shaped bars are placed, and the mode more exactly in which they are tied together.

Fig. 20. A magnified view of a minute portion of a *single* blade-like bar from the gill of *Mytilus.* It illustrates the distribution of the cilia; and the water-currents, denoted by the arrows, set in motion by them. *a, b,* are intended to show the position of the blood-channels in the axes of the thickened lines of either edge of the blade. If the upper lamella in the exceptional gills of *Mytilus* should be hereafter proved to carry only a *single system* (afferent or efferent) of blood-currents, the channel carrying such a single current must prove to be a *flat* passage, whose transverse section would extend from *a* to *b*; *e, e, & c,* fleshy nodules.

Fig. 21. Two longitudinal lobes, or pectinations, from the gill of the common Oyster. *a, c,* the *double* loops of which the free margin is composed. They are drawn as if separated from each other, in a tubular form; but, naturally, the two planes of loops lie in close apposition. At this border in *Ostrea,* the branchial bars are soldered together by a *continuous* membrane over the interval included in the dotted lines *g*. *f,* are the transverse pieces of the intra-tubular framework. By these transverse pieces, the lamellæ forming the water-tubes are sometimes drawn into quadrilateral figures, *d, e.*

Fig. 22. A few of the "bars" from the same gill, showing that each bar is an independent vessel. The component hyaline cartilages, *d, c,* are brought *close* together, so as to form a cylindrical channel, *e. a, b,* exhibit the transverse structures, as running along *one* (the internal) of the tubes. This arrangement proves that the latter cannot be transverse *vessels.*

Fig. 23. A portion of the *single* gill of *Venus,* drawn as an outline plan. *e, d, f,* mark the course of the blood, and the character of the blood-channel, from the attached margin (*a*) of the superior lamella, to the end of its course at the proximal border (*b*) of the inferior lamella.

Fig. 24. A second plan of the gill of *Mytilus,* constructed on the supposition that each *lamella* carries only a single blood-current, of which the beginning is shown at *d,* margin *a,* and the end at *d,* margin *b.* The border, *h,* depicts the order of the vibratile cilia.

[To be continued.]

XXIV.—*On the Remains of a gigantic Bird* (Lithornis Emuinus) *from the London Clay of Sheppey.* By J. S. Bowerbank, F.R.S. &c.

The first indication of the former existence of new and often very large animals is frequently afforded by small and comparatively insignificant fragments, and such is the case in the present instance.

Professor Owen has described, in his 'Fossil Mammals and Birds,' the remains of more than one species of the latter from the London clay, which specimens are in the collection of the College of Surgeons, and in those of Mr. Wetherell and myself; and since that period I have acquired another specimen, which appears also to be the remains of *Lithornis vulturinus*; but none of these birds could have exceeded in size one of the smaller species of the Gull tribe. The unassuming specimen that I now introduce to my readers as a portion of one of the long bones of a bird, surpasses in size a full-grown Albatross, a bird having an expanse of wing of about 12 or 13 feet.

I procured this fragment at Sheppey some years since, and had really forgotten it until it was brought to my recollection in consequence of the late Dr. Mantell having obliged me with the examination of some similar but somewhat smaller portions of bone of a *Pterodactylus* from the Wealden formation of the Isle of Wight, when the idea arose in my mind of the possibility of its turning out to be the remains of a Tertiary Pterodactyl of like dimensions to some of the larger chalk species; but on submitting a fragment of it to microscopical examination, I at once saw that there was not a trace of reptilian character in its structure, but that, on the contrary, the bone-cells and Haversian canals presented all the well-known peculiarities of form and arrangement that characterize the Bird tribe.

The length of the specimen is 4 inches, and the greatest diameter of the larger end is exactly 1 inch. At this part the section of the bone is triangular, with the angles rounded off, and having two sides somewhat larger than the third one; the angularity decreases progressively to the other end of the specimen, and at that portion but faint traces of it are observable; at this end of the bone the greatest diameter rather exceeds 10 lines. The thickest portion of the walls of the bone, which is at the curves supplying the place of the angles at the larger end, is $1\frac{3}{4}$ line, while the thinnest portion in the same plane is about the middle of the shortest side of the triangular section, and does not exceed $\frac{3}{4}$ of a line.

These structural proportions, in combination with the microscopical characters and the great density of the walls of the bone, leave no doubt of the character of the animal to which this specimen has formerly belonged; and from the marks of muscular attachment, the form and other peculiarities, my friend Professor Quekett, who has examined the bone, is of opinion that it has formed part of the proximal end of a tibia belonging to a bird little if at all inferior in size to an Emu. On comparing the fossil with the tibia of an adult Emu, the skeleton of which was about 6 feet high, I found that the latter was 16 inches in length; and on measuring the diameter of the parts of the recent bone corresponding with those of the fossil one, they appeared to be as nearly as possible identical; and the remains of the impression of the muscular attachment, and of the orifice for the admission of the blood-vessel into the shaft of the bone, which are situated in the recent one within the first 6 inches of its length from the proximal end, are in precisely the same relative position in both specimens.

There is every appearance therefore, as far as the mutilated condition of the fossil will allow us to judge, that it has formed part of an ancient Struthious bird as large as, and probably closely allied to, the Emu. The section of the bone represented in the woodcut is taken at the transverse fracture, about one-third of the length of the specimen from the larger end.

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

[Concluded from p. 115.]

257. Numenius arquata, Linn. *Coudrey-malley-cotan,* Mal. *Whelp,* Dutch.

Common along all the flat sea borders in company with

258. Numenius Phæopus, Linn.

Neither of these species seem ever to be found in the interior.

259. Totanus fuscus, Linn.

260. Totanus ochropus, Linn.

261. Totanus calidris, Linn.

262. Totanus hypoleucos, Linn.

263. Totanus glottis, Linn.

264. Totanus stagnatilis, Bechst.

265. Actitis glareola, Gmel.

266. Tringa minuta, Leis.

267. Tringa subarquata, Gmel.

268. Tringa platyrhyncha, Gould, B. E. pl. 331. *Ola-watua,* Cing. *Cotan,* Tam.

These birds are generally distributed in all parts of the island where mud and water combine to offer them congenial homes. *Totanus hypoleucos* is found high up in the hilly country, frequenting the streams, walking upon the boulders which appear above the foaming torrents, in search of flies, or running on the sand in the shallow pools to feed upon the minute crustaceans which abound in such localities.

Tringa platyrhyncha is the rarest of the whole; one or two specimens were procured at Pt. Pedro, where also I procured a single pair of

269. Limosa ægocephala, Linn.

These I killed in the month of April in fine plumage.

270. Himantopus candidus, Bonn. *Poullow-kall,* Mal.; lit. "Long-legs."

Abundant in small flocks about the jungle tanks. They are by no means shy, but will suffer a near approach, and often alight on the same spot, though shot at several times; in flying they carry their long legs stretched out behind them, and utter a shrill cry of "wheet, wheet," which, when many join in chorus, is not an unmusical sound.

271. Recurvirostris avocetta, Linn.

A pair of these birds were shot by my esteemed friend D. Quinton, Esq., at Chundicolom near Jaffna, on the estuary.

272. Rhynchæa Bengalensis, Gmel. *Rajah-kas-watua,* Cing.; lit. King Snipe.

Not uncommon in all marshes; it is a bird of passage, arriving in October. Some few breed with us, the season of incubation being from May to July. The nest is a simple depression in the soil, and the eggs, four in number, are dark nankeen-yellow, profusely blotched with very large dark dry blood-coloured markings. Axis 1 inch 4 lines, diam. 1 inch.

273. Scolopax rusticola, Linn.

The Woodcock has been shot several times at Nuwera Elia, but has never fallen under the notice of either Dr. Kelaart or myself in its feathers. Dr. Kelaart says that he saw "a couple of birds called 'woodcocks' at a dinner table, which tasted uncommonly like the birds of that name." I heard that a specimen was preserved in the Military Medical Museum in Colombo in Dr. Kinnis' time, but, like many other specimens there, has been abstracted or suffered to fall into decay.

274. Gallinago stenura. *Kas-Matua,* Cing.

The common Indian Snipe is very abundant in all parts of Ceylon. They arrive in Jaffna about September.

275. Gallinago scolopacinus, Bon.

Not having met with this Snipe, I am obliged to quote Dr. Kelaart for its identity; he says, it "is found only in some of the highland districts. We have seen a few at Nuwera Elia*." I shot many snipes at Gillymalle which proved to be the preceding species, but I see no reason why the bird should not exist in the island, particularly as it is found in Calcutta: why, however, in this case should it be confined to the hills?

276. Gallinago gallinula, Linn.

In this instance I think the "sportsman's authority" may be trusted, as there is but little fear of the "Jack" being confounded with any of the Indian Snipes.

The late Mr. V. Burleigh of Jaffna, an ardent sportsman and beautiful bird-stuffer, told me that he used frequently to meet with them about Wally some years ago, but that of late he had not seen any. My own testimony only reaches to a bird I saw on table, luckily with both bill and legs perfect, and this I feel convinced in my own mind was a Jack Snipe.

* And yet he says at page 135 that he has only "*sportsmen's authority*" for this species. There are *very few sportsmen* that I ever found sufficiently discriminating to trust.

277. Hydrophasianus chirurgus, Scop. *Ballal-saaru,* Cing.; lit. Cat Teal (also *Juana,* Cing.), from their mewing cry.

Exceedingly abundant on all tanks, and not uncommon even on Colombo lake, frequenting the Lotus beds, walking on the broad leaves; they fly with great strength and facility, mounting to a considerable altitude.

278. Porzana fusca, Linn.

Syn. *Gallinula rubiginosa,* Temm.

Korawaka, Cing. The family name of all the tribe.

Rare: I have only seen three specimens, all found at Cotta near Colombo.

279. Porzana Ceylonica, Gmel. *Nordewind,* Dutch.

These birds arrive in the south of Ceylon in great numbers in the month of October and November, coming in with the first northerly wind which blows (whence the Dutch name). They drop exhausted, as if from a long flight, in the streets and houses, and conceal themselves till recovered from their fatigues. I found one in the well of my carriage, another in the folds of the gig apron, and a third in a shoe under my bed! The irides are a lovely yellow and carmine blended, the yellow forming a circle nearest the pupil. Some eggs were given me by a native as the eggs of this bird, which were precisely similar in all respects, save that of size, to those of the *Gallinula phœnicura.* Axis 13 lines, diam. 10 lines.

280. Porzana pygmæa, Nan.

Very rare: a single specimen was brought to me alive from Cotta.

281. Rallus striatus, Linn.

I received one specimen of this bird from Batticaloa, and another was brought alive to me while at Pt. Pedro. I placed it in my aviary, and it lived well on small sea-fish, soaked grain, &c.; it was unfortunately destroyed, along with many other favourites, by rats.

282. Rallus Indicus, Blyth, J. A. S. xviii.

Three or four of these Rails were shot in the Jayelle paddy fields near Colombo, by Lieut. Long of H.M. Ceylon Rifle Regiment, to whom I am indebted for these and several other interesting specimens.

283. Gallinula phœnicura, Pennant. *Korawaka,* Cing., from its cry, which this word precisely resembles.

Abundant throughout Ceylon in all marshy places, tanks, rivers, and even ditches. It constructs a nest similar in shape and position to that of our English Water-hen, and deposits from six to fourteen eggs of a pale fawn colour, thickly mottled with dark pinkish brown and bluish markings. Axis 1 in. 7 lines, diam. 1 in. 2 lines.

284. Gallinula chloropus, Linn.

Very rare: I only procured one specimen, that I shot in a marsh near Pt. Pedro.

285. Gallinula cristata, Lath. *Willi-kukula,* Cing.; lit. Marsh Fowl.

Common in the south about Matura, frequenting the sedges, and feeding mornings and evenings on the inundated grassy lands or paddy fields. It is very rare northward, only one specimen falling under my notice: I shot it in the same locality as the preceding.

286. Porphyrio poliocephalus, Lath. *Kittala,* Cing.

Abundant in secluded marshes. It is a shy wary bird, difficult to flush (unless the shooter comes suddenly upon it), preferring to skulk amongst the reeds, over and between which it runs with great facility and swiftness. Its nest is constructed like that of *Gal. phœnicura*; the eggs a yellowish buff colour, sparingly marked with smallish purple, faint blue, and olive-green spots.

287. Phœnicopterus roseus, Pallas. *Inglis Koku,* Tam.; lit. English Heron; the birds when standing in lines, feeding, resembling with their red wings and white bodies an English regiment in full parade dress. *Krop-gans,* Dutch.

Migratory, appearing in the north in November; they are so plentiful on the salt-lakes and estuaries of the northern and eastern provinces that I have seen the shores for miles white with them, and when the assembled multitudes rose on the wing, it was with a noise that drowned the roar of the surf which thundered on the beach close by. They are said to breed near Hambantotte.

288. Sarkidiornis melanonotus, Pennant.

Not uncommon on the larger tanks in the Wanny; it keeps together in flocks, and I fancy breeds with us.

289. NETTAPUS COROMANDELIANUS, Gmel. *Mal-saaru,* Cing.; lit. Flower Teal, from its beauty. *Rajah-tara,* Mal.; lit. King Duck.

Common on many of the tanks in the Wanny, particularly in the neighbourhood of Anarajahpoora, where also

290. ANAS PŒCILORHYNCHA, Pennant,

is frequently met with, though it is one of our rarest ducks.

291. DENDROCYGNA ARCUATA, Cuvier. *Chemba-tara,* Mal.; lit. Red Teal; and *Tatta-saaru,* Cing. *Tree Duck* and *Whistling Teal* of European sportsmen.

Common on all fresh water throughout Ceylon, but never found on the sea. They breed with us in the month of June.

292. DAFILA ACUTA, Linn.

The "*Pin-tail*" is occasionally shot on the Jaffna estuary by the native duck-shooters and brought into the bazaar for sale, fetching about 3*d.* each.

293. QUERQUEDULA CRECCA, Linn.

and

294. QUERQUEDULA CIRCIA, Linn.

During the months of November, December, and January, the head of the Jaffna estuary, and all the low grounds just within the sea-bank (which is usually broken through at this season), are covered with vast flocks of these birds, which are killed so plentifully by the natives with their miserable guns and worse powder, that they are sold in the bazaars as low as one halfpenny each. The method adopted by the native hunter is to train one of the plough buffaloes for the sport; it is guided by means of a couple of ropes attached to its horns, a slight pull at which turns the animal right or left, thus enabling the shooter to keep on the off-side till within shot, when he rests his rusty musket on the brute's shoulder and fires. A punt and gun on these waters would do wonders, and I conceive amply repay an ardent sportsman the trouble and expense of reaching the spot.

295. FULIGULA RUFINA? Pallas?

I introduce this species with a mark of doubt, because I only know them through my telescope. I saw two or three pairs for several weeks on a piece of brackish water between Jaffna and Chavagacherry; they would not allow me to get within 250 or 300 yards of them, and I therefore never managed to shoot one.

A head of *F. rufina*, however, which I received from Calcutta was identified by a native as of a bird he knew and had killed on that very piece of water, though he had not seen them elsewhere.

296. Spatula clypeata, Linn.

Passing over the bridge crossing an arm of the above-named lake, I surprised a female of this bird with her brood of twelve young ones, most of which I captured; the mother, though shot at before I knew of the little ones, kept flying round me and often dropping into the water and feigning lameness, to draw me away from her offspring: this occurred in the early part of March. I have bought old birds from the shooters in November.

297. Podiceps Philippensis, Gmel. *Mukelepan*, Tam.; lit. Diver.

Common on large tanks and even in Colombo lake.

298. Larus brunnicephalus, Jerd. *Pullu*, Tam.; lit. Wormer. Family name for Gulls and Terns.

Common all round the coast and on the lakes and estuaries; it swims well and catches small fish.

299. Larus ichthyaëtus, Pallas.

I saw two specimens of this fine and unmistakeable Gull on the 11th of November 1851, at Pt. Pedro, after a severe storm; they were leisurely wending their way along the edge of the coral reefs northward, and I watched them with the glass for five minutes or more.

300. Dromas ardeola, Payk.

I place this bird here among the Terns, as I cannot help agreeing with Mr. Blyth in his remarks upon its affinities and position. I have obtained several specimens, all at sea, with one exception, which was on Calpentyn lake or estuary. A description of the egg which I formerly sent to Mr. Blyth, and his observation on the species, will be found in 'Contributions to Ornithology,' published by Sir William Jardine.

301. Sylochelidon Caspius, Lath.

302. Gelochelidon Anglicus, Mont.

303. Hydrochelidon Indicus, Stephens.

304. Thalasseus cristatus, Stephens.

305. Thalasseus Bengalensis, Lesson.

306. Seena aurantia, Gray.

307. Sterna Javanica, Horsf.

308. Sternula minuta, Linn.

309. Onychoprion anasthætus, Scop.

The nine species here enumerated are found pretty generally along our sea-border and on the lakes, estuaries, and salt lee-ways. I could on any evening shoot six or eight specimens of *Sy. Caspius,* either off Wally or Puthencally Bridges, as they flew *outwards* to sea, and the same in the morning as they returned *inland.* *G. Anglicus* and *H. Indica* are common all round the island. Of *Th. cristatus* I obtained one specimen at Pt. Pedro. *Th. Bengalensis* and *S. aurantia* pass in vast flights westward along the coral-reefs on the north of Ceylon during the months of May and June. *St. Javanica* is common even on the lakes at Anarajahpoora, where also *St. minuta* is often seen, though the latter is most common on tanks and still waters near the sea-shore; these two species hunt much over dry paddy fields, picking up insects of all kinds, small crabs, &c. *Ony. anasthætus* is very rare; I obtained three specimens about ten miles out at sea, off Pt. Pedro, when on a dredging excursion.

310. Atagen ariel.

Mr. Brodie of the Ceylon Civil Service first shot this species on Calpentyn lake, and I subsequently saw two, which were killed from the Light-house in Colombo in February 1853; one passed into my possession, the other into the Museum of the Ceylon Branch of the Royal Asiatic Society. I frequently saw them during the month flying at immense altitudes over the coast.

311. Plotus melanogaster, Gmel. *Beli Kawa,* Cing.

Common on all good-sized tanks: breeds at the Tangalle lake.

312. Pelecanus Philippensis, Gmel. *Koolookedai,* Mal.

Not unfrequently met with in small flocks on the sea-coast upon estuaries and still water. I am told they breed near Mul-letivoe, which is a splendid locality for all these tribes.

313. Graculus Sinensis, Shaw.

I have seen a few of these birds on the fishing kraals in the Jaffna estuary, in company with the much commoner

314. GRACULUS PYGMÆUS, Pallas. *Cadel cagam,* Mal.; lit. Sea Crow. *Dia Kawa,* Cing.; lit. Water Kawa. *See Krai,* Dutch. *Graya de Mare,* Port.

—which is also found abundantly on all the inland lakes and rivers of any magnitude.

315. THALASSIDROMA PELAGICA, Briss.

The Stormy Petrel is occasionally seen flitting about Colombo roadstead and Galle harbour, particularly after rough weather. It was the last bird that I saw when I quitted the shores of the island, and the last of my "Notes on the Ornithology of Ceylon."

XXVI.—*On the Fertilization of Ferns.* By W. HOFMEISTER *.

[THE author having kindly sent me a copy of the following note, I place it before the readers of the 'Annals' as an important supplement to the notices I have published on the subject in this Journal † and elsewhere. It may be remarked that these statements, recording direct observation of the passage of the spermatozoids down the archegonium, take away the necessity of attributing a conducting power to the mucilaginous contents of the canal of the archegonium, which I speculatively suggested, never having been able to find a spermatozoid in contact with the germinal vesicle.—A. H.]

Numerous examinations of the prothallia of various Ferns in which the embryo was in course of development—examinations made for the purpose of ascertaining the order of formation of the cells of the vegetative organs—have led to my discovery of certain circumstances, hitherto unknown, affording more direct conclusions regarding the process of reproduction in the higher Cryptogamia.

The germinal vesicle originates in the central cell of the archegonium, around a nucleus which appears in the vaulted apex of that cell, without the primitive central nucleus undergoing any essential change. I have already observed and described this phænomenon in the Equisetaceæ (Abhandl. der kön. Sächs. Gesellsch. der Wiss. ii. 172); it holds good of all the vascular Cryptogamia. Before fertilization the germinal vesicle fills scarcely one-third of the central cell. The primary nucleus of

* From the Reports of the Royal Society of Sciences of Saxony, April 22, 1854. Communicated by Arthur Henfrey, F.R.S. &c.

† Ann. Nat. Hist. 2nd Ser. vol. ix. p. 444. Linnæan Transactions, vol. xxi. p. 117.

the latter has vanished by the time when the archegonium is ready for impregnation. In the Ferns, as in the Equisetaceæ, I never found more than one germinal vesicle in each archegonium. In *Salvinia*, on the contrary, there are often two present.

During the formation of the canal traversing the neck of the archegonium, the membrane at the apex of the central cell becomes softened. The spermatozoids which enter this canal make their way through the mucilage filling it, as far as the interior of the central cell, where they move actively round about the germinal vesicle, which is closely adherent to the vaulted apex of the central cell near the internal end of the canal, with its hemispherical free end hanging down in the cavity. In one case, when these spermatozoids had arrived at the central cell of an archegonium of *Aspidium Filix-mas*, the movements lasted for seven minutes from the commencement of the observation. The cessation was accompanied (and probably caused) by the coagulation of the albuminous substance of the fluid contents of the central cell *.

When spermatozoids occurred in the cavity of the central cell,

* This is the place to mention the mode in which I proceeded in my investigations. When Fern spores are thickly sown, a number of the germinating prothallia soon advance far beyond the rest. At the time when the advanced ones have long ceased to produce antheridia, and bear abundance of archegonia (which in closely-tufted erect prothallia are produced on both surfaces, and most abundantly on those having most roots), those which have remained behind in their growth are beginning to be covered with antheridia. If the crop is now kept with little moisture for several weeks and then suddenly abundantly watered, a large number of antheridia and archegonia simultaneously burst. Then, in a few hours afterwards, the surface of the larger prothallia will be found almost covered with moving spermatozoids. I now take such prothallia as exhibit freshly opened archegonia, holding them by one wing between the finger and thumb of the left hand, so that the upper face of the prothallium lies upon the thumb, and with a thin, narrow knife make delicate longitudinal sections perpendicular to the surface of the parenchymatous part of the prothallium. When the cushion-like thickening of the tissue is only $\frac{1}{8}$th of a line thick, after some practice it is not difficult to cut sections not more than $\frac{1}{15}$th of a line broad. If such sections are quickly examined under a power of 200 or 300 diameters, spermatozoids may sometimes be found in the interior of the archegonia which are exposed in their whole length. I once saw two, one close behind the other, in the canal of the archegonium of *Pteris aquilina*, when their movements ceased during the observation; in the same Fern I saw one in motion in the central cell, at the side of the germinal vesicle. In *Asp. Filix-mas* I have seen a spermatozoid moving in the central cell, once more besides the case mentioned in the text; and in this, as well as in *Asplenium septentrionale* and *Filix-fœmina*, I have seen motionless spermatozoids lying beside the partially-developed germinal vesicle. Thus the unequivocal observations of moving spermatozoids in the central cell amount only to three; but these were so clear and distinct as to exclude all possibility of deception.

the entrance of this appeared almost closed by the expansion of the neighbouring cells. This growing up of the internal mouth of the canal evidently followed immediately the entrance of the spermatozoid into the central cell. This is the first phænomenon which gives evidence of the completion of the fertilization, and not, as I formerly assumed (Vergleich. Unters. p. 82), the division of some of the cells immediately surrounding the central cell. The number of these is very variable in unfertilized archegonia of the above-mentioned species. The impregnated germinal vesicle enlarges until it fills the central cell, and then commences its series of divisions (segmentation) which lay the foundation of the various organs of the embryo.

In the Mosses also, the central cell of the archegonium behaves as an embryo-sac. There again the germinal vesicle is found around a nucleus appearing free near (under) the primary nucleus; shortly before the formation of the canal leading through the neck of the archegonium, formed by the dissolution of the axile row of cells of the latter. The new canal lies in the *lower* convexity of the central cell,—its position, and that of the young germinal vesicle, are therefore opposite to those of the same organs in the vascular Cryptogamia. The primary nucleus soon disappears, the germinal vesicle grows considerably, and in the mature archegonium more than half fills the central cell. In the Mosses it mostly floats free in the centre; more rarely it adheres to the side or the upper part of the wall, which, in the archegonium ready for impregnation, softens into a jelly, but does not completely dissolve. In Hepaticæ with very large cavity of the archegonium, such as *Riccia, Riella* and *Fossombronia,* the germinal vesicle often rests against some point of the upper convexity, projecting freely into the cavity. I have no doubt that spermatozoids of the Mosses pass the cord of mucus (strongly refracting light) which occupies the axis of the canal of the archegonium and projects a short distance into its expanded portion, that they enter into the latter and come in contact with the outer surface of the germinal vesicle. I am the more confident from having found moving spermatozoids, in *Funaria hygrometrica,* which had penetrated down one-third of the length of the neck of the archegonium. The tenuity of the spermatozoids and the want of transparency in the walls of the archegonium, will be a sufficient apology for the further fate of the spermatozoids not having yet been observed here.

XXVII.—*Upon a new species of* "Alpheus" *discovered upon the coast of* "*Herm*" (*Channel Islands*). By W. V. Guise, Esq., F.G.S.*

In the course of an excursion to the Channel Islands, undertaken last summer with a view to natural-history pursuits, I spent three days in the little islet of Herm, which, though a mere rock, scarcely three miles in circumference, is equalled by few spots of similar extent within the area of the British seas, in respect of the rich field it offers for the researches of the marine naturalist.

The Channel Islands, though an appanage of the crown of Great Britain, are, geographically speaking, rather a part of France than of England; and this situation, in a sort of debateable ground, may perhaps in some degree account for the fact of their natural history having been to a certain extent overlooked by the naturalists of both countries; though few districts can be expected to yield a richer harvest to the scientific investigator, constituting as they do the northern limit to many Mediterranean forms, which, here found flourishing in full vigour, and showing no signs of decrepitude, dwarfishness or decay, suddenly disappear, and find no footing upon our side of the Channel. This is well known to be the case amongst the testaceous Mollusca; and there is little reason to doubt, that researches prosecuted amongst the other kingdoms of nature would be rewarded by the discovery of many novel and important facts.

Amongst the Crustacea, to which I propose especially to direct your attention, it is only necessary to refer to the discovery of the singular and beautiful "*Phyllosoma sarniense*," figured and described by Mr. C. F. Lukis in the 8th volume of 'Loudon's Magazine of Natural History,' which example, still I believe unique, has its only analogues in one Mediterranean species, and in a few others confined to tropical areas.

I propose now to lay before you another Crustacean, which it has been my good fortune to obtain in a tide-pool at low water on the islet of Herm, and which, from its immediate recognition as the "red shrimp" by the fisherman who accompanied me, I have reason to believe is not of unfrequent occurrence. My first idea was, that I had obtained "*Alpheus ruber*," itself a great prize, being a Mediterranean species of the greatest rarity in our seas; but upon comparing it carefully with the descriptions of Milne-Edwards in his 'Histoire Naturelle des Crustacés,' I be-

* Read at a Meeting of the Cotteswold Naturalists' Club, on Tuesday 9th May 1854.

came convinced that I had had the good fortune to obtain an entirely new species of *Alpheus*; and further investigations have only tended to confirm me in that opinion.

The genus "*Alpheus*" is thus characterized by Milne-Edwards:—

Carapace prolonged in form of a hood or vault over the eyes.

Rostrum small, and sometimes wanting.

Superior antennæ small; first articulation short, and armed without with a plate, generally spiniform; two following joints cylindrical, having two terminal threads, of which the superior is thicker and shorter than the inferior, and presenting traces of a division into two filaments towards the end.

Inferior antennæ inserted without and below the preceding.

Lamellar palp of moderate size, sometimes small and pointed.

Mandibles provided with a short, broad, palpiform appendage.

External pedipalps more or less slender and elongated, termination broad and somewhat foliaceous.

Two first pairs of legs didactyle, the first pair strong; the one much larger and more robust than the other.

Second pair weak and filiform, having the wrist multi-articulate.

Three last pairs of legs monodactyle and of moderate length.

This genus, says M. Edwards, appears to belong properly to the seas of warm climates. Some species are found in the Mediterranean; but the greater part come from the seas of the Antilles or from the Indian Ocean.

The genus is *divided* into those which *have*, and those which *have not*, a *spiniform rostrum*. It is further *subdivided* into those having a spine attached externally to the basal joint of the *external antennæ*, and those *not* so furnished.

The example now before us will be found to belong to the second subdivision of the first division, *i. e.* to those provided with a pointed beak, and not having an external spine at the base of the external antennæ.

Under this head three species are described by M. Edwards as inhabiting the European seas, viz.—

Alpheus ruber, *Alpheus Edwardsii*, and *Alpheus dentipes*, which are characterized as follows:—

Alpheus ruber. "Body very slender; larger hand provided with four longitudinal carinæ, two on the upper edge, two on the external face; lower margin obtuse; moveable finger *much shorter* than the immoveable one. A spine upon the upper margin of both arms at some distance from the termination."

It will be remarked that nothing is here said concerning the character of the anterior portion of the carapace; but as this species is said to be "très voisine de la précédente" ("*Alpheus brevirostris*," a new Holland species), which is characterized as having the border of the supra-orbital hood rounded and *without spines*, it is to be inferred that the like character also applies to *A. ruber*.

Alpheus Edwardsii. "Very closely allied to the preceding. *Anterior* borders of *supra-orbital vaults armed* with a *spine*, so that the front presents three nearly equal teeth. The second joint of the superior antennæ about half as long again as the first. Lamellar appendage of the external antennæ dilated a little within towards the end, and not passing the footstalk of the superior antennæ. Pedipalps very narrow towards the end, and extending beyond the footstalk of the superior antennæ. Anterior legs nearly of the same form as in the preceding species, but more enlarged, and having the pincers more irregular; those on one side slender and lengthened."

Alpheus dentipes. "Closely allied to the preceding: having likewise the supra-orbital vaults prolonged into points, but having the two anterior legs nearly of the same size; the pincers of the smaller large at the base, but becoming extremely narrow towards the end; having the third articulation of the second, third and fourth pairs of legs armed with a pointed tooth externally, at one-third the length of each."

Upon comparison of my Channel Island individual with the three species described above, I find the following points of agreement and difference between them.

It *assimilates* with *A. ruber* in having the larger hand furnished with longitudinal carinæ on the upper and the outer surface;

Differs, in *not* having the moveable finger longer than the immoveable one; and *essentially* in the spinous armature to the supra-orbital hoods.

It *assimilates* with *A. Edwardsii* in having the anterior edge of the supra-orbital hoods armed with short spines; and in having the second joint of the superior antennæ half as long again as the first;

Differs, inasmuch as the lamellar appendage is *not* dilated towards the end; in the longitudinal carinæ upon the upper and outer surface of the larger pincers; in the proportions and form of the anterior feet, and in other minor particulars.

Assimilates with *A. dentipes,* as with *Edwardsii,* in the spinous terminations to the supra-orbital hoods;

Differs, with respect to the comparative proportion between the two anterior pairs of legs; and inasmuch as the three hinder pairs of legs are not armed externally with a pointed tooth.

Having thus shown in what respects the *Alpheus* from Herm assimilates with, and differs from, the three species above referred to, it remains to describe its own particular characteristics, which are as follows:—

The medial line of the carapace prolonged anteriorly into a short beak: *supra-orbital vaults,* each furnished at the extremity with a minute spine: *anterior legs unequal*; the *larger hand* having upon the upper edge two carinæ, one behind the other, each terminating anteriorly in a small tooth projecting forwards; two carinæ upon the outer surface of the claw, the lower one having a short tooth: the *moveable finger not* shorter than the immoveable one, flattened laterally, and broad at the point: the *immoveable finger* triangular, strong, and forming a kind of socket into which the opposing finger fits by a tubercle at its extremity: *lesser pincer* having a toothed keel upon its upper edge, equal in length to the others, but thinner, narrower, and much less robust: second pair of legs didactyle, slender, and having the wrist many-jointed.

Length 15 lines.

Colour deep scarlet, except the chelæ, which are mottled with yellow.

From the want of other works of reference, besides those of M. Edwards and of Professor Bell, I have it not in my power to ascertain whether the species now under notice has been distinguished by later carcinologists; but I have endeavoured, I think satisfactorily, to show that it cannot be identified with either of the European species of *Alpheus* described by the former distinguished naturalist. As regards both the figure and description of *Alpheus ruber* in Bell's 'British Crustacea,' they having been confessedly taken from an *imperfect* individual, found in the stomach of a Cod-fish, have so little in common with my Channel Island example, that, if identical with it, it must be presumed that all the more marked points of agreement between them had been digested away in the interior of the fish.

In the 8th volume of 'Loudon's Magazine of Natural History,' page 272, is however a notice of a Crustacean by the late Mr. Hailstone, which certainly agrees far more nearly with my example than do either of those to which I have already referred;

so nearly indeed, that but little doubt remains upon my mind of its being identically the same. This species, which Mr. Hailstone calls "*Hippolyte rubra*," and of which a figure is annexed, is thus described:—

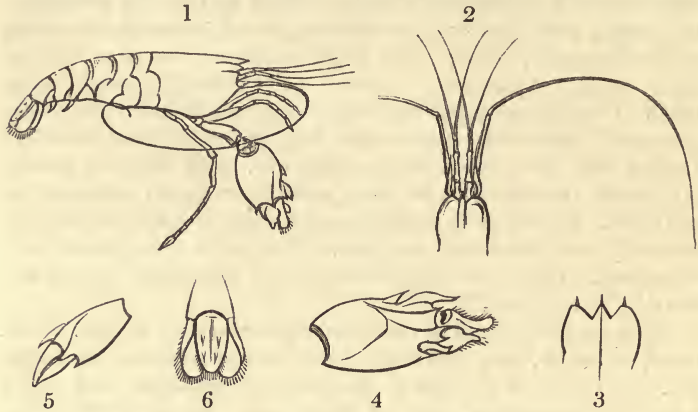
"Superior antennæ with two setæ, the upper ones fringed with hair and excavated below. Inferior antennæ nearly the length of the body. Pedipalps with three exserted joints, the last bluntly pointed, and twice the length of the preceding one, with two rows of fasciculi of hairs. First pair of legs didactyle, very large, with the hands much compressed, unequal, the right being the larger, bristly; the thigh excavated beneath, and its inner margin spinulose; second pair didactyle, very long, slender; wrists many-jointed; other legs terminated by a single claw and spinulose within; the last pair the most slender. Thorax with three short spines anteriorly. Tail with five plates, the middle one blunt at its apex, with four spines arranged in two lines. Colour deep scarlet, except above the eyes, *which are concealed under the shell*, and above them it is transparent and colourless. The tail is fringed with white hairs, and the legs are mottled with yellow."

Upon this, at page 274 (same volume), is a note by Mr. Westwood, in which, with much skill and critical acumen, he traces Mr. Hailstone's individual to the group of *Alpheadæ*, and refers it to *Cryptophthalmus ruber* of Rafinesque, which M. Edwards identifies with his "*Alpheus ruber*." Mr. Westwood afterwards, at page 552, proposed to elevate it into the type of a new genus by the name of '*Dienecia*.'

Mr. Hailstone's description, as quoted above, might almost stand word for word as applicable to my example, with which it seems to tally in all important particulars, excepting as regards size, which, in the case of Mr. Hailstone's Crustacean, is barely two-thirds that of mine. The figures too attached to Mr. Hailstone's notice would serve equally well to illustrate mine, with the exception of the hairy fringe attached to the setaceous extremities of the superior antennæ.

If I am right in my supposition of the identity of my Channel Island Crustacean with the three individuals described by Mr. Hailstone as brought up by the trawl-net off Hastings in 1835, it is evident that the half-digested relics procured by Mr. Cocks at Falmouth are not the first examples of an *Alpheus* having been recorded as an inhabitant of the British seas. Indeed it is impossible to read Mr. Hailstone's careful and minute description without feeling convinced that a true *Alphean* was before him when he made his drawing and description; and I may be pardoned for expressing my surprise, which I do with great deference to the high attainments of Professor Bell, that that distinguished naturalist, in adopting the "*Crangon bispinosus*" and "*trispinosus*" of Mr. Hailstone, should have omitted all reference to a form so very remarkable and so carefully detailed as Mr. Hailstone's "*Hippolyte rubra.*"

In the belief that my Channel Island Crustacean is a new and undescribed species, I propose to bestow upon it the name of *Alpheus affinis*; thereby indicating the close relationship which it bears to the three other European species already referred to.



1. *Alpheus affinis*, natural size.
2. Enlarged view of front of carapace, showing supra-orbital vaults, insertion of antennæ, &c.
3. Front of carapace still further enlarged, showing beaked rostrum and spinous armature of supra-orbital vaults.
4. Enlarged view of larger pincer.
5. Enlarged view of lesser pincer.
6. Tail.

XXVIII.—*Descriptions of three new species of British* Actiniæ. By Philip H. Gosse, A.L.S.

Actinia aurora. The Orange-tentacled Anemone.

Body in contraction a hemispherical button $\frac{1}{2}$ inch in diameter, of an umber-brown hue, occasionally varying to olive, marked with narrow longitudinal pale bands, which become wider and more conspicuous towards the base, and obsolescent at the discal margin, where the brown hue is deepest. The pale bands are separated by about four times their own width, but have at the base several short and vanishing pale lines between them.

The exterior of the body is studded with numerous pale oblong sucking-glands, not prominent, to which grains of sand, fragments of shell, &c. adhere strongly.

Tentacles about eighty in number, set in four rows, of which the inner row contains about six a little more prominent than the rest, and often either perpendicular or bent over the disk; the others are set so irregularly, that though there is an approximation to a serial arrangement, they can scarcely be distributed into rows, except arbitrarily. The external ones are the smallest. They are moderately thick at the base, tapered to a blunt point, and the longest about equal in length to the diameter of the disk. They are pellucid at the basal moiety, and nearly colourless; thence they are tinged with orange or red-lead, faintly at first, but becoming very brilliant at the tips. Under a lens this colour appears to be superficial, and to be composed of minute dust-like powdery specks; but on submitting the tentacles to pressure under a power of 220 diameters, I find that the red pigment is deposited on the *interior* surface, from which it escapes by the rupture of the walls. The latter are somewhat thin, yellowish, clear, and full of minute thread-cells of the usual form, and about $\frac{1}{1100}$th of an inch in length.

Disk variegated with dark brown, grayish drab and white; the former two colours arranged irregularly in a minute pattern, the latter forming a circle of opake white spots surrounding the mouth. The angles of the mouth are indicated by a pale band, which passes from each across the disk, in which are conspicuous the ovarian orifices.

The pattern of the disk is often the same as that of *troglodytes*, but is never so distinct: in some specimens only the ring of white spots can be seen on a blackish-olive ground; in others nearly the whole disk is yellowish-white. One specimen (which I take to be a variety of this species) has all the tentacles pure opake white, without any trace of orange, and the disk also white, marked dimly with gray.

I find it in one of the caverns of St. Catherine's Island, Tenby, where it is common, in company with *A. troglodytes*, and with the same habits.

One specimen in my possession produced young freely, ejecting them from the oral aperture four or five at once. They varied in size, from that of a mustard-seed downwards; were very prettily marked, with radiating white bands on a yellowish ground when contracted; and displayed, when expanded, from twelve to eighteen orange tentacles.

Actinia venusta. The Orange-disked Anemone.

Button about $\frac{1}{2}$ inch in diameter, and the same in height. Flower-like expanse 1 inch wide.

The button varies from deep buff to rich brown-orange, studded with minute pale sucking-glands, and marked around the base with short and vanishing longitudinal pale lines.

Tentacles about 200 or more, not in distinct rows, the inner ones about as long as the diameter of the disk, the outermost small and close-set; slender, acute, somewhat flaccid; pure white, becoming pellucid at the base, and sometimes at the tip.

Disk commonly ovate, wholly of a brilliant orange or red-lead colour, with no markings except the indications of internal structure, which are dimly visible through the integument. Its surface is plane; the mouth a simple orifice, without distinct lips or cone.

This most elegant species I have met with only in the neighbourhood of Tenby, where it is so abundant as to be quite characteristic. It occurs all along the south coast of Pembrokeshire, at least from Monkstone Point to St. Gowan's Head, but is more than usually numerous in the fine perforated caverns of St. Catherine's Island, that form such an attraction to Tenby visitors. It is a troglodyte species, almost invariably choosing for its residence some crevice or cranny, or one of those little cavities made by boring mollusks, with which the limestone here is so generally honeycombed. Though we often see it in shallow pools with a bottom of mud, we invariably find on examination that it is attached to a hole in the rock beneath, protruding its body through the deposit by elongation, and expanding its beautiful disk on the surface. From this habit it is difficult to procure, nothwithstanding its abundance, as it must be chiselled out,—an operation, which, from the great hardness of the limestone, is both tedious and precarious.

Hundreds may be seen in the largest of the caverns alluded to, hanging down from the walls during the recess of the tide; the button elongated to an inch or more. They expand very readily in captivity, displaying the brilliant disk in full, fringed with its elegant border of white tentacles; yet not unseldom do we see the margin puckered into frilled folds, in the manner of *A. bellis* and *dianthus*, though to a less extent.

This species has close relations with *A. nivea* and *A. rosea*, especially with the former. Its colouring, however, seems constant, without any tendency to albinism; and its habit of throwing the margin into puckers, and its tendency to an ovate outline, also distinguish it, though less satisfactorily. From *rosea* it is better distinguished by its superior size, and by the greater comparative thickness of its inner tentacles, which also are more discal, whereas in *rosea* they are all marginal. All the three species throw out white filiferous filaments in great profusion when annoyed.

In *venusta* these are densely crowded with capsules $\frac{1}{450}$th of an inch long, which protrude a thread about three times their own length. This is slender, but occasionally I have detected a waved outline which indicates a bearded appendage.

Actinia thallia. The Glaucous Warty Anemone.

Button $1\frac{1}{4}$ inch in diameter, usually 1 inch in height, but capable of elongation to double this altitude. Expanded flower 2 inches.

Button pale bluish-green, studded with prominent warts of a darker hue, set in 25 to 30 longitudinal rows, about 25 in each row; the topmost or marginal wart becoming an elongated pale tubercle or rudimentary tentacle.

Tentacles about 48 in number, in two rows, equal in size; thick, obtuse, scarcely more than half as long as the diameter of the disk, even when extended:—pellucid grayish-brown, with a longitudinal, undefined, dark brown streak along the facial side of each, on which are placed irregularly several specks and splashes of opake white, varying in number, shape, size and position.

Disk a many-rayed star of yellow rays on a blackish ground: thus produced:—the inner circle of tentacles have their discal ribs blackish, with a spindle-shaped spot of yellow near the mouth. Those of the outer row are similarly marked, but the yellow spot is drawn out to a long line, dividing the primary tentacle-ribs from each other: these lines make the rays of the facial star.

This is a very well-marked and constant species; out of a dozen specimens that I procured, no two differed in any appreciable degree, except in size. It approaches close to *A. gemmacea*, from which however it is easily distinguished by colour, and by its superior dimensions.

I found it in only one locality; in the dark angles and pools of a little insular rock, exposed at spring tide, that lies just off the Cove called the Droch, near Lidstep in Pembrokeshire, on the east side. It is not troglodyte in habit, but adheres to the open rock, and is therefore easily detached. It is very social: I almost invariably found four or five clustered together in a lump, each pressing upon the sides of the others.

In captivity it is shy of expanding: it is also reluctant to adhere, and very readily detaches its base, either wholly or in part, when it will frequently remain for days without again affixing itself. If the water become stale, it manifests its impatience in this way, and dies sooner than most species. Like *gemmacea*, it throws off successive rings of mucus from its body, which accumulate around its base if not removed.

The resemblance of this species to *A. gemmacea* is heightened by the habit of elongating itself in the form of a column, when closed.

It does not throw out filiferous filaments when irritated, but the convoluted bands are protruded from wounds in the base. Examining a small portion of one of these, I found two sorts of capsules; one of a lengthened oval form, $\frac{1}{900}$th of an inch in length, from which a thread apparently simple, $\frac{1}{24}$th of an inch long, is evolved; the other and more numerous, excessively linear, $\frac{1}{450}$th in length. I am not sure, however, whether these latter be capsules, as I did not see one discharge.

In the skin surrounding the margin the capsules are linear-oblong and very minute, $\frac{1}{1750}$th in length. Those in the walls of the tentacles are similar in form and size.

The name is from *θαλλία*, an olive shoot, in allusion to its elongated form and glaucous colour.

BIBLIOGRAPHICAL NOTICES.

The Ferns of Great Britain. Illustrated by John E. Sowerby. *The Descriptions, Synonyms, &c. by* C. Johnson. London: J. E. Sowerby, 3 Mead Place, Lambeth.

We have received the first two Numbers of this new work upon the British Ferns, and have much pleasure in being able to recommend it to botanists and fern growers. Mr. Johnson has succeeded in making his part of the book readable, without omitting the requisite technical descriptions of the plants. We think that he has acted wisely in retaining the names that are now most in use, for those are also we believe the more correct ones, in nearly if not quite all cases. Much as we are indebted to Mr. Newman for our present knowledge of British Ferns, and greatly as his earlier writings tended to the adoption of a correct nomenclature, we cannot allow the present opportunity to pass without expressing sorrow that he should have made such extensive and, as we think, uncalled-for changes in the names in the lately-issued new edition of his 'History of British Ferns.' It is right however to add, that we have only seen his abridged account of them, published in connection with the 'Phytologist,' as we have not yet had an opportunity of examining his larger work with the requisite care. Having paid no slight attention to the nomenclature of Ferns, we do not expect that our views will be much changed by its perusal.

But to return to the work before us. It may be considered as a proof of how little objection we make to the describer's part of it, when we mention a subject of such slight consequence as the names of the localities. It is nevertheless rather singular that all the Welsh names are spelled wrong; one of them indeed we have not identified, it is Moel Sichog; a name that does not occur in Mr. Moore's very complete list of the localities of our ferns. The latter author has made very similar blunders in printing the singular names of these places, and those who are not intimately acquainted with the Snowdonian mountains may well be excused for transcribing them incorrectly.

No notice is taken of *Polypodium alpestre* and its ally or variety *P. flexile*, in the place which it might have been expected to occupy; but probably Mr. Johnson intends to adopt Mr. Newman's genus *Pseudathyrium*. Neither do we find any remark upon the *Lastrea uliginosa* of Newman, which, if not a variety of *L. cristata*, as some suppose, should find a place between that plant and *L. spinulosa*.

The plates bear out the remark in the Prospectus, that "the figures will be all accurately drawn and engraved from the respective plants, and thus many errors in identity and general detail, which had unavoidably occurred in 'English Botany,' will be rectified." Still, there are manifest traces of the 'Eng. Bot.' plates being before the artist when preparing those now issued.

We look forward with much interest to the publication of the successive parts, and shall probably again notice the work when it is further advanced.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 15, 1854.—The Earl of Rosse, President, in the Chair.

"Contributions to the Anatomy of the Brachiopoda." By Thomas H. Huxley, F.R.S.

In the course of the dissection of certain Brachiopoda with which I have recently been engaged, I have met with so many peculiarities which are unnoticed in the extant and received accounts of their anatomy, that although the pressure of other duties prevents me from attempting to work out the subject with any degree of completeness for the present, I yet gladly avail myself of the opportunity of communicating a few of the more important results at which I have arrived, in the hope that they may find a place in the Proceedings of the Royal Society.

My investigations were principally made upon *Rhynchonella psittacea*, for specimens of which I am indebted to Prof. Edward Forbes, while Dr. Gray obligingly enabled me to compare them with *Waldheimia flavescens* and with *Lingula*.

1. *The Alimentary Canal of Terebratulidæ.*—Professor Owen, in both his earlier and his later memoirs on the anatomy of the Terebratulidæ, describes at length the manner in which the intestine, as he states, terminates on the right side between the lobes of the mantle.

On the other hand, Mr. Hancock has declared himself unable to observe at this point any such anal aperture, and concludes from his own observations that the latter is situated on the ventral surface of the animal in the middle line, just behind the insertion of the great adductor muscle. M. Gratiolet, in a late communication to the Académie des Sciences, takes the same view. To get rid of the obvious difficulty, that this spot is covered by the shell, and therefore that if the anus existed here, there would be no road of escape for the fæces, Mr. Hancock and Mr. Woodward appear to be inclined to suppose that some cloacal aperture must exist in the neighbourhood of the pedicle.

The existence of any such aperture, however, has recently been denied with great justice by Professor Owen.

The result of my own repeated examinations of *Rhynchonella psittacea* and of *Waldheimia flavescens* is—1. that the intestine does not

Fig. 1.

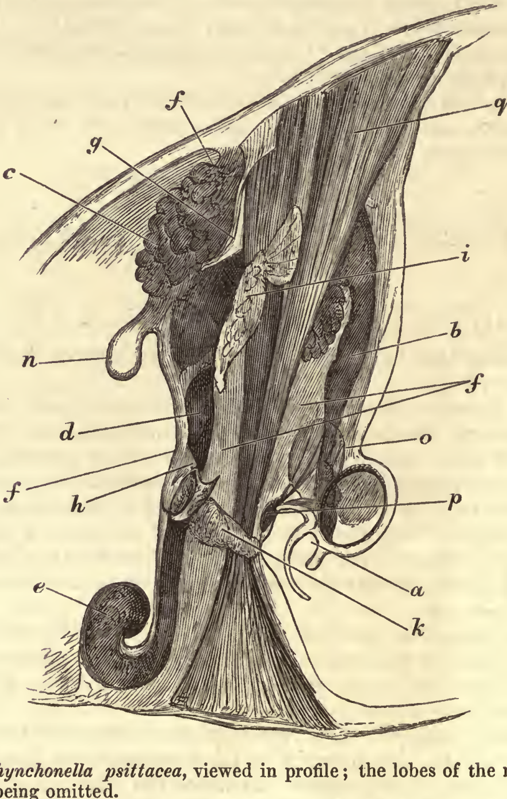


Fig. 1. *Rhynchonella psittacea,* viewed in profile; the lobes of the mantle and the pedicle being omitted.

Fig. 2. The same viewed from behind, the pedicle having been cut away. The left half of the body and the liver are omitted.

a. mouth; *b.* œsophagus; *c.* stomach and liver; *d.* intestine; *e.* imperforate rectum; *f.* mesentery; *g.* gastro-parietal bands; *h.* ilio-parietal bands; *i.* superior 'heart'; *k.* inferior 'heart'; *l.* genital bands; *m.* openings of pallial sinuses; *n.* pyriform vesicle; *o.* sac at the base of the arm; *p.* ganglion; *q.* adductors.

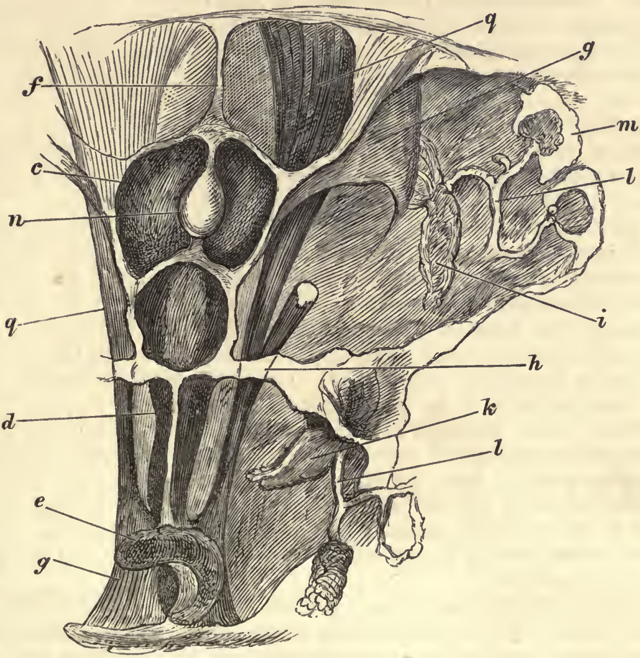
terminate on the right side of the mantle as Professor Owen describes it, but in the middle line, as Mr. Hancock describes it in *Waldheimia*, while in *Rhynchonella* it inclines, after curving upwards, to the *left* side; and 2. that there is no anus at all, the intestine terminating in a rounded cæcal extremity, which is straight and conical in *Waldheimia*, curved to the left side and enlarged in *Rhynchonella*.

I confess that this result, so exceptional in its character, caused me no small surprise, and I have taken very great pains to satisfy myself of the accuracy of my conclusion; but notwithstanding the strong prejudice to the contrary, to which the known relations of the anal aperture in *Lingula* gave rise, repeated observation has invariably confirmed it.

Professor Owen's statement is, that in *Rhynchonella* (*Terebratula*) *psittacea* " the intestine inclines to the right side and makes a slight bend forwards before perforating the circumscribing membrane in order to terminate between the mantle lobes on that side."—*On the Anatomy of the Brachiopoda*, p. 152.

I find, on the contrary (figs. 1 and 2), that the intestine passes

Fig. 2.



at first straight downwards in the middle line, as in *Waldheimia*, but instead of terminating in a rounded tapering extremity as in that genus, it bends upwards and then curves round to the *left* side, forming a sort of free cæcum in the visceral cavity. My reasons for believing that it is a free cæcum are these:—in the first place, no anal aperture can be detected in the mantle cavity, either on the right or left sides, although the small size of the animal allows of its being readily examined uninjured, with considerable magnifying powers.

Secondly. If the shell be removed without injuring the animal and the visceral cavity be opened from behind by cutting through its walls close to the bulb of the pedicle, it is easy not only to see that the disposition of the extremity of the intestine is such as I have described it to be, but by gentle manipulation with a needle to convince oneself that it is perfectly unattached. And in connexion with this evidence I may remark, that the tissues of the Brachiopods in general are anything but delicate; it would be quite impossible for instance to break away the end of the intestine of *Lingula* from its attachments without considerable violence.

Thirdly. If the extremity of the intestine, either in *Rhynchonella* or in *Waldheimia*, be cut off and transferred to a glass plate, it may readily be examined microscopically with high powers, and it is then easily observable that its fibrous investment is a completely shut sac. In *Rhynchonella* the enlarged cæcum is often full of diatomaceous shells, but it is impossible to force them out at its end, while if any aperture existed they would of course be readily so extruded.

However anomalous, physiologically, then, this cæcal termination of the intestine in a molluscous genus may be, I see no way of escaping from the conclusion that in the *Terebratulidæ* (at any rate in these two species) it really obtains. There are other peculiarities about the arrangement of the alimentary canal, however, of which I can find either no account at all or a very imperfect notice.

The intestinal canal (figs. 1 and 2 *b*, *d*, *e*) has an inner, epithelial, and an outer fibrous coat; the latter expands in the middle line into a sort of mesentery, which extends from the anterior face of the intestine between the adductors, to the anterior wall of the visceral chamber, and from the upper face of the intestine to the roof of the visceral chamber; while posteriorly it extends beyond the intestine as a more or less extensive free edge. I will call this the *mesentery* (*f*).

From each side of the intestinal canal, again, the fibrous coat gives off two 'bands,' an upper (*g*), which stretches from the parietes of the stomach to the upper part of the walls of the visceral chamber, forming a sort of little sheath for the base of the posterior division of the adductor muscle, which I will call the *gastro-parietal band*; and a lower, which passes from the middle of the intestine to the parietes, supporting the so-called '*auricle*.' I will call this the *ilio-parietal* band (*h*).

The ilio-parietal and gastro-parietal bands are united by certain other ridges upon the fibrous coat of the intestine, from whose point of union in the middle line of the stomach posteriorly, a pyriform vesicle (*n*) depends.

The mesentery divides the liver into two lateral lobes, while the gastro-parietal bands give rise to the appearance that these are again divided into two lobules, one above the other. I am inclined to think that these bands are what have been described as 'hepatic arteries,' at least there is nothing else that could possibly be confounded with an arterial ramification upon the liver.

This description applies more especially to *Rhynchonella* and *Waldheimia*, but the arrangement in *Lingula* is not essentially different.

2. *The Circulatory System of Terebratulidæ.*—Considerable differences of opinion have prevailed among comparative anatomists as to the nature and arrangement of the vascular system in the Brachiopoda. A pair of organs, one on each side of the body, have been recognized as Hearts since the time of Cuvier, who declared these hearts in *Lingula* to be aortic, receiving the blood from the mantle and pouring it into the body, the principal arterial trunks being distributed into that glandular mass which Cuvier called ovary, but which is now known to be the genital gland of either sex.

Professor Owen in his first memoir follows Cuvier's interpretation, stating that in *Orbicula* the pallial veins terminate in the hearts, from which arterial branches proceed to the liver and ovary. Professor Owen further adds for the Brachiopoda in general,—

"Each heart, for example, in the Brachiopoda is as simple as in Ascidia, consisting of a single elongated cavity, and not composed of a distinct auricle and ventricle as in the ordinary Bivalves," and he compares the hearts of Brachiopoda to the auricles of *Arca*, &c. (Trans. Zoological Society, vol. i. p. 159.)

In 1843, however, M. Vogt's elaborate memoir on *Lingula* appeared, in which the true complex structure of the 'heart' in this genus was first explained and the plaited 'auricle' discriminated from the 'ventricle'; and in 1845, Professor Owen, having apparently been thus led to re-examine the circulatory organs of Brachiopoda, published his 'Lettre sur l'appareil de la Circulation chez les Mollusques de la Classe des Brachiopodes,' in which he felicitates M. Milne-Edwards on the important confirmation of the views which the latter entertains with respect to the lacunar nature of the circulation in the Mollusca, afforded by the Brachiopoda, and describes each heart of the Terebratulidæ as consisting of a ventricle and a plaited auricle, the pallial veins not terminating in the latter, but in the general visceral cavity. As the Professor does not recall the view which he had already taken of the circulation in *Orbicula*, I presume that he considers two opposite types of the circulatory organs to obtain in the Brachiopoda, the direction of the current being from the mantle through the heart towards the body in *Orbicula*, and from the mantle through the body towards the heart in *Terebratula*.

The possibilities of nature are so various that I would not venture, without having carefully dissected *Orbicula*,—no opportunity of doing which has yet presented itself,—to call this view in question, but I think it seems somewhat improbable. Indeed the structural relations which I have observed, and which are described below, do not appear to me to square with any of the received doctrines of Brachiopod circulation, but I offer them simply as facts, not being prepared at present to present any safe theory on the subject.

In *Waldheimia flavescens* there are two 'hearts,' situated as Professor Owen describes them, but so far as I have been able to observe, the ventricle cannot be described as an 'oval' cavity, inasmuch as it is an elongated cavity bent sharply upon itself. Hastily examined of course this may appear oval. I have been similarly unable to discover 'the delicate membrane of the venous sinuses,' which is said by Professor Owen to "communicate with and close the basal apertures of the auricles," or to perceive that the auricular cavity can be "correctly described as a closed one, consisting at the half next the ventricle, of a beautifully plicated muscular coat in addition to the membranous one, but at the other half next the venous sinus of venous membrane only; the latter might be termed the auricular sinus, the former the auricle proper."

I presume that 'this delicate membrane of the venous sinuses' is what I have called the ilio-parietal band, in which the base of the auricle is as it were set, like a landing-net in its hoop, but this does *not* close the base of the auricle, the latter opening widely into the visceral chamber.

I have equally failed in detecting any arteries continued from the apices of the ventricles; and I have the less hesitation in supposing I have not overlooked them, as Mr. Albany Hancock, whose works are sufficient evidence of the value of his testimony, permits me to say that he long since arrived at the conclusion that no such arteries exist.

What has given rise to the notion of the existence of these arteries appears to me to be this. A narrow band resembling those I have already described, is attached in *Waldheimia* along the base of the 'ventricle' and the contiguous outer parietes of the auricle: inferiorly it passes outwards to the sinuses, and running along their inner wall, forms a sort of ridge or axis* from which the genitalia, whether ovaria or testes, are developed, stretching through their whole length and following the ramifications of the sinuses. It is the base of these ridges seen through the walls of the sinuses, where they extend beyond the genitalia, which have been described as arteries.

The upper end of the band passes into the sinuses of the upper lobe of the mantle, and comes into the same relation with the genitalia which they enclose.

The walls of the auricle in *Waldheimia* are curiously plaited, but I have been unable, in either auricle or ventricle, to detect any such arrangement of muscular fibres as that which has been described. The epithelial investment of the auricle, on the other hand, is well developed, and in the ventricle the corresponding inner coat is raised up into rounded villous eminences.

The ventricle lies in the thickness of the parietes, while the auricle floats in the visceral cavity, supported only by the ilio-parietal band. The former is at first directed downwards, but then bends sharply

* This arrangement is, I find, particularly described by M. Gratiolet.

round and passes upwards to terminate by a truncated extremity close to the subœsophageal ganglion and bases of the arms.

Mr. Hancock informs me, that in his dissections he repeatedly found an aperture by which the apex of the 'ventricle' communicated with the pallial cavity; and that, taking this fact in combination with the absence of any arteries leading from this part, he had been tempted to doubt the cardiac nature of these organs altogether, and to regard them rather as connected with the efferent genital system, had not the difficulty of determining whether these apertures were artificial or natural prevented his coming to any definite conclusion at all.

Before becoming acquainted with Mr. Hancock's investigations, I had repeatedly observed these apertures in *Rhynchonella*, but preoccupied with the received views on the subject, I at once interpreted them as artificial. A knowledge of Mr. Hancock's views, however, led me to reconsider the question, and I have now so repeatedly observed these apertures both in *Waldheimia* and in *Rhynchonella*, that I am strongly inclined to think they may after all be natural.

If these organs be hearts, in fact, *Rhynchonella* is the most remarkable of living Mollusks, for it possesses *four* of them. Two of these occupy the same position as in *Waldheimia*, close to the origins of the calcareous crus (*k*), while the other two are placed above these, and above the mouth, one on each side of the liver (*i*). It is these latter which Professor Owen describes, while he has apparently overlooked the other two; at least he says (speaking as I presume of *Rhynchonella*) (*l. c.* p. 148) that the venous sinuses "enter the two hearts or dilated sinuses which are situated exterior to the liver, and in *T. Chilensis* and *T. Sowerbii* just within the origins of the internal calcareous loop."

The fact is, that while the ilio-parietal bands support two 'hearts' as usual, the gastro-parietal bands are in relation with two others. The base of the 'auricle' of the latter opens into the re-entering angle formed by the gastro-parietal band with the parietes, while its apex is directed backwards to join the ventricle, which passes downwards and backwards along the posterior edge of the posterior division of the adductor muscle.

The auricles in *Rhynchonella* are far smaller, both actually and proportionally, than in *Waldheimia*. They exhibit only a few longitudinal folds, and not only present the same deficiency of muscular fibres as those of *Waldheimia*, but are so tied by the bands which support them that it is difficult to conceive how muscular fibres, even if they existed, could act. The 'ventricles' in like manner lie obliquely in the parietes of the body, and simply present villous eminences on their inner surface, which has a yellowish colour.

All these 'hearts' exhibit the same curious relation with the genitalia in *Rhynchonella* as in *Waldheimia*; that is to say, a 'genital band' (*l*) proceeds from the base of the 'ventricle' and becomes the axis of the curiously reticulated genital organ. But in *Rhynchonella* the genital bands of the upper genitalia come from their own 'hearts.'

The arrangement of the genitalia in *Rhynchonella* is very remarkable. The sinuses have the same arrangement in each lobe of the mantle. The single trunk formed by the union of the principal branches in each lobe opens into the inner and anterior angle of a large semilunar sinus which surrounds the bases of the adductors, and opens into the visceral cavity. The floor of this great sinus is marked out into meshes by the reticulated genital band, and from the centre of each mesh a flat partition passes, uniting the two walls of the sinus, and breaking it up into irregular partial channels.

There are the same anastomosing bands uniting the gastro-parietal and ilio-parietal bands on the stomach in *Rhynchonella* as in *Waldheimia*, and a pyriform vesicle of the same nature, but I did not observe in *Rhynchonella* those accessory vesicles upon the origins of genital bands, which I observed once or twice in *Waldheimia*.

I could find no trace of arteries terminating the elongated, ovoid and nearly straight 'ventricles' of *Rhynchonella*; their ends appeared truncated, and as I have already said, repeatedly presented a distinct external aperture.

Such appear to me to be the facts respecting the structure of the so-called hearts in the *Terebratulidæ*; what I believe to be an important part of their peripheral circulatory system, has not hitherto, so far as I am aware, received any notice.

In *Waldheimia* the membranous walls of the body, the parieto-intestinal bands and the mantle, present a very peculiar structure; they consist of an outer and an inner epithelial layer, of two corresponding fibrous layers, and between them of a reticulated tissue, which makes up the principal thickness of the layer, and in which the nerves and great sinuses are imbedded.

The trabeculæ of this reticulated tissue contain granules and cell-like bodies, and I imagined them at first to represent a fibro-cellular network, the interspaces of which I conceived were very probably sinuses. Sheaths of this tissue were particularly conspicuous along the nerves. On examining the arms, however, I found that the oblique markings, which have given rise to the supposition that they are surrounded by muscular bands, proceeded from trabeculæ of a similar structure, which took a curved course from a canal which lies at the base of the cirri (not the great canal of the arms, of course) round the outer convexity of the arm, and terminated by breaking up into a network. These trabeculæ, however, were not solid, but hollow, and the interspaces between them were solid. The network into which they broke up was formed by distinct canals, and then, after uniting with two or three straight narrow canals which ran along the outer convexity of the arm close to its junction with the interbrachial fold, appeared to become connected with a similar system of reticulated canals which occupied the thickness of that fold.

It was the examination of the interbrachial fold, in fact, which first convinced me that these reticulated trabeculæ were canals; for it is perfectly clear that vessels or channels of some kind must supply the proportionally enormous mass of the united arms with their nutritive material, and it is so easy to make thin sections of this part, that I can say quite definitely that no other system of canals than these exists in this locality.

The *facts*, then, with regard to the real or supposed circulatory organs of the *Terebratulidæ*, are simply these:—

1. There are two or four organs (hearts), composed each of a free funnel-shaped portion with plaited walls, opening widely into the visceral cavity at one end, and at the other connected by a constricted neck, with narrower, oval or bent, flattened cavities, engaged in the substance of the parietes. The existence of muscular fibres in either of these is very doubtful. It is certain that no arteries are derived from the apex of the so-called ventricle, but whether this naturally opens externally or not is a point yet to be decided.

2. There is a system of ramified peripheral vessels.

3. There are one or more pyriform vesicles.

4. There are the large 'sinuses' of the mantle, and the 'visceral cavity' into which they open.

To determine in what way these parts are connected and what functions should be ascribed to each, it appears to me that much further research is required.

Nervous System of Terebratulidæ.—Professor Owen describes and figures the central part of this system as a ring surrounding the oral aperture, its inferior portion being constituted by a mere commissural band.

M. Gratiolet, however, states with justice that the inferior side of this collar is the thicker, and I find both in *Rhynchonella* and in *Waldheimia* that it constitutes, in fact, a distinct oblong ganglion, of a brownish colour by reflected light. From its extremities commissural branches pass round the mouth, while other cords are distributed to the arms, to the superior and inferior pallial lobes, and to the so-called hearts. The nerves are marked by fine and distinct longitudinal striations, and can be traced to the margins of the pallial lobes, where they become lost among the muscular fibres of the free edges of the mantle.

Structure of the Arms.—I have not been able to convince myself of the existence of that spiral arrangement of the muscular fibres of the arms which has been described in *Rhynchonella* and *Waldheimia*. I have found the wall of the hollow cylinder of the arm to be constituted (1) externally by an epithelium, within which lie (2) the reticulated canals, which have been already described; (3) by a delicate layer of longitudinal or more oblique and transverse fibres, which are probably muscular, and (4) internally by a granular epithelial layer.

In *Rhynchonella* the bases of the arms are terminated by two considerable sacs, which project upwards into the visceral cavity. Have these the function of distending and so straightening the spirally coiled, very flexible arms of this species?

Affinities of the Brachiopoda.—All that I have seen of the structure of these animals leads me to appreciate more and more highly the value of Mr. Hancock's suggestion, that the affinities of the

Brachiopoda are with the Polyzoa. As in the Polyzoa, the flexure of the intestine is neural, and they take a very natural position among the neural mollusks between the Polyzoa on the one hand, and the Lamellibranchs and Pteropoda on the other.

The arms of the Brachiopoda may be compared with those of the Lophophore Polyzoa, and if it turns out that the so-called hearts are not such organs, one difference will be removed.

In conclusion, I may repeat what I have elsewhere adverted to, that though the difference between the cell of a Polyzoon and the shell of a Terebratula appears wide enough, yet the resemblance between the latter with its muscles and the Avicularium of a Polyzoon, is exceedingly close and striking.

ZOOLOGICAL SOCIETY.

November 25, 1851.—W. J. Broderip, Esq., F.R.S., Vice-President, in the Chair.

On a species of Æquorea inhabiting the British Seas. By Prof. Edward Forbes, F.R.S.

In the first volume of the 'Wernerian Memoirs' a "*Medusa æquorea*" is mentioned by Prof. Jameson as an inhabitant of the seas of the north of Scotland, and in the 'History of British Animals' by Dr. Fleming, the name "*Geryonia æquorea*" is used to designate it. As no description or figure was ever published of this creature, and as the diagnosis of the "*Medusa*" to which Linnæus applied the name of "*æquorea*" was too brief for identification, it is possible that some one out of several Acalephæ inhabiting our seas might have been intended.

It is also possible, however, that a true *Æquorea* had been seen, for there is a most beautiful species of this genus an inhabitant of the Scottish seas. I met with it for the first time in August 1850, when exploring the Minch (the channel between the outer Hebrides and Skye) in company with Mr. MacAndrew and Prof. Goodsir, with the advantages of the appliances for natural-history research with which Mr. MacAndrew has furnished his yacht, the *Naiad*. As there is neither figure nor description of any British *Æquorea* to be found, and as considerable obscurity hangs around the Atlantic species of the genus, I have drawn up the following notice.

A number of individuals were observed: they were swimming near the surface of the sea on a very calm and hot day: they varied in size, from three inches in diameter to as much as half a foot or more: they resembled broad shield-shaped discs of glass, slightly prominent above, incurved at their sides and concave beneath: through the discs were seen shining the pendent brown-tinged stomach, and around it, like so many equal stripes or rays proceeding to the margin, the linear violet genital glands: from the margin depended highly-contractile violet tentacles.

The umbrella is broad, shallow, and disc-shaped, its outline describing a gentle curve. It is hyaline, not very thick, and quite smooth. The central portion of its interior, occupying about one-fourth of its diameter, has dependent from it the membranous veil-like walls of the stomach; these hang not quite so low as on a line with the margins of the umbrella. The stomach, although equal in width throughout, may be divided into two regions, an upper and a lower. The latter has a furbelowed and somewhat scalloped, but not cirrated margin, and may be regarded as the mouth. The former is marked internally by eight bands of transverse fibres, separated by as many longitudinal ones; these appear to be muscular. The whole of the membrane of the stomach and lips is tinged with pale foxy brown, partly disposed in streaks. Around the upper and inner margin of the cavity are the orifices of the gastro-vascular canals; these run, without dividing or anastomosing, to the circular marginal canal of the umbrella. In a specimen five inches across, they were 136 in number. From the lower side of each canal depend two narrow, rather wavy membranes of a violet colour, causing the ray-like streaks that shine so conspicuously through the disc; each of these arises gradually near the superior extremity of a gastro-vascular canal, and ceases abruptly at about one-eighth of the entire length of the canal from the margin: they are the genital glands. At the junction of each alternate gastro-vascular canal with the circular marginal one is the bulb-like base of a marginal tentacle: these tentacles arise from ovate bulbs and gradually taper to a fine point. The bulbs are pale, but the tentacle is tinged with violet. Opposite the intermediate canal there is a smaller bulb with a tentacle, hollow and containing corpuscles in its centre, and on each side, between it and the neighbouring tentacle, is a still smaller lobe-like body. Along the upper margin of the circular canal are very minute pedunculated organs that move to and fro. On the bulb at the base of the tentacula is a minute tongue-shaped process at the base of a depression; at its own base the ocellus or rudimentary eye is lodged. When seen laterally, the peculiar tissue of the base of the tentacles is observed to be set obliquely. Within the umbrella, from a line just opposite the tentacular circle, a short but rather broad veil with a simple edge is seen to depend; this veil is tinged with pale brown. A band of motor tissue, forming a sphincter to the umbrella, accompanies the circular vessel.

According to the size of the example, the number of genital glands and of tentacula varied: they increase with age. The smallest number of tentacula seen was sixteen, and there is reason to believe that they are never fewer.

To ascertain whether this beautiful animal be the *Medusa æquorea* of Linnæus and the naturalists who wrote during his time, it is necessary to inquire into the history of that species. The name just mentioned occurs first in the 'Iter Hispanicum' of Peter Loefling, published in 1758. In his journal of observations on the 18th of April, at Cumana, he notices, along with *Medusa* (i. e. *Aurelia*) *aurita*, *Medusa pelagica* (*Pelagia cyanella*?), and *Velella*, another Medusa, which he styles *Æquorea*, and describes as "*orbicularis,* *planiuscula, tentaculis plurimis ex margine inflexo, branchiis nullis.*" This notice, which occurs at page 105 of the Swedish edition of his 'Travels,' is the entire original foundation for numerous references in after-authors. Linnæus, in the first instance, adopted Loefling's name and brief record, which, when read with our present knowledge of *Acalephæ*, barely indicates the genus to which the animal observed probably belonged. In 1775, the descriptions and figures of animals observed during his journey to the East by the lamented Forskäl were published under the superintendence of Carsten Niebuhr. Among them was a representation and description of a *Medusa*, referred to the *æquorea* of Linnæus, both excellent, as indeed may be said of all that Forskäl did. In 1776 a *Medusa æquorea* was noticed, scarcely more than by name, in the 'Zoologiæ Danicæ Prodromus' of Otho Frederic Müller. In 1780, Otho Fabricius, in his excellent 'Fauna Groenlandica,' gives a shorter account than usual with him of a Medusa, which he refers to the *æquorea* of Linnæus. He speaks of it as a very simple animal, smaller and softer than *Medusa aurita*, convex above, concave beneath, with very much inflected margins and white marginal cilia. The two last-mentioned characters are opposed to the notion of *Medusa æquorea*, as represented and described by Forskäl, and the first of them to the slight idea of its shape that we gather from Loefling. In 1791 Adolph Modeer commenced the work of hair-splitting by separating the animal of Forskäl, under the name of *Medusa patina*, from that of Loefling, for which he reserved the name *Medusa æquorea*. In 1809 Peron and Lesueur published in the 'Annales du Muséum d'Histoire Naturelle,' vol. xiv., their important classification and synopsis of all known Medusæ. In that paper, excellent though it be, they increase the confusion, by giving the name of *Æquorea atlantica* to Loefling's animal, *Æq. danica* to Müller's, *Æq. grœnlandica* to that of Fabricius, *Æq. Forskalea* to that of Forskäl, and *Æq. stauroglypha* to a new species of their own, probably identical with all the others. In 1829 Eschscholtz, in his 'System der Acalephen,' attempted to rectify this confusion, by rejecting all these names excepting *Æq. Forskalina*, that alone having been sufficiently described. In 1843 Lesson published his History of Acalephæ in the 'Nouvelles Suites à Buffon,' and, to make confusion worse confounded, rejected all rectifications and restored all the names and imperfectly noticed individuals to full specific rank.

After attentively considering the notices more or less perfect that the various older observers have given, of what they call *Medusa æquorea*, I am led to the belief that in most instances one species, not several, was met with, and that the creature which I now describe as British is identical with the *Medusa æquorea* of Loefling, Forskäl and Müller. Since Forskäl alone described and figured it in a comprehensible manner, the name *Æquorea Forskalea*, proposed by Peron, is peculiarly appropriate, the more so since that of *Medusa patina* of Modeer was proposed under a mistake. Forskäl expressly states that his species is common to the North Atlantic and the Mediterranean, and that it inhabits the Danish seas, where it is called "Vandmand," that is, Waterman.

It remains to be seen whether our species is related to the *Æquorea violacea* of Milne-Edwards, well described and beautifully figured in the 16th volume of the 2nd series of the 'Annales des Sciences Naturelles,' and observed by that eminent naturalist in the Mediterranean. From an examination of its anatomy he first showed the serious error committed by Eschscholtz in considering the *Æquoridæ* as cryptocarpous. I am inclined to agree with Milne-Edwards in considering his species distinct from that of Forskäl. The genital glands are not prolonged nearly so close to the margin; the lips of the stomach are not furbelowed; the bases of the tentacles are not bulbous, and originate regularly *between* the gastro-vascular canals.

There were no eyes observed by the distinguished zoologist just quoted in the species he examined. In ours the eyes are evident, and a determination of their position and appearance is of consequence, since they confirm the affinity of *Æquorea* with the Naked-eyed Medusæ, whilst at the same time, in the little appendage or rudimentary lid projecting above them, they indicate an approach to the *Steganophthalmatous* type, such as is consistent with the general high organization and aspect of the *Æquorea* when compared with other *Gymnophthalmatous* forms.

It is interesting to remark that the *Æquorea ciliata* of Eschscholtz is a North Pacific species, beautifully representing, yet quite distinct from, *Æquorea Forskalea*.

December 9, 1851.—W. Yarrell, Esq., in the Chair.

On some Bones of Didus. By A. D. Bartlett.

The history of the Dodo having been recently the subject of so much inquiry, and the exertions made by Mr. Strickland, Dr. Melville and others, having succeeded in bringing together so many important facts, it might appear that there was little more to be said upon the subject; this, however, I believe is far from being the case. A few facts established upon a subject which was before obscured in doubt and error will, I trust, always act as a charm, and induce us at every opportunity to investigate that subject still further, in the hope of learning the truth. On the present occasion I am desirous of calling attention to a few bones upon the table. In so doing I beg to say, that in the year 1830 a collection of bones arrived in Paris, which attracted the attention of the scientific world. These bones came from the island of Rodriguez, but on account of their being incrusted with stalagmite, little has been done with them; they were, however, the cause of search being made for more in the same locality, and two collections were made in the year 1831 by the late Mr. Telfair. One of these collections was forwarded to the Andersonian Museum in Glasgow, the other to the collection of this Society, and at the evening meeting, March 12, 1833, the bones sent by Mr. Telfair were laid upon the table.

I will here read an extract from the Society's Proceedings:—"Dr. Grant pointed out that they were the bones of the hinder extremity of a large bird, and the head of a humerus. With reference to the metatarsal bone, which was long and strong, Dr. Grant pointed out that it possessed the articulating surfaces for four toes, three directed forwards and one backwards, as in the foot of the Dodo preserved in the British Museum, to which it was also proportioned in magnitude and form."

I beg now to read a paragraph from Mr. Strickland's book. At page 52 we find: "The bones sent by Mr. Telfair in 1833 to the Zoological Society have met with some unfortunate fate. Three or four years ago, Mr. Fraser, the late Curator of that Society, made, at my request, a diligent search for these specimens, but all his endeavours to find them were fruitless: he found the identical box sent by Mr. Telfair, but, alas! the bones of the Solitaire, apterous as it was, had flown away, and the only bones that remained belonged to tortoises."

In the month of July last an opportunity was afforded me by the Secretary of renewing this search, and I had the good fortune to find what I believe to be all the specimens sent to the Society by Mr. Telfair.

Upon my informing Mr. Mitchell of my success, that gentleman, knowing the trouble and interest I had taken to recover them, granted me permission to examine, compare, and describe them, and to bring the subject before the Society.

In the first place, we are led to believe (and I think without the slightest doubt) that these bones came originally from the island of Rodriguez. There cannot be any doubt, also, that Rodriguez and the neighbouring islands were at one period inhabited by several species of large birds. Whether any of the same species of these birds inhabited different islands, or whether each island was inhabited by distinct species, is a question to which I beg most particularly to call your attention: the most recent publication by Mr. Strickland and Dr. Melville would lead us to believe that the true Dodo (*Didus ineptus*) was solely confined to the island of Mauritius, and another species, known as the Solitaire, was said to be its representative on the island of Rodriguez. If this be true, I should have the pleasure of introducing to your notice the bones of at least two new species of birds from that island: I do not however myself feel justified in so doing, but believe some of the bones sent here by Mr. Telfair belong to the true Dodo (*Didus ineptus*). There are also in the collection (I think without doubt) bones of two other species, one of these of much larger size than the Dodo, the other considerably smaller. The bones in question having all the usual and well-known characteristics of those of adult birds, we cannot therefore suppose the differences which they present to be such as might arise from age; and on the other hand, you will perceive that the proportions are too dissimilar to allow of our regarding them as having belonged to different sexes of the same species. There often exists great difference of size in the bones of the opposite sex, but I have never noticed any very evident difference of proportion. These are to me satisfactory reasons for considering them specifically distinct. But to return to the question,—Was the Dodo found on the island of Rodriguez? Sir Thomas

Herbert says *it was*; and his evidence appears to me of much importance, considering the number of years he spent travelling about, visiting these islands, and collecting rare and curious things; having also repeatedly described the Dodo, and very probably brought one to England. I am therefore inclined to regard the assertions made by Sir Thomas Herbert with more respect than they have elsewhere received. It may appear at first sight impossible that the same species of birds which were destitute of the power of *swimming* or *flying* could inhabit islands so far from each other; but, were these islands always in the state in which we find them? may they not at some distant period have been united and formed part of the same land? In endeavouring in this manner to account for the existence of the Dodo upon the island of Rodriguez as well as at Mauritius, it has been remarked that this argument would not hold good, as the islands in question were of volcanic origin: if this be the case, to account for its existence at either place appears to me equally difficult. I am fully aware it has been the practice of late to consider the animals obtained from localities remote from each other specifically distinct; they may be so; but unless we have some certain means of distinguishing them, I do not think we ought to regard them as such.

I now venture to introduce to your notice what I believe to be the *tibia* of the Dodo (*Didus ineptus*): its agreement with the foot in the British Museum struck me as being exceedingly remarkable and conclusive: its size and proportions, as compared with the metatarsal in question, are exactly what I should have expected upon the supposition of their belonging to the same species: they fit each other so perfectly, that one might think they belonged to the same individual. With this evidence before me, I cannot for one moment hesitate in considering the *Dodo of the Mauritius to be identical with the Dodo of Rodriguez.* There are also in this collection two other bones, which, from their size and form, I believe to belong to this species: the most remarkable is the head of the *humerus*, which would indicate by its magnitude and broad attachments that it belonged to a bird of large bulk, while the sudden reduction in the size of its shaft clearly indicates a bird with small wings. The great thickness and consequent weight is sufficient to cause us to suppose that this bird had not the power of flight.

The next bone to which I will call your attention is a right metatarsal, which appears to me to have belonged to a bird known to Leguat as the Solitaire, and described by him during his residence on the island of Rodriguez. I beg to read Leguat's description, in order to point out to you its near agreement in point of size and form with the Turkey, with which bird Leguat compared the bird he called the Solitaire:—

"Of all the birds in the island, the most remarkable is that which goes by the name of the *Solitary*, because it is very seldom seen in company, though there are abundance of them. The feathers of the male are of a brown-grey colour: the feet and beak are like a Turkey's, but a little more crooked. They have scarce any tail, but their hind part covered with feathers is roundish, like the crupper of a Horse; they are taller than Turkeys. Their neck is straight, and a little longer in proportion than a Turkey's when it lifts up its head. Its eye is black and lively, and its head without comb or cop. They never fly, their wings are too little to support the weight of their bodies; they serve only to beat themselves, and flutter when they call one another. They will whirl about for twenty or thirty times together on the same side, during the space of four or five minutes. The motion of their wings makes then a noise very like that of a rattle, and one may hear it two hundred paces off. The bone of their wing grows greater towards the extremity, and forms a little round mass under the feathers, as big as a musket ball. That and its beak are the chief defence of this bird. 'Tis very hard to catch it in the woods, but easie in open places, because we run faster than they, and sometimes we approach them without much trouble. From March to September they are extremely fat, and taste admirably well, especially while they are young; some of the males weigh forty-five pounds.

"The females are wonderfully beautiful, some fair, some brown; I call them fair, because they are of the colour of fair hair. They have a sort of peak, like a widow's, upon their breasts (*lege* beaks), which is of a dun colour. No one feather is straggling from the other all over their bodies, they being very careful to adjust themselves, and make them all even with their beaks. The feathers on their thighs are round like shells at the end, and being there very thick have an agreeable effect. They have two risings on their *craws*, and the feathers are whiter there than the rest, which livelily represents the fine neck of a beautiful woman. They walk with so much stateliness and good grace, that one cannot help admiring and loving them; by which means their fine mien often saves their lives."—*Leguat's Voyage to the East Indies*, 1708, p. 71.

You will perceive this bird was said to be larger and taller than a Turkey. A comparison of this metatarsal bone with the metatarsal bone of the Turkey I think will satisfactorily show the accuracy of Leguat's description, and at the same time justify our conclusion that this metatarsal bone belonged to the Solitaire of Rodriguez, to which the name of *Didus solitarius* has been applied. I trust I shall be pardoned for avoiding the use of the new generic term adopted by the authors of 'The Dodo and its kindred,' for in a group so little known, and at present so limited in species, it seems to me so much to increase the trouble and difficulty of those who endeavour to study such subjects, that I cannot help expressing my belief that many of the new names so often introduced serve only to impede and embarrass us, and I therefore regard them as much worse than useless.

I have now remaining the bone of a bird which when alive was much *larger, heavier,* and more *powerful* than the *Dodo*. For further examples of this bird's bones, I must refer to the plates in the work before alluded to, by Mr. Strickland and Dr. Melville: plate xv. fig. 2, the metatarsal bone of the large species in the Andersonian Museum, Glasgow; fig. 3, a metatarsal bone in the Parisian collection. A glance at these specimens will, I imagine, convince any one that this bird was of gigantic size, and probably double the weight of the *Dodo*. I am sure it cannot be supposed (after what has been said) that Leguat was describing this great bird when he wrote his beautiful description of the Solitaire. Another important fact will, I think, set this question at rest. Leguat states, that some of the males of the Solitaire weigh *forty-five pounds*. Now we know the weight of the largest Turkeys to be considerably less, rarely reaching *thirty pounds*, while the weight of the Dodo is stated to have been at least *fifty pounds*. It cannot, therefore, be supposed, had Leguat seen birds nearly double the size of the Dodo, he could have made the statements or comparison he has made between the Solitaire and Turkey.

I have before expressed my great dislike to an unnecessary increase of names: I feel, however, the necessity of finding an appropriate name for this large bird, and therefore propose one somewhat familiar to all who have paid any attention to the subject, and apply the name of *Didus Nazarenus* to this the largest species of the genus. In doing this, I may remark that Mr. Strickland, in his work before alluded to, has considered the *Didus Nazarenus* to be a phantom species, which he says has haunted our systems of ornithology from the days of Gmelin downwards.

The conclusions which I have arrived at from the examination of the bones to which I have just called your attention are these:—That there existed formerly three distinct species of Apterous birds in the island of Rodriguez; namely, one which is apparently identical with the *Dodo* (*Didus ineptus*) of the Mauritius; a second, which was well described under the name of *Solitaire*; and a third, which was much larger than either of the above.

12 College Street, Camden Town.

Description of two new species of Mammalia of the genus Antechinus. By John Gould, F.R.S. etc.

One of these species is remarkable for being spotted on the under instead of on the upper surface, and the other for its very diminutive size: both rank among the smallest members of the genus. For the former I propose the specific appellation of *maculatus*; it may be thus described:—

Antechinus maculatus.

Fur short, dense, and closely applied to the skin; general tint of the upper surface dark blackish brown, minutely grizzled with yellowish brown; lower part of the flanks and under surface of the body dark brownish slate-grey, ornamented with oblong spots of greyish white arranged in irregular rows in the direction of the body; down the centre of the throat a streak of white.

	inches.
Length from the tip of the nose to the base of the tail	$3\frac{1}{2}$
——— of the tail	$2\frac{1}{4}$
——— from the tip of the nose to the base of the ear	$\frac{1}{2}$
——— of the ear	$\frac{1}{4}$
——— of the tarsi and toes	$\frac{7}{16}$

Hab. Brushes of the river Clarence, on the east coast of Australia.

The other species I propose to name

ANTECHINUS MINUTISSIMUS.

Fur short, dense, and closely applied to the skin; upper surface and flanks brown, slightly grizzled with black; under surface pale buff, approaching to white on the throat; tail brown above, lighter beneath; feet buffy brown, toes covered with hairs of a somewhat lighter hue.

	inches.
Length from the tip of the nose to the base of the tail	$2\frac{3}{4}$
——— of the tail	$2\frac{1}{4}$
——— from the tip of the nose to the base of the ear	$\frac{7}{16}$
——— of the ear	$\frac{1}{4}$
——— of the tarsi and toes	$\frac{3}{8}$

Hab. Brushes of the east coasts of Australia.

DESCRIPTIONS OF A NEW SPECIES OF PTILOTIS AND A NEW SPECIES OF EÖPSALTRIA. BY JOHN GOULD, F.R.S.

Mr. Gould also exhibited two new species of birds of the genera *Ptilotis* and *Eöpsaltria*, which he characterized as follows:—

PTILOTIS FASCIOGULARIS.

All the upper surface, wings and tail olive-brown, the feathers of the head and back with darker centres, and the primaries and tail-feathers narrowly margined externally with greenish wax-yellow; lores and a streak down the side of the head from the posterior angle of the eye blackish brown; ear-coverts pale yellow; on each side of the neck a patch of yellowish white; feathers of the throat brownish black, each bordered with pale yellow, presenting a fasciated appearance; breast blackish brown; under surface striated with brown and buffy, becoming paler towards the vent; irides lead-colour; bill and feet black.

Total length, $7\frac{1}{2}$ inches; bill, $\frac{7}{8}$; wing, $3\frac{3}{4}$; tail, $3\frac{1}{2}$; tarsi, $1\frac{1}{8}$.

Hab. Mangrove Island, Moreton Bay.

Female.—Similar in colour, but of smaller size.

EÖPSALTRIA CAPITO.

Upper surface olive-green, inclining to brown on the head; wings and tail slaty brown, faintly margined with olive-green; ear-coverts grey; lores and a line descending in front of the eye and the throat greyish white; under surface yellow; irides hazel; bill black; feet brownish flesh-colour.

Total length, 5 inches; bill, $\frac{5}{8}$; wing, $3\frac{1}{8}$; tail, $2\frac{1}{4}$; tarsi, $\frac{7}{8}$.

Hab. Brushes of the River Brisbane, New South Wales.

Remarks.—Shorter and less elegantly formed than *E. Australis*, with a stout broad bill and a proportionately large and heavy head.

Feb. 24, 1852.—W. J. Broderip, Esq., F.R.S., V.P., in the Chair.

ON THE HABITS OF STRIGOPS HABROPTILUS OR KAKAPO. BY DAVID LYALL, M.D., R.N., LATE SURGEON TO H.M.S. ACHERON.

Although the *Kakapo* is said to be still found occasionally on some parts of the high mountains in the interior of the North Island of

New Zealand, the only place where we met with it, during our circumnavigation and exploration of the coasts of the islands in H.M.S. Acheron, was at the S.W. end of the Middle Island. There, in the deep sounds which intersect that part of the island, it is still found in considerable numbers, inhabiting the dry spurs of hills or flats near the banks of rivers, where the trees are high, and the forest comparatively free from fern or underwood.

The first place where it was obtained was on a hill nearly 4000 feet above the level of the sea. It was also found living in communities on flats near the mouths of rivers close to the sea. In these places its tracks were to be seen resembling footpaths made by man, and leading us at first to imagine that there must be natives in the neighbourhood. The tracks are about a foot wide, regularly pressed down to the edges, which are two or three inches deep amongst the moss, and cross each other usually at right angles.

The *Kakapo* lives in holes under the roots of trees, and is also occasionally found under shelving rocks. The roots of many New Zealand trees growing partly above ground, holes are common under them; but where the *Kakapo* is found many of the holes appeared to have been enlarged, although no earth was ever found thrown out near them. There were frequently two openings to these holes, and occasionally, though rarely, the trees over them were hollow for some distance up.

The only occasion on which the *Kakapo* was seen to fly was when it got up one of these hollow trees and was driven to an exit higher up. The flight was very short, the wings being scarcely moved; and the bird alighted on a tree at a lower level than the place from whence it had come, but soon got higher up by climbing, using its tail to assist it.

Except when driven from its holes, the *Kakapo* is never seen during the day, and it was only by the assistance of dogs that we were enabled to find it.

Before dogs became common, and when the bird was plentiful in inhabited parts of the islands, the natives were in the habit of catching it at night, using torches to confuse it. It offers a formidable resistance to a dog, and sometimes inflicts severe wounds with its powerful claws and beak. At a very recent period it was common all over the west coast of the Middle Island, but there is now a race of wild dogs said to have overrun all the northern part of this shore, and to have almost extirpated the *Kakapos* wherever they have reached. Their range is said to be at present confined by a river or some such physical obstruction, and it is to be feared that if they once succeed in gaining the stronghold of the *Kakapo* (the S.W. end of the island) the bird may soon become extinct.

During the latter half of February and the first half of March, whilst we were amongst the haunts of these birds, we found young ones in many of the holes, frequently only one, never more than two, in the same hole. In one case where there were two young ones I found also an addled egg. There was usually, but not always, an old bird in the same hole with the young ones.

They build no nest, but simply scrape a slight hollow amongst the dry dust formed of decayed wood. The young were of different ages, some being nearly fully fledged, and others covered only with down. The egg is white and about the size of a pigeon's.

The cry of the Kakapo is a hoarse croak, varied occasionally by a discordant shriek when irritated or hungry. The Maories say that during winter they assemble together in large numbers in caves, and at the times of meeting, and, again before dispersing to their summer haunts, that the noise they make is perfectly deafening.

A good many young ones were brought on board the ship alive. Most of them died a few days afterwards, probably from want of sufficient care; some died after being kept a month or two, and the legs of others became deformed after they had been a few weeks in captivity. The cause of the deformity was supposed to be the want of proper food, and too close confinement. They were fed chiefly on soaked bread, oatmeal and water, and boiled potatoes. When let loose in a garden they would eat lettuces, cabbages and grass, and would taste almost every green leaf that they came across. One, which I brought within six hundred miles of England (when it was accidentally killed), whilst at Sydney, ate eagerly of the leaves of a *Banksia* and several species of *Eucalyptus*, as well as grass, appearing to prefer them all to its usual diet of bread and water. It was also very fond of nuts and almonds, and during the latter part of the homeward voyage lived almost entirely on Brazilian ground-nuts.

On several occasions the bird took sullen fits, during which it would eat nothing for two or three days at a time, screaming and defending itself with its beak when any one attempted to touch it. It was at all times of an uncertain temper, sometimes biting severely when such a thing was least expected. It appeared to be always in the best humour when first taken out of its box in the morning, hooking on eagerly with its upper mandible to the finger held down to lift it out. As soon as it was placed on the deck it would attack the first object which attracted its attention—sometimes the leg of my trowsers, sometimes a slipper or a boot. Of the latter it was particularly fond: it would nestle down upon it, flapping its wings and showing every symptom of pleasure. It would then get up, rub against it with its sides, and roll upon it on its back, striking out with its feet whilst in this position.

One of these birds, sent on shore by Capt. Stokes to the care of Major Murray of the 65th Regiment at Wellington, was allowed to run about his garden, where it was fond of the society of the children, following them like a dog wherever they went.

Nearly all the adult Kakapos which I skinned were exceedingly fat, having a thick layer of oily fat or blubber on the breast which it was very difficult to separate from the skin. Their stomachs contained a pale green, sometimes almost white, homogeneous mass, without any trace of fibre in it.

There can be little doubt but that their food consists partly of roots (their beaks are usually more or less covered with indurated mud), and partly of the leaves and tender shoots of various plants.

At one place where the birds were numerous we observed that the young shoots of a leguminous shrub growing by the banks of a river were all nipped off, and this was said by our pilot, who had frequented these places for many years in a whaling vessel, to be the work of the Kakapo.

Their flesh is white, and is generally esteemed good eating.

March 23, 1852.—Professor Owen, F.R.S., Vice-President, in the Chair.

On the Species of the Genus Sericinus. By G. R. Gray, F.L.S., F.Z.S. etc.

In the Transactions of the Entomological Society of London for 1851 (p. 173), Mr. Westwood established a Lepidopterous genus under the name of *Sericinus*, which he founded on bad specimens of an insect sent from Shanghai by Mr. R. Fortune, and then supposed to comprise "both sexes" of the insect figured by Donovan in his 'Insects of China,' pl. 27. f. 1, under the appellation of *Papilio Telamon*, no specimen of which, as Mr. Westwood justly observed, was then known to exist "in any continental or British collections."

Lately Mr. Fortune has returned to this country, bringing with him many specimens of the same insect in a more perfect state, which enables me to take up the genus and endeavour to define the species and give characters for each. I should state, however, that I think I shall be able to point out that these "two sexes" are, in fact, distinct species of the genus.

I think it best, first, to give a description of the species figured by Donovan under the name of *Papilio Telamon*, but which will now stand under that of

Sericinus Telamon, Westw.

The fore wings yellowish white, with the anterior and most of the exterior margins rather broadly edged with black; an abbreviated line in the middle, another at the anterior part of the costal area, and then a curved line of irregular spots, which ends towards the posterior angle, and with two small spots at the anterior angle near the outer margin, also one spot on the inner margin, black. The hind wings yellowish white, with the anal angle black, which apparently extends towards the anterior margin by two oblong spots of the same colour; the anal angle is ornamented by a crimson line that reaches to the third nervure from the inner margin; there are also three pale blue lunes. The under surface of the fore wings is very similar to the upper side, except that the black which surrounds the anterior and part of the exterior margins is not apparent. The under surface of the hind wings is also similar to the upper side, except that the spot of the anterior margin is ornamented by a crimson centre.

Donovan informs us that the only specimen brought to Europe was taken near Pekin, by a gentleman in the suite of Earl Macartney, and was at that time, when Donovan figured it, in the possession of Mr. Francillon.

Having thus recorded the peculiarities of the species which must be considered the type of this genus, I shall now point out how one series of specimens brought by Mr. Fortune differ from it, though in general they are very similar to the one just described. Yet the uniformity of all the specimens of the series, which comes nearest to Donovan's figure, induces me, provisionally at least, to form it into a separate species, under the name of

Sericinus Montela*. (Cat. of Lepid. B. M. i. 78. pl. 13. fig. 1, 2.)

Like the preceding; but the fore wings have a large subtriangular black spot very near the base, which is divided into three spots by the nervures. The anterior margin is slightly edged, and the exterior margin is, for most part, broadly margined with black. The hind wings have a broad band obliquely across the costal area, and the crimson band at the anal angle appears broader in this species.

The species is always, as Mr. Fortune has kindly informed me, found in the valleys among the hills.

Sericinus Fortunei†. (Cat. Lep. B. M. i. pl. 13. fig. 5.)

The fore wings are yellowish white, with many irregular black spots which vary in size, some of them so placed that they apparently form five bands across the wing; the external margin is also black. The hind wings also yellowish white, with a basal band and three irregular curved bands of black spots; the second band from the base is broadest at the anterior angle, and marked with a small crimson spot; while that portion towards the anal angle is margined exteriorly by an irregular crimson band, which extends from the angle to the fifth nervure; the third or marginal band is ornamented on the deep black below the crimson by a series of pale blue lunes. The under surfaces of all the wings are less prominently marked, otherwise they are similar to the upper side, except that on the fore wings there are two crimson spots, one on the band near the costal area and the other on the posterior margin.

This species is found, according to Mr. Fortune, on the sides of the hills.

Mr. Wilson Saunders has obliged me by the loan of a specimen for examination, which presents several differences from those previously noticed. It is rather smaller and the caudal appendages are shorter than in the other three species; the latter being only about half an inch in length. These with other characters induce me to form it into a species under the name of

* *Sericinus Telamon*, Westw. & Hewits. Gen. Diurnal Lep. p. 530 suppl. pl. 1. fig. 1.

† *Sericinus fasciatus*, Brem. & Grey, Beitr. Schm. des Nörd. China, p. 5. Since this paper was read, Mr. Fortune has sent a series of specimens which show that this is the female of the preceding.

Sericinus Telmona*. (Cat. Lep. B. M. i. pl. 13. fig. 3.)

The fore wings ochraceous, with the base black, and the other black markings placed as in *S. Montela*, though not quite so prominent, but the short band which crosses the wing just beyond the costal area and the spot on the posterior margin are both ornamented with a small crimson spot. The hind wings have the inner margin black, and are without the basal spot in the costal area; the crimson band at the anal angle extends, as in *S. Fortunei*, to the fifth nervure, and like it also the spot on the anterior margin is ornamented by a crimson mark, which is more equally placed with the commencement of the crimson band that advances to the anal angle, than in the other species; the black space at the anal angle is less in size, but is furnished with blue lunes. The under surface of the fore wings is marked like the upper side. That of the hind wings is also similar to the upper side, but the black spots on the anterior margin are both ornamented with crimson; the lengthened crimson band is marked between the second and third nervures from the anal angle with a white lune, and there is also a less quantity of black at the anal angle.

This species (male) was also brought to this country with the others by Mr. Fortune, through whose exertions we are thus enabled to describe three additional species of a division which had been hitherto only known by the one figured by Donovan.

Notes on the Dissection of a species of Galago. By W. H. Flower, Curator to the Middlesex Hospital Museum.

Having recently had an opportunity of examining the body of a Galago which died in the Society's Gardens, and which I believe to be an undescribed species, I proceed, at the request of the Secretary, to lay before the Society some notes on its anatomy made during the dissection.

The animal was a male. When I received it the skin was removed, and its dimensions were as follows:—

	in.	lin.
Length of the head and body	$9\frac{1}{2}$	0
——— of the tail	$13\frac{1}{2}$	0
——— of the head	2	7
Breadth of the head (at the widest part, viz. the malar bones)	1	9
Length of the humerus	2	3
——— of the fore-arm	2	7
——— of the hand	1	0
——— of the femur	3	0
——— of the tibia	3	0
——— of the foot	3	0

Dentition:—inc. $\frac{4}{6}$; can. $\frac{1-1}{1-1}$; mol. $\frac{5-5}{5-5}=34$.

* The female of this species is described as *Sericinus Greyi*, Brem. & Grey, Beitr. Schm. des Nörd. China, p. 6.

The upper incisors very small, placed vertically, a considerable space existing between the two middle ones. The lower incisors long, very narrow, projecting horizontally, and closely approximated.

The stomach was simple, almost globular in form; the œsophagus entered far to the right, the cardiac orifice very nearly approaching the pyloric, so that while the greater curvature measured $6\frac{1}{2}$ inches, the lesser was but $\frac{3}{4}$ of an inch. The small intestines were wide, 46 inches in length. The cæcum was nearly 5 inches long, wider near its commencement than any part of the intestine, and slightly sacculated, but tapering and becoming smooth towards the extremity. The ileum entered the colon at a very obtuse angle, and there was scarcely any difference in the calibre of these two parts of the intestine. The colon was without sacculations and peculiar in form, being widest at the upper end, then gradually contracting till it became narrower than any part of the intestine, and dilating again into the rectum; and this appeared not to be the result of muscular contraction, as it retained this form after macerating in water several days and then inflating. The length of this part of the intestine, from the ileo-cæcal valve to the anus, was 18 inches.

The liver presented three very distinct lobes: the left one was entire; the middle cleft into three by two fissures on its under surface, in one of which (that most to the right) the gall-bladder was placed; the right lobe was entire, but on its under surface was placed the lobulus Spigelii.

The gall-bladder was pyriform; the duct, 3 lines in length, joining the hepatic duct, formed the common gall-duct, which was half an inch long and entered the duodenum one inch from the pylorus.

The spleen was long, narrow and flattened, half an inch wide at the broadest part, and $2\frac{1}{2}$ inches in length.

The kidneys, simple, large and oval, were 1 inch long and 8 lines broad; the right one situated nearly the whole length of the kidney higher than the left.

The penis was 3 inches in length, containing a bone 11 lines long. The skin of the glans covered with minute spines or tubercles, which, when examined microscopically, were found to be tooth-like bodies, most having two points, some one, others three or more, all directed backwards.

The testes were oval, 8 lines long, 5 broad.

The vesiculæ seminales consisted of two large simple culs-de-sac, 7 lines in length.

On opening the thorax the left lung was found to have two lobes, the right four.

The heart presented nothing unusual. From the arch of the aorta two large vessels arose, the first giving rise to the innominate and left carotid; the second being the left subclavian.

On examining the brachial and femoral arteries, no division into smaller trunks, forming a rete mirabile, as is observed in several animals belonging to this family, was discovered. The brachial artery perforated the humerus near its lower extremity.

The tongue was long and narrow, $2\frac{1}{2}$ inches long from the root of the epiglottis to the tip, and 5 lines broad. Its dorsal surface was covered with small papillæ, and at the posterior part were three large or circumvallated papillæ, arranged as the points of the letter V. On the under surface is a curious body, 7 lines long and 3 wide, the tip of which is free, flat and pectinated, the rest free at the sides and attached in the middle. From the form, position and size of this singular organ, one cannot help conjecturing that the pectinated end may act as a brush to free the inferior incisor teeth from adherent particles of the insect food on which the animal subsists.

The submaxillary and parotid glands were very large, particularly the former.

The masseter and temporal muscles were largely developed, and the whole muscles of the upper extremity very powerful.

The cerebral hemispheres were large, and extending some way back over the cerebellum, but their surface was remarkably smooth and almost free from convolutions, resembling in this respect the brain of Cheiroptera, to which order the Lemurs present several points of affinity.

LINNÆAN SOCIETY.

January 17th, 1854.—Robert Brown, Esq., V.P., in the Chair.

Read a letter from David Moore, Esq., A.L.S., of the Botanic Garden, Glasnevin, near Dublin, addressed to James Yates, Esq., F.L.S., &c. "On the introduction of *Anacharis Alsinastrum*, Bab. into Ireland."

"It is rather remarkable," Mr. Moore observes, "that it should have been noticed in England and in Ireland about the same time. I am not perfectly certain now, but I think it was in the early part of 1842 I first saw the plant growing in a small pond in the garden of Isaac M. D'Olier, Esq., of Booterstown, near Dublin. That gentleman has been long known for his zeal in horticultural pursuits, as well as for his fine collection of exotic plants, which he has been in the habit of getting from various parts of England, as well as from the continent, along with some of which he considers the *Anacharis* was introduced to his collection, though he has no knowledge of its being so. At the time stated, Mr. D'Olier acted as Chairman of the Committee of Botany for the Royal Dublin Society, which caused me to have frequent official intercourse with him, and for which purpose I occasionally went to Booterstown. In the centre of his garden, where a number of gold and silver fish were kept in a small pond, we first noticed the *Anacharis*. I did not then know the plant, further than that it was not a British species, and brought some of it to cultivate in the Botanic Garden, where it was placed in an earthenware crock and put in the pond. Little more was thought about it, until the late Mr. Macauley brought it from the pond in Mr. D'Olier's garden to the College garden, about the time inquiry was awakened respecting it in England. My foreman then told me there was plenty of it growing in our pond, which I had not before noticed, but I had no doubt, on inquiry, of this being the increase of the few plants I first brought from Booterstown. In the way then I have stated, the *Anacharis* made its appearance in this neighbourhood, where I believe it is still confined: I have not seen or heard of its being elsewhere in Ireland, though it increases equally fast here as it does in England. There are now some millions of plants in our pond, and as many more destroyed since it was first introduced."

Read also, some observations "On the correctness of the position assigned to *Oxycladus* in the Family of *Bignoniaceæ*." By John Miers, Esq., F.R.S., F.L.S. &c.

Mr. Miers states, that after a careful consideration of the arguments advanced at the last Meeting by Dr. Seemann, he sees no reason to alter his conviction as to the proper position of the genus in question. Dr. Seemann contends that *Oxycladus* is too anomalous in form to be admitted among *Bignoniaceæ* on account of its fruit, which is a hard monospermous nut, with the seed suspended from near the summit of the cell, and of its embryo, which has large fleshy cotyledons, while there are no wings developed on the testa; and maintains that on these grounds it rather belongs to *Myoporaceæ*, with which family it agrees better in habit, having broom-like branches terminating in a spine, and especially with the genus *Bontia*, with which it agrees in its hard nut, and which it approaches in the country of its origin. Mr. Miers on the other hand believes that it is easy to oppose to these arguments a number of facts, showing that *Oxycladus* presents far greater discrepancies in relation to the *Myoporaceæ* than to the *Bignoniaceæ*. In *Myoporaceæ*, in nearly all cases, the leaves are alternate; the flowers have always didynamous stamens, without any rudiment of a fifth; the ovarium is only bilocular in two instances, which he has elsewhere shown (Ann. Nat. Hist. 2nd Ser. xi. 439) are doubtful, or at least abnormal genera of the order; in nine other genera the ovarium is distinctly four-celled, with a single ovule suspended from the apex of each cell, and this ripens into a four-celled ligneous indehiscent nut, with a seed in each cell. The only remaining case is *Bontia*, which differs from all others of this family in having originally a bilocular ovarium, but where by the subsequent growth and inflexion of the placentæ, eight pseudo-cells are produced, each with a single suspended ovule. This ripens into a hard indehiscent eight-celled nut, each cell producing a single seed, with a thick osseous testa, which is often confluent with the sides of the cell. Mr. Miers's knowledge of this genus is derived wholly from the descriptions of authors, and he finds no observations of a more recent date than those of Gaertner and Jacquin; our evidence of its real structure is therefore imperfect, but enough is recorded to show that it is a very anomalous form, if it really belong to the *Myoporaceæ*. It is a large tree, 30 feet high, has a trunk 2 feet in diameter, with a large head of thick foliage; its leaves are always alternate, somewhat serrated, marked with transparent dots, and have an acrimonious taste. *Bontia* occurs in the West Indies, while all other species of *Myoporaceæ* are found in Australia, in Asia, or in the islands of the Pacific bordering on that continent.

The author next proceeded to indicate those points of structure in *Oxycladus* which establish the relative value of its affinity to the *Myoporaceæ*, or the *Bignoniaceæ*. In this genus, both the branches and rudimentary leaves are distinctly opposite, as in *Bignoniaceæ*, in which family we find two other genera, where the branches terminate in spines, viz. *Catophractes* and *Rhigozum*: the flowers are bluish, a colour not met with in *Myoporaceæ*; they present a sterile fifth stamen, a circumstance almost constant in *Bignoniaceæ*, and never seen in *Myoporaceæ*; the anther-cells are distinct, and widely divaricated upon a large fleshy connective, as in *Bignoniaceæ*, not oscillatory, lunulate, and opening by a hippocrepiform fissure, and therefore almost one-celled, as in *Myoporaceæ*; the ovarium is seated upon a five-lobed fleshy disk, which never occurs in the latter family, though constant in *Bignoniaceæ*; it is completely bilocular, with about six ovules in each cell, suspended and attached by a ventral thread to a distinct flat dissepiment, and arranged in three superimposed pairs upon its opposite faces, in two lines parallel with the axis, a structure which offers a marked character in the *Bignoniaceæ*, and unknown in the *Myoporaceæ*; of these twelve ovules, all become abortive with the exception of one; the fruit is therefore 1-locular and monospermous, presenting an osseous nut, with four deep furrows in the apex, and divisible to the base along these striæ into four valves, two of these sutures being more easily separable, and always corresponding with the margin of the persistent dissepiment, which is pressed against one side, and which distinctly exhibits on both faces its several abortive ovules, the ripened seed filling the whole capacity of the nut. In *Myoporaceæ*, whether the nut be 4-celled, or by abortion 2-locular, the intervening space is always solid, and perfectly indehiscent, leaving small circular cells, surrounded by thick ligneous walls, without showing any marks of division; there is no analogy whatever between this structure and that of *Oxycladus*. The absence of the alary expansion of the testa, so common in *Bignoniaceæ*, is urged as a reason for excluding this genus from that family, but the argument is not valid, where as in *Oxycladus* only one of the ovules becomes impregnated, and where it is thus left at full liberty to acquire the size and shape of the whole space of the cell. The want of wings in the seeds occurs however in other *Bignoniaceous* plants; for instance in *Spathodea* of Palisot de Beauvois, from which all the species from the New World referred to that genus have been rightly separated by Chamisso under the name of *Dolichandra*. Mr. Miers has also found in Brazil another *Bignoniaceous* genus, *Adenocalymna*, the carpological characters of which are yet undescribed, which has a cylindrical, capsular, 2-celled fruit, containing several large, thick, angular seeds, attached by a large hilum to the broad dissepiment, and without wings. In *Argylia* the seeds are likewise apterous. The last consideration as regards *Oxycladus* is not the least important; its seeds are exalbuminous, as in *Bignoniaceæ*, whereas in those of the *Myoporaceæ* the embryo is always contained within albumen.

After the comparison of these several circumstances, the author is unable to perceive the existence of any marked affinity between *Oxycladus* and any genus of the *Myoporaceæ*, and therefore sees no reason to alter the conclusion at which he formerly arrived, that this genus, although deviating from the usual form of its fruit and seed, bears in every essential respect all the characteristic features of a member of the family of the *Bignoniaceæ*. It is not however in the singularity of the large fleshy cotyledons, or the wingless state of the seed, that *Oxycladus* is remarkable, for Mr. Miers has shown that these occur in other genera of the *Bignoniaceæ*; its peculiarity consists in the development of only one of its many ovules, and in the shape of its cotyledons, which in most other instances are deeply cordate, or almost bipartite at each extremity, with the radicle placed between the lobes: in this genus, however, they are entire, oval, and plano-convex; in *Rhigozum* they are likewise fleshy, orbicular, and entire.

The limits of many genera of *Bignoniaceæ* appear, Mr. Miers adds, ill-defined, and the characters derivable from the seeds much neglected. Fenzl and DeCandolle have done much in extending our knowledge of the family, but the subject still requires farther investigation, for he has observed many singular deviations from recorded structure that have not yet been noticed. Should it be found desirable to class *Rhigozum* with *Oxycladus*, the character suggested for this tribe in his former paper would require modification. In that of the *Crescentieæ*, this name ought to be suppressed, and that of *Tanæcieæ* substituted, with the same character there indicated: all the genera of this section of DeCandolle's Prodromus strictly coincide with the *Bignoniaceæ* in their completely 2-locular ovarium, and in the development of their ovules on the surface of the dissepiment, and they agree also with the genus *Bignonia* in the form of their embryo: *Crescentia* and *Kigelia*, however, present characters wholly at variance with the Order, because of their parietal placentation. He is not, however, persuaded of the propriety of establishing a separate order for these two genera, which has been done upon high authority, when they might so well form a good tribe of the *Cyrtandraceæ*. *Crescentia*, with its large amygdaloid embryo, does not differ more widely from the *Cyrtandraceæ*, than *Adenocalymna* does from *Bignonia*: in habit and in floral structure the two last-mentioned genera are scarcely distinguishable.

BOTANICAL SOCIETY OF EDINBURGH.

July 13, 1854.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "Notice of a new species of *Caulerpa*," by R. K. Greville, LL.D. &c. This paper will be found in the 'Annals' for September, and in the Society's Transactions.

Professor Edward Forbes remarked, that the plant resembled the marine *Caulerpites* more than any other described by Brongniart. The genus was interesting, as embracing the *Prasium* of Aristotle, which, until recently translated either a Leek or an Onion, was now known to be *Caulerpa prolifera*, a Mediterranean species.

2. "On the Analogy between the Processes of Reproduction in the Plant and in the Hydroid Zoophyte," by Professor Wyville Thomson. Dr. Thomson stated that the term "Zoophyte" had been originally applied to indicate an intermediate position which these beings were supposed to hold between the animal and vegetable kingdoms; that subsequently their animal nature had been completely made out; and that the old term Zoophyte had then only been retained as an innocent remnant of the superstition of those dark ages; that latterly, however, some strange analogies had been made out between the mode of growth of Zoophytes and of the higher tribes of plants, which seemed to indicate that they had some right to their old designation; that when there was a strong tendency, as in Zoophytes and in Plants, to the indefinite multiplication of similar parts, there was a tendency likewise to the development of these parts according to the same laws. He alluded to the union in these indefinitely repeated parts of the functions of respiration and assimilation in both tribes; to the tendency to spiral arrangement of parts of the polypidom; and to the formation of corpuscles bearing ova, and which are due to the modification or compression of ordinary branches with their buds. Dr. Thomson said that he had had opportunities of observing the process of reproduction in several species of the genus *Campanularia*; he described the peculiar reproductive process in this family, which has been called an "alternation of generations," and alluded to the discovery by Schultze of male individuals of the various species forming capsules containing spermatozoids. He believed that he had been able to make out distinctly three varieties in the development of the medusoids in three species of *Campanularia* (*gelatinosa*, *geniculata*, and *volubilis*). In the first, the capsule of the female individual first appears with a free hollow rod in the centre, like the free central placenta in the *Primulaceæ*. This rod is covered by a partially developed membrane. After a time, a round mass pullulates from this rod beneath this membrane. A communication at first exists between the canal in the centre of the rod, and this globe; this communication is at length closed up, and the projection assumes the form of a true ovarian ovum with a distinct germinal vesicle. The germinal vesicle then disappears, and is gradually replaced by a mass of embryo cells. This mass shows very well the usual process of merismatic division. It afterwards becomes developed into a free ciliated embryo, which fixes closely to a solid body and is quickly developed into a polyp. The contents of the male capsules are formed almost in a like manner, only the original spherical bodies become filled with a substance resembling fovilla, which escapes into the water, without any secondary embryonic formation. In the second species, the embryo is not developed in the capsule, but a mass which Dr. Thomson regarded as homologous with the "ovum" in the former species, is extended from the mouth of the capsule, in

the form of a half-developed medusoid, never becoming detached, but forming the embryo in that position. In the third species, the medusoid was completely developed, and escaped freely into the water. Certain points of resemblance, and their single mode of origin, left no doubt in his mind that the medusoids in the case of *C. volubilis* were only a more highly developed form of the "ova" observed in *C. gelatinosa*, the extreme forms connected by the undeveloped medusoids of *C. geniculata*. It is possible that these three forms of reproduction may not be characteristic of the three species, but may be common to them all under certain modifying circumstances. Dr. Thomson then mentioned the distinction so broadly drawn between the "ovum," the *product* of the true generative process, and the gemma or bud. He suggested that the ovum might be perhaps considered more properly a gemma separated from the parent, and capable of attaining a greater or less development, and that the definition now generally applied to the ovum might be attached to the embryo in its early stages.

The conclusions to which the author seemed inclined to arrive, were,—1. That the medusoids were, in their least developed form, closely allied to the ovarian ovum in the higher animals.

2. That these medusoids, thus resembling the ovarian ovum, might be considered as being produced by a process of gemmation from the parent, and that as free gemmæ they had the power of attaining a considerable degree of development in some species.

3. That these medusoids closely resembled the ovules in plants in their structure and in their mode of development, and that, like ovules, they were sometimes entirely absorbed by the growing embryo while within their capsule, and were sometimes extruded from the capsule when the embryo was extremely small (or even before impregnation?). This property they of course possess in common with the ovarian ovum in higher tribes.

Dr. G. Johnston of Berwick stated, that he differed from Dr. Thomson in regarding the development and reproduction of Zoophytes as indicating an analogy with these processes in plants.

Professor Edward Forbes said, that Dr. Thomson's paper referred to some of the most debateable points in zoology, and that this was not the place to discuss them. He thought that Dr. Thomson had not kept in view the difference between analogy and homology, in drawing a comparison between the zoophyte and the plant.

3. "Notes of a Tour in Switzerland," by John Sibbald, Esq.

4. "Notice of the Discovery of *Hierochloë borealis*, near Thurso," by Robert Dick, Esq. Mr. Dick stated, that at "about ten minutes' walk from the town of Thurso, there is, by the river-side, a farmhouse known by the name of the Bleachfield, opposite to which, on the eastern bank of the river, there is a precipitous section of boulder clay; opposite to the clay cliff, and fringing the edge of the stream, any botanist can, in the last week of the month of May, or in the first and second weeks of June, gather 50 or 100 specimens of *Hierochloë borealis*. Passing upwards along the river bank, and at no great distance, there is another clay cliff, where a few hundreds of

Hierochloë may likewise be got. It also fringes the edge of the river. But the plant must be looked for at the time indicated; for by the third week of June, the beauty of *Hierochloë* has passed away, and by the first week of July the herbage has become so rank, that the Holy Grass, now ripe, and turned of a silky brown, is completely hidden from view. Farther up, between Geize and a section of boulder clay a little below Todholes, the plant may likewise be picked in hundreds. *Hierochloë* has never failed to appear in these localities for twenty years."

5. "On the occurrence of 'Cinchonaceous Glands' in *Galiaceæ*, and on the relations of that Order to *Cinchonaceæ*," by Mr. G. Lawson. This paper will be found in the 'Annals' for September, and in the Society's Transactions.

6. "Notes of a Trip to Inchkeith and Inchcolm," by Professor Balfour. The Professor found upon Inchkeith 132 flowering plants and 6 ferns; on Inchcolm he saw 160 of the former class of plants and 4 of the latter.

The following were the principal plants found on Inchkeith:—*Sinapis nigra, Cochlearia danica, Geranium pratense, Conium maculatum, Haloscias scoticum, Sambucus* (*nigra var.*) *laciniata, Silybum marianum, Carduus acanthoides, Senecio viscosus, Hyoscyamus niger, Linaria Cymbalaria, Marrubium vulgare, Habenaria viridis, Carex distans* and *vulpina*, and *Sclerochloa maritima*.

On Inchcolm:—*Cochlearia danica, Papaver somniferum, Cheiranthus Cheiri, Dipsacus sylvestris, Haloscias scoticum, Hyoscyamus niger*, and *Parietaria erecta*.

7. "Observations on the Morphology of Pines," by Professor M'Cosh.

MISCELLANEOUS.

On the Cœnurus cerebralis *of the Sheep.* By Dr. Küchenmeister*.

On the 6th January 1854, at 8 o'clock in the evening, and on the 7th January, at 11 o'clock in the forenoon, I gave some mature proglottides of the *Tænia cœnurus* of the dog to six lambs of from six to nine months old, taken from three different flocks, which were not subject to vertigo. On the 20th January, the animals exhibited the first symptoms of vertigo. They were then successively killed, and presented the following phænomena on examination.

On the seventeenth day after introduction, from twenty to thirty vesicles (*Cœnuri*) inhabited the surface of the brain; the substance of the brain was hollowed into galleries, as though a *Sarcoptes* had been forming its passage; the vesicles were still free and without envelopes, and of the size of a grain of millet.

* The experiments here detailed were made previously to those of Prof. Van Beneden, of which we gave a notice in our last Number. The proglottides employed by the learned Professor of Louvain, were derived from Tænias produced from the *Cœnuri* obtained in these experiments of Dr. Küchenmeister.

On the twenty-fifth day the vesicles were larger. On the twenty-sixth day they were of the size of a lentil; the envelope began to be formed and the first traces of heads appeared.

On the thirtieth day, the heads, under the form of tubercles, were visible to the naked eye. On the thirty-eighth day the eminences appeared more distinctly on the surface, and the heads exhibited signs of their suckers and hooks. Towards the forty-fifth day the *Cœnuri* were of the size of a bean, and the cavities in which the heads are lodged were formed.

Besides the brain, the heart, the œsophagus, and the diaphragm of some of the lambs also contained encysted vesicles; but these are not the *Cysticercus tenuicollis,* as I was at first inclined to think with M. Leuckart,—they are strayed and aborted worms.

The following is the result to which my researches have led:—The adult *Cœnuri* live and become developed in the intestine of the dog, forming the *Tænia cœnurus,* which has hitherto been confounded with the *Tænia serrata.*

The malady known as the *turn-sick, staggers* or *vertigo* is propagated in the following manner:—The shepherds cut off the heads of the sheep affected with this disease and throw them to the dogs, which swallow the *Cœnuri* along with the brain, and these *Cœnuri* give rise to Tænias in their intestines. As the *Cœnuri* sometimes bear as many as 300 heads, and each head (*scolex*) can produce a *Tænia,* it will be easily imagined that these worms must multiply with great rapidity.

The dogs following the sheep in the meadows, pass the proglottides filled with eggs along with their excrements; and these eggs are thus scattered over the herbage upon which the sheep feed.

Moist meadows are most favourable to the development of the malady, as the proglottides and eggs dry there more slowly.—*Bull. de l'Acad. Royale de Belgique,* 1854, p. 306.

On the Occurrence of Zinc in the Vegetable Organism. By A. Braun.

It is well known that the calamine hills of Rhenish Prussia and the neighbouring parts of Belgium possess a peculiar flora; visitors to these regions are particularly surprised by a species of violet allied to *Viola tricolor,* which unfolds its beautiful yellow flowers in uninterrupted profusion from spring until the end of autumn, and is known in the neighbourhood of Aix as the Calamine violet, or in the dialect of the district "Kelmesveilchen." This plant has been described by Lejeune in his "Revue de la Flore de Spaa" as a distinct species under the name of *Viola calaminaria,* but he has since characterized it (*Comp. Floræ Belgicæ*) as *Viola lutea,* Smith. Koch and other authors have also rightly considered it as a variety of *V. lutea,* Smith (*grandiflora,* Huds.), a species principally distinguished from *V. tricolor* by its filiform subterraneous runners, by means of which it survives the winter. In its habits it is remarkably distinct from the ordinary *Viola lutea* of the Alps, as well as from the form of this plant occurring on the higher Vosges on granitic and syenitic soils (described by Spach as *Viola elegans*); its stem being more procumbent and repeatedly branched at the base, and the flowers being generally smaller. I will not, however, express any further opinion as to whether this violet may or may not be a distinct species, for the violets of the same group as *V. tricolor* present so many difficulties to systematic botanists in consequence of their extraordinary variability, that it is difficult to find the middle course between the union of them all under one name, and the establishment of a multitude of species. Many other plants grow in company with the *Viola calaminaria*, which, although in this district peculiar to the calamine hills, nevertheless grow in other localities in soil free from calamine.

The colour of the flowers of the *Viola lutea* of the Alps and Vosges varies from the darkest violet to the purest yellow, whilst the flowers of *V. calaminaria*, at least in the neighbourhood of Aix, are almost always yellow. On the borders of the calamine district specimens are met with here and there with pale violet, or bluish, or mixed blue and yellow flowers, which have been regarded by Kaltenbach as hybrids between this plant and the *V. tricolor*, which certainly occur on cultivated land in the neighbourhood. But I have also seen a specimen of the true *V. calaminaria* from the calamine region of Westphalia which is of a dark violet colour. The plant when cultivated in gardens is said to change and become like the common *V. tricolor*.

The connexion between the occurrence of the *V. calaminaria* and the presence of calamine in the soil, which is so constant that even mining experiments have been undertaken with good results from the indications furnished by this plant, induced me, when in Aix, to urge M. Victor Monheim of that place, to examine the plant especially with reference to its containing zinc. He afterwards sent me the following account of a chemical investigation of the plant, performed in his laboratory and under his eye, by M. F. Bellingrodt, which I give in the latter gentleman's own words:—

"The plants, some of which were still in flower, were collected in the month of October on the Altenberg and in the immediate neighbourhood of its large zinc works. To get rid of adhering earth completely, the fresh, uncut herbage with the roots was washed with water, until, when macerated for sixteen or eighteen hours with water containing muriatic acid, it gave no inorganic matter to the dilute acid. The whole was then finely chopped and digested on the vapour-bath for twelve hours with water and muriatic acid; the vegetable matter was separated from the extract, and this treated with chlorate of potash. The addition of an excess of ammonia to the decolorized extract, now produced a precipitation of alumina, organic substances, and partially of the iron.

"The precipitate produced in the filtrate by sulphuret of ammonium was dissolved in muriatic acid, oxidized by nitric acid, and the iron then completely separated by ammonia. A portion of the filtered fluid was boiled with solution of potash, when traces of manganese were precipitated. Solution of sulphuretted hydrogen then rendered the presence of *zinc* in the filtrate quite evident.

"Another portion of the fluid filtered from the iron precipitate was precipitated at once by sulphuret of ammonium, the dried precipitate calcined in a platinum crucible, moistened with nitric acid, again calcined, and then treated with dilute acetic acid; the zinc was precipitated from the solution in acetic acid by solution of sulphuretted hydrogen.

"From another portion of the herb, freed from external impurities, the juice was expressed, and the presence of zinc in this was also distinctly proved by the above process."

This metal must therefore be added to the eighteen elements hitherto known to occur in the vegetable organism.—Poggendorff's *Annalen*, vol. xcii. p. 175.

Notes on the Bovine Animals of the Malay Peninsula. By George Windsor Earl.

1. The Sapi, or Wild Ox of the Malay Peninsula, was scarcely known to exist until 1850, when Dr. Oxley, and a hunting-party from Singapore, killed a young cow on the banks of the Muah River. He described it as 6 feet 2 inches high at the shoulder, from hoof to dorsal vertebræ; back curved, highest about the centre. Horns small, curved inwards, white, tipped with black. Forehead flat, with tuft of long hair, large in the bulls. Hair smooth and silky. Colour brown, with white about the feet. Mane 2 inches long, running along the entire back. No dewlap. The bulls are from 7 to $7\frac{1}{2}$ feet high. The flesh is described as delicious. Calves could be obtained with a little trouble, but I suspect it would be difficult to get a full-grown animal; but he would be worth something if caught.

2. The Saladang, another species of wild cattle, is even less known than the Sapi, as no specimen has yet been shot by Europeans. It seems to me to be a sort of Bison, or *Bos Gaurus*. The males are 10 feet high at the shoulder, and they are altogether fiercer and more formidable than the Sapi, but not so graceful. In my opinion it would be worth while for the Zoological Society to send a man out expressly for the purpose of bringing home specimens of these two beasts. The Muah River, where both varieties abound, would be the best spot to seek them; and Inchi Basow, a Malay chief who takes great delight in hunting, would soon procure live specimens of each at a small expense.

3. The Water Buffalo does not seem to be known in England, although it is common all over the Archipelago. The larger specimens stand 7 feet at the shoulder, sometimes more. Barrel very large. Legs short and strong. Skin black and wrinkled, and almost hairless, like that of the Elephant. It is amphibious, and has been known to swim across straits as wide as the Channel at Dover; in fact, the way the head is set on the body, with the nose up, and the

horns lying along the back, shows that it is more adapted for the water than the land, although it is an excellent draught animal, and at Singapore supplies the place of the Elephant.

4. The Domestic Ox of Bali and Lombok, a large, sleek, thin-skinned species, as graceful as the Antelope. This would be very much admired in the Gardens. Specimens can be obtained at Singapore, but it would be better to get them from Lombok, whence ships now come direct to England with cargoes of rice. Mr. Lange of Bali Badong (merchant) would, I have no doubt, forward specimens at a trifling cost.—*Proc. Zool. Soc.* Feb. 8, 1853.

METEOROLOGICAL OBSERVATIONS FOR AUG. 1854.

Chiswick.—August 1. Cloudy: clear. 2. Clear: very fine: heavy rain at night. 3. Overcast: rain. 4. Overcast: heavy rain. 5. Rain: overcast. 6, 7. Overcast: clear. 8. Very fine. 9. Fine: overcast: very clear at night. 10, 11. Very fine. 12. Densely clouded: very clear at night. 13. Very fine. 14. Cloudy: very fine: clear. 15. Very clear: cloudy: clear. 16. Fine: overcast. 17. Fine: rain: very clear. 18. Fine: cloudy. 19. Very clear. 20. Cloudy and fine. 21. Overcast. 22. Cloudy and fine: clear. 23. Overcast: rather boisterous, with rain. 24. Fine: cloudy and boisterous: fine. 25. Fine. 26. Exceedingly fine. 27. Very fine: overcast. 28. Very fine. 29. Very hot. 30. Cloudless and very hot, with dry air. 31. Very fine.

Mean temperature of the month	60°·70
Mean temperature of Aug. 1853	59 ·69
Mean temperature of Aug. for the last twenty-eight years...	62 ·03
Average amount of rain in Aug.	2·47 inches.

Boston.—Aug. 1, 2. Cloudy: rain A.M. and P.M. 3. Cloudy. 4. Cloudy: rain A.M. and P.M. 5—9. Cloudy. 10, 11. Fine. 12, 13. Cloudy. 14. Cloudy: rain P.M. 15. Fine: rain P.M. 16. Fine. 17. Cloudy: rain P.M. 18. Cloudy. 19. Fine. 20. Fine: rain. 21. Cloudy: rain A.M. 22. Fine: rain, with thunder and lightning P.M. 23. Cloudy. 24. Fine: rain P.M. 25. Fine. 26, 27. Cloudy. 28—30. Fine. 31. Cloudy.

Sandwick Manse, Orkney.—Aug. 1. Fog A.M.: drizzle P.M. 2. Bright A.M.: clear P.M. 3, 4. Cloudy A.M. and P.M. 5. Damp A.M.: drizzle P.M. 6. Cloudy A.M.: drizzle P.M. 7. Cloudy A.M.: damp P.M. 8, 9. Cloudy A.M.: drops P.M. 10. Cloudy A.M.: clear, fine P.M. 11. Bright A.M.: bright, fine P.M. 12. Cloudy A.M.: showers P.M. 13. Showers A.M.: clear, fine P.M. 14. Cloudy A.M.: rain, thunder P.M. 15. Bright A.M.: cloudy P.M. 16. Bright A.M.: clear P.M. 17. Bright, fine A.M.: clear, fine P.M. 18. Clear, fine A.M.: cloudy P.M. 19. Cloudy A.M.: showers, aurora P.M. 20. Bright A.M.: cloudy, fine P.M. 21. Drops A.M.: showers P.M. 22. Showers A.M.: cloudy P.M. 23. Rain, cloudy A.M.: showers P.M. 24. Showers A.M. and P.M. 25. Cloudy A.M. and P.M. 26. Drizzle A.M.: cloudy P.M. 27. Damp A.M.: cloudy P.M. 28. Cloudy A.M. and P.M. 29. Cloudy A.M.: rain P.M. 30. Showers A.M. and P.M. 31. Showers A.M.: cloudy P.M.

Mean temperature of Aug. for twenty-seven previous years .	54°·99
Mean temperature of this month	55 ·06
Mean temperature of Aug. 1853	55 ·98
Average quantity of rain in Aug. for fourteen previous years .	2 99 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London;* *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1854. Aug.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
☽ 1.	29·697	29·658	29·14	29·73	29·77	69	46	63	58	55	sw.	wsw.	n.	·24	·44	....
2.	29·783	29·684	29·18	29·81	29·88	73	56	61	56	51	nw.	w.	n.	·40	·11	....
3.	29·854	29·805	29·38	29·97	30·06	58	46	61	53	52	ne.	nnw.	nnw.	·27	·39	....
4.	29·929	29·916	29·45	30·08	30·11	57	52	51	53	52	n.	nnw.	nnw.	·39	·12	....
5.	30·038	29·974	29·55	30·08	30·10	59	54	56·5	54½	52	n.	nnw.	nnw.	·04	·24	....
6.	30·110	30·060	29·65	30·13	30·11	67	49	60	57½	55	ne.	nnw.	w.	....	....	....
7.	30·059	30·037	29·63	30·06	30·00	68	44	61	60½	56½	n.	nnw.	ssw.	....	....	....
○ 8.	30·057	29·971	29·57	29·91	29·82	74	48	67	58½	57	sw.	ssw.	......	....	....	....
9.	29·944	29·882	29·46	29·81	29·81	73	48	66	55	56	sw.	sw.	......	....	....	·10
10.	29·838	29·791	29·37	29·76	29·77	77	48	63	56	54	nw.	w.	......	....	....	....
11.	29·947	29·934	29·44	29·80	29·78	75	58	65	58	54	w.	nw.	ese.	....	....	....
12.	29·924	29·897	29·38	29·52	29·38	74	48	64·5	58½	56½	sw.	sw.	sw.	....	....	·14
13.	29·902	29·731	29·36	29·69	29·81	86	54	70	56½	55	s.	w.	e.	·01	....	·09
14.	29·836	29·726	29·25	29·68	29·68	72	52	65	57	52	sw.	w.	nnw.	....	....	....
☾ 15.	29·845	29·836	29·33	29·71	29·76	71	43	62	54½	52	w.	sw.	w.	....	·12	·34
16.	29·954	29·836	29·40	29·76	29·84	67	42	53·5	55½	50	w.	w.	w.	·11	·12	....
17.	30·038	29·987	29·50	29·92	30·01	64	40	58	54	50	w.	w.	......	·10	....	....
18.	30·128	30·095	29·66	29·99	29·96	73	46	58	56	56	w.	nw.	ssw.	....	·04	....
19.	30·139	30·042	29·63	29·84	29·76	76	58	62	58½	56	sw.	sw.	w.	·12	....	·06
20.	29·996	29·924	29·47	29·74	29·76	75	49	66	57½	55	w.	w.	ssw.	·01	....	·05
21.	29·824	29·765	29·32	29·56	29·31	70	50	68	55½	55	s.	w.	w.	....	....	·06
22.	30·013	29·865	29·34	29·45	29·72	71	41	58·5	54½	54½	w.	wnw.	w.	....	·03	·28
● 23.	30·108	30·000	29·60	29·66	29·37	67	57	59	56	54	sw.	wsw.	sw.	·08	·14	·48
24.	29·996	29·935	29·37	29·17	29·62	72	47	62	56	51	w.	sw.	nw.	....	·03	·35
25.	30·266	30·158	29·64	30·05	30·19	70	39	58	51	52	nw.	w.	w.	....	....	·20
26.	30·361	30·330	29·87	30·16	30·11	76	51	60	56½	58	n.	calm	wsw.	....	....	·03
27.	30·398	30·395	29·87	30·22	30·26	79	63	69	56½	59	nw.	calm	wsw.	....	....	·02
28.	30·438	30·425	29·92	30·17	30·27	82	50	67	60	54½	n.	nnw.	w.	....	....	....
29.	30·432	30·319	29·90	30·27	30·03	84	45	69	56	54	w.	calm	se.	....	....	....
30.	30·252	30·127	29·70	29·84	29·82	84	54	62	56	53	w.	w.	w.	....	....	·10
☽ 31.	30·260	30·157	29·72	30·01	30·16	73	40	61	53	53½	ne.	nw.	w.	....	....	·10
Mean.	30·044	29·976	29·51	29·856	29·871	72·45	48·96	62·0	56·09	54·04				1·77	1·78	2·40

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XXIX.—*Contributions to the Natural History of the Infusoria.* By A. Schneider*.

[With a Plate.]

I. *On Polytoma Uvella.*

Polytoma Uvella is given by Ehrenberg† as the only species of the genus *Polytoma*, and characterized in the following words:—"Animal e familia Monadinorum, ocello destitutum, ore terminali truncato, ciliis aut proboscide subtili flagelliforme duplici instructo natantibus solitariis antico, divisione spontanea decussata et imperfecta, multipartitum in Mori formam enascens, dein partitum et altera vice solitarium." In a subsequent passage he adds—"With regard to its organization the polygastric alimentary organs appeared distinctly. Besides these I perceived a larger contractile vesicle, which did not belong to the nutritive apparatus, and which appeared to be connected with the male sexual organs. Lastly, a large, free, white spot in the anterior part of the body, the outline of which could not be made out distinctly, but which pressed the stomachal sacs towards the hinder extremity, led to the supposition that a seminal gland existed in that place." After repeated failures he succeeded, but only by employing a magnifying power of 6–800 diameters, in seeing the little sacs of the posterior portion filled with indigo. Dujardin, apparently, has never examined *Polytoma* himself, as he could not repeat Ehrenberg's observations upon its mode of division‡, and I am unacquainted with any subsequent observations upon this creature.

* Translated from Müller's Archiv, 1854, p. 191.
† Die Infusorien als volkommene Organismen, &c., p. 24.
‡ Dujardin, Hist. Nat. Infusoires, p. 276.

As it appeared desirable that we should be better acquainted with the mode of division of *Polytoma,* I have made a series of observations upon this elegant creature, the results of which will be found in the following pages. The material for the investigation is easily obtained. *Polytoma Uvella* is to be met with in every puddle, in rain-water tanks, &c., and its rapid increase may readily be effected, by the putrefaction of animal or vegetable matters.

Polytoma Uvella is of an oval form; it is from $\frac{1}{200}$ to $\frac{1}{40}$ of an inch long, and about half that width. At one end, which, with Ehrenberg, we will call the anterior extremity, it bears two filaments as long or longer than the body. When the living animal is examined under a magnifying power of 300 diameters, the body appears to be bounded by a simple outline. But in many instances, and especially when a large specimen can be found at rest, it may be seen that the internal substance of the body is surrounded by a thin and perfectly clear membrane, from which it is separated by a distinct space. When the investing membrane is more closely attached, its existence may always be demonstrated by the employment of reagents to produce the contraction of the substance of the body: chromic acid and solution of iodine in chloride of zinc are the best substances to employ, the latter especially, as it at the same time communicates a brown colour to the internal sac (Pl. XI. fig. 2). Under certain circumstances, the investing membrane divides into minute granules, assuming when viewed from the side a regular necklace-like appearance (fig. 8). A reproduction of the membrane then takes place. The substance of the body is perfectly clear, with the same refractive properties as that of *Amœba.* About the middle lies a clear, globular nucleus, surrounded by a narrow, reddish halo. Dilute acids render this more distinct. At the anterior extremity, close to the margin, there are two reddish vesicles, the contractions of which may easily be recognised in individuals in a state of repose. The hinder extremity always contains a mass of granules, with dark outlines, which are not altered by acetic acid. A weak solution of iodine in iodide of potassium gives them a deep blue colour, generally verging upon black, as it is difficult to hit the right quantity of the reagent to be added. The fine blue colour is better attained by the addition of diluted solution of iodine in chloride of zinc, as with this the granules become slightly liquefied, and when left standing for some time even form a blue paste. Muriatic and sulphuric acids also dissolve them, so that the subsequent addition of iodine gives the whole body a blue colour. When the putrefaction of the infusion is going on very rapidly, the granules fill the entire body. They are not arranged in balls like the nutritive matter in the bodies of other Infusoria, and it is by no means probable that they are taken in from the exterior. Besides the two contractile vesicles, single, non-contractile, reddish vacuoles are seen scattered through the substance of the body.

The starch-like granules are often converted into an indigo-blue pigment, which is then partially dissolved, and colours the whole parenchyma. Such specimens as these still retain the power of division, so that there can be no doubt as to their identity with *Polytoma Uvella.* Individuals were also frequently met with of which the substance of the body was of a uniform green colour, but which in other respects agreed exactly with *Polytoma.*

Deviations from this normal form never occur singly in the same vessel, but always make their appearance simultaneously in a great number of individuals. Certain peculiarities of their abode appear therefore to have an influence upon the form. Very compressed forms are rare. However, it not unfrequently happens that whilst the investing membrane retains its normal form, the substance of the body is not equally distributed in its interior. Sometimes it lies to one side, so as to fill only half the interior of the sac; sometimes it is entirely collected in the anterior, and sometimes in the posterior extremity; in the latter case it is connected with the anterior extremity by a slender filament (figs. 13 & 14). In infusions in which fermentation has long ceased, and which contain a large quantity of brown humus-like matter, but very small portions of nitrogenous substances in solution, the two last modifications of the parenchyma are most frequently met with. At the same time the starch-like granules disappear, the substance of the body acquires a darker, fatty outline, and finally disappears, with formation of the well-known large vacuoles.

The movements of *Polytoma* are the same as those usually ascribed to organisms furnished with two filaments. Whilst in motion the filaments are always in front, the animal rotates upon its axis, and this again describes circular vibrations upon a central point. If a movement in the opposite direction is taking place, the animal is endeavouring to turn the anterior extremity, and until this is effected, it swims backwards. When a drop of the infusion has been left for a few minutes upon a glass plate covered over with a piece of thin glass, a considerable number of the animals will be found attached to both glasses by their anterior extremity; the filaments are free, and it is probably by their vibration that the hinder extremity is made to oscillate in the direction of the plane of the two filaments. They collect in the same manner in crowds upon aquatic plants, as well as upon the sides of the vessel containing them. Their mode of attachment is still unintelligible to me. In any case some contrivance for this purpose, however simple, must exist either between the two filaments, or at the side of their points of issue from the membrane.

Reproduction.

During the swarming state a division of the substance of the body goes on uninterruptedly, at all hours of the day. The different stages of this process follow one another with greater or less rapidity in proportion as the conditions of nutrition are more or less favourable. Soon after the commencement of fermentation in an infusion, the rate of increase attains its maximum; it then diminishes as the fermentation ceases, the offspring at the same time undergoing a diminution of size.

The commencement of the process of division is indicated by the uniform distribution of the granular substance. A constriction of the substance then takes place, usually commencing on one side; by this the body is divided into two parts, which are still enclosed in the uninjured investing membrane. Simultaneously with, or perhaps before the completion of this bisection, the nucleus also divides (fig. 3). Although no constriction of the nucleus was ever noticed, nothing certainly was observed to contradict the supposition, that the second nucleus was produced in this mamner. The two halves then become constricted from their surfaces of contact, in such a manner that the constriction of one half crosses that of the other at right angles (fig. 4). To every depression thus produced on the one side there is a corresponding elevation of the other. The quadrisection (figs. 4 & 5) then takes place suddenly as if by cutting, and without any appearance of a circular constriction, each portion containing its proper nucleus. The divisions now acquire an oval form, and arrange themselves in such a manner that the ends of the posterior pair, which are turned towards the middle, alternate with those of the anterior pair in the same place (fig. 6). In very favourable circumstances (as for instance, at the commencement of fermentation), a third division into eight parts takes place, each division being still furnished with a nucleus. As a general rule, however, the young individuals acquire filaments soon after the quadrisection, and move about in various directions within the investing membrane, until this bursts, and the young, which are exactly like the mother except in their smaller size, are set free. In favourable circumstances the empty membrane remains with the two filaments. After the division of the substance into four or eight parts, the investing membrane is always visible without the employment of any reagents. This has not escaped Ehrenberg (*loc. cit.* and tab. I. xxxii.); he explains the appearance as a consequence of a superficial constriction. The filaments of the parent always appear to be connected only with one of the young individuals, although this is less distinguishable in the present mode of division than in that about to be described.

In this the quadrisection takes place in another manner. After bisection, the two portions shift their position in such a manner, that the surfaces of contact form a distinct angle with their original position. If this change of position be but trifling, the quadrisection goes forward nearly in the manner just described, and the arrangement of the developed young only differs as far as is rendered necessary by this change of position (figs. 11 & 12). But if it be more considerable, the new surfaces of division run parallel to each other and nearly perpendicular to the surfaces of contact of the two halves. The position of the young individuals is then completely different from that seen in the preceding case; all four lie parallel to each other, with their longitudinal axis oblique as regards the axis of the whole (figs. 9 & 10).

This difference may perhaps be explained as follows:—each portion has a tendency to acquire an oval form, so that soon after the bisection the anterior portion extends itself posteriorly, and the posterior towards the front. When sufficient time has not elapsed for the one dimension to predominate over the other, the quadrisection takes place as in the former case; but when, on the other hand, one dimension has become predominant, the division into four takes place in accordance with the same law as the original division into two.

The method of division first described is always met with in the early periods of an infusion, which are most favourable to the development of the creatures. Towards the end the latter mode alone occurs. This phænomenon was so remarkable, that on the first occasion of my examining an infusion towards the close of its action, I imagined that I had at first misunderstood the mode of division.

Under certain circumstances the individuals pass to a state of rest. They are then completely filled with the starch-like granules, so that the nucleus only appears as a reddish spot. The substance of the body becomes spherical, and invests itself with a membrane which is frequently of considerable thickness (fig. 7). In this state I have never observed them to undergo any division or any other change, and when dried the cysts still retain their contents. When clear water is poured over them they do not return to life, but would probably do so in a fermenting infusion.

The mode in which the swarming individuals arrive at this state of repose appears to be as follows. The filaments are gradually shortened, their substance collecting at the free extremity in the form of a small knob, until at last the filiform portion entirely disappears, and in place of the filaments, two vesicles are seen at the anterior extremity of the investing membrane (fig. 15). I have observed a similar contractibility of the substance of the filaments in a *Bodo* which is most nearly allied to *Bodo grandis*, Ehrbg. As this possesses not three filaments only, as seen by Focke (Ehrbg. p. 34), but often as many as five, the vesicles produced in this manner cannot easily be overlooked. I cannot however state with certainty, whether all the individuals which undergo this change invest themselves with cysts. When infusions containing *Polytoma* are dried slowly, individuals with the vesicles just described are found in the deposit, but no cysts, and it is not impossible that such individuals may assist in the continuation of the species in some other way.

Nearly allied to *Polytoma* is the *Chlorogonium euchlorum* of Ehrenberg *, which consists of a firm, transparent, fusiform investing membrane, with which I was not able to obtain any reaction for cellulose. Its interior is filled with a homogeneous green mass, which is generally somewhat rounded behind; the green colour disappears in front, where the mass is distinctly connected with the filaments inserted in the apex. In the middle there is a transparent, round nucleus, the reddish halo surrounding which is extended in a spindle shape towards the two extremities. The surface of the green mass is completely covered with reddish spots (as many as twelve), but none of these are of such a fine red colour as the eye-spot of *Euglena*.

Ehrenberg describes *Chlorogonium* as possessing an eye; he says,—"The eye of *Chlorogonium* is very distinctly marked, but very minute, so that it may easily be overlooked." Unfortunately during my observations upon this creature I had not Ehrenberg's work at hand; I cannot however call to mind that one of the reddish spots was unusually distinct. I could not discover a contractile space; but if this were no larger than in *Polytoma*, it would require uncommon acuteness of vision to distinguish it from the non-contractile reddish spots. Division takes place in the interior of the investing membrane, in exactly the same manner as in *Polytoma*. The number of individuals produced is never less than four, but often as many as thirty-two—in the latter case they are very small, but always resemble the parent in other respects. A spherical state of rest also occurs. It appears that when the requisite conditions are present, the young proceeding from the division of the parent pass into this state immediately after they are set free; their soft investing membrane probably rendering them fitter for this

* P. 114. tab. VII. fig. XVII.

purpose. The contractions which then take place are probably the same that were observed by Ehrenberg. In other respects I have found the form quite unchangeable, and *Chlorogonium* must consequently be separated from the *Astasiæa,* amongst which it has hitherto been arranged. On the addition of iodine only a few blue granules are to be seen in the fusiform individuals; the green spheres, on the contrary, which are completely filled with green granules, acquire a deep blue colour with this reagent: if the colouring matter be destroyed by means of concentrated sulphuric acid, the granules are dissolved, and on the addition of iodine a beautiful blue colour is produced. By long keeping the green of the cysts passes to red. The cysts are not to be roused from their torpid state by the production of fermentation. I have, however, observed their revivification under other circumstances, but my materials are insufficient to enable me to describe the mode of reproduction of the investing membrane and filaments, which would certainly be interesting. The conditions required for the existence of *Chlorogonium* are apparently quite different from those of *Polytoma*; the former did not multiply abundantly in infusions until the latter had passed to the state of repose.

To show how very different is the mode of division in other *Monadina,* in which the investing membrane is deficient, we may refer to *Chilomonas paramecium,* Ehrbg. (p. 30. tab. II. fig. vi.). The form of this animal is subject to considerable variation. It usually presents a longish oval, broader at one end than at the other. At the broader end, a little to one side of the apex, there is a small indentation, in which the two filaments are placed. The interior is principally filled with round granules (as represented by Ehrenberg), which distinctly exhibit the reactions of starch. In the hinder portion a clear nucleus with a reddish halo may be observed. The oval is but rarely perfect; it is generally flattened on two sides, and the surfaces thus produced are even somewhat impressed in a longitudinal direction. It is to this impression, I think, that the reddish colour which makes its appearance when the animal is examined lying flat before the observer, is to be ascribed. I could discover no contractile space, although a reddish vesicle certainly does always exist in the anterior extremity; I must, however, leave its contractibility an undecided point. Ehrenberg mentions expressly, that *Chilomonas paramecium* never could be made to take in coloured nourishment, nor have I been able to observe this any more than with *Polytoma.*

Whatever number of these animals may be observed, no trace of division will ever be remarked in them. Very rarely we may see two individuals adhering by their middle, evidently produced by a longitudinal division. We shall endeavour to explain this.

On close examination, one or two reddish lines may be seen running backwards from the bottom of the indentation (fig. 25), which might readily be taken for organs lying in the interior of the body. I have convinced myself, however, especially by the comparison of the process of division in a species of *Bodo,* that these lines indicate furrows, which gradually divide the whole by cutting deeper and deeper on each side. As during this process the animal undergoes no change of form, except in becoming a little broader, and the division takes place along its whole length, the process must readily escape observation. The anterior end is always a little thicker; the furrows consequently are deeper and more distinctly recognizable in that part. With a suitable arrangement of the microscope, it is evident that, the two furrows being looked at simultaneously, two reddish lines are seen. It is only in rare cases, when the division has taken place more slowly in some particular spot, that the two specimens must endeavour to tear themselves free, and thus, by twisting in contrary directions, draw our attention to them. That the process of division is effected in a similar manner in other *Monadina,* appears from an observation of Ehrenberg's upon *Cryptomonas cylindrica* (p. 42):—"I saw no instance of constriction or fissation, but two individuals were swimming whilst adhering together, which might lead one to suppose that a longitudinal division from behind forwards had taken place." And it is not improbable that the specimen represented by him on tab. II. fig. xix. 2, with two seminal glands (nuclei ?) and two longitudinal lines, was in the act of division.

The occurrence of an encysted or quiescent state in *Polytoma* cannot be considered remarkable, since Stein has made known the encystation of *Vorticella microstoma**, and Cohn that of *Trachelius Ovum, Trachelocerca Olor, Holophrya Ovum, Prorodon teres* and *Chilodon uncinatus*†. To this list I can add some others from my own observations. *Stylonychia pustulata,* Ehrbg., gradually acquires a spherical form, still retaining its cilia; the cilia then quickly fall off, continual little contractions take place, and a clear mucus is secreted by the whole surface, which gradually hardens into a strong, solid membrane. When a spherical specimen is obtained, the casting off of the cilia and the secretion of the membrane may easily be followed under the microscope. The exclusion of the animal completely furnished with cilia may often be observed, merely by re-establishing fermentation in the fluid. The animals which are somewhat elongated previously twist round spirally with great rapidity within the cyst. After exclusion, they present a remarkable resemblance to

* Wiegmann's Archiv, 1848.

† Siebold und Kölliker's Zeitschrift, iv.

Oxytricha caudata, Ehrbg. (tab. XL. fig. xi.), although I will not say that they are perfectly identical; the posterior extremity in particular is always bent round in the manner represented by Ehrenberg at No. 3 of the figure just cited.

Euplotes Charon, Ehrbg., contracts itself within its shield-shaped carapace into a ball, which then invests itself with a new membrane. As long as the carapace, which is distinguished by its striæ, is still retained, there can be no doubt as to the animal enclosed in the cyst. The cysts of both these Infusoria are, as might be expected, very common in infusions, and are probably often confounded with the cysts of *Vorticella.*

Pontotrichum lagenella forms a cyst like that of *Trachelius* described by Cohn (*op. cit. supra,* p. 267), which completely retains the flask-like form of the body. Within this the animal contracts itself into a ball and invests itself with a new membrane. *Amœba* also actually has a state of rest. I observed it become round on one side, on which a firm membrane was then formed, whilst the other portion continued its peculiar movements. By degrees the membrane extends itself over the whole body, the moveable portion constantly becoming smaller, until at last a completely closed cyst is produced, in the clear interior of which a round nucleus with a reddish halo, exactly like that of *Polytoma* and other *Monadina,* may be distinctly observed*.

During our investigation of *Polytoma,* we have always tacitly regarded it as of animal nature. But if we consider how very difficult it is, in the present state of our knowledge, to draw the boundary-line between the animal and vegetable kingdoms, it becomes necessary to inquire with what right we have done so. If the cycle of development of *Polytoma* be completed by the forms now known, it is clear, in the first place, that *Polytoma* behaves very like a simple cell. A structureless membrane invests a soft, membraneless substance, which is continued externally in the form of a pair of filaments. The nucleus behaves like a cell-nucleus. It is true that if it be necessary that the nucleus of an animal cell should be a vesicle, the nucleus of *Polytoma* does not fulfil this condition. But is the proper membrane a necessary element of the animal cell-nucleus? Is it not possible that this may be formed only under certain circumstances? In the nucleus of *Amœba,* I have often observed, on the outer surface of the reddish halo, granulations which united to form a closed membrane; whilst at other times the nucleus exactly resembled that of *Polytoma.*

* I take this opportunity of calling attention to this nucleus, which, as far as I am aware, has not yet been noticed. By the comparison of numerous specimens, its constant appearance will distinguish it from enclosed particles of food. It occurs in *A. diffluens* and *radiosa.*

So that if it be considered possible that contractile spaces may occur in a primordial vesicle without the necessity for a peculiar apparatus of contractile fibres, *Polytoma* fulfils all the requisite conditions of a cell.

That *Polytoma* is an animal may be maintained upon two grounds.

1. *The constitution of the investing membrane.*—As soon as the starch-like granules have been destroyed by the long action of concentrated sulphuric acid, no part of the creature is coloured blue by iodine. Now we have no more reason for believing that the vegetable cell-membrane *must* necessarily consist of cellulose, than that the animal cell-membrane should *not* consist of that substance, so that we are still compelled to seek for other characters for their distinction. These would be—

2. *The contractile spaces.*—A statement of Cohn's* has certainly rendered it doubtful, whether the occurrence of these is henceforward to be regarded as an essential indication of an animal nature. He says, "On the other hand, certain genera of Algæ exhibit a stage of development, in which, in external form, in the absence of a cellulose membrane, in the distinct existence of ciliary organs of motion, red eye-like spots, vacuoles, and, according to a very recent discovery, *of internal pulsating spaces,* they undoubtedly appear very similar to the Astomatous Infusoria." If these pulsating spaces occur only in unicellular Algæ provided with cilia, these perhaps should properly be restored to their place amongst animals, notwithstanding the subsequent appearance of cellulose-membrane upon them. But if they occur in the swarm-cells of the Confervæ, they certainly cease to be a characteristic of animal nature. Thus, if we are not yet in a position to refer *Polytoma* with perfect certainty to its proper place, there is decidedly no reason for excluding it from the animal kingdom. We will not, however, venture to consider the Infusoria furnished with a mouth (*Stomatoda,* Von Siebold), as formed, like *Polytoma,* upon the type of a simple cell; for, high as we may rate the advantage accruing to science from the comparison of the Protozoa with simple cells, difficulties stand in the way of its complete application in the case of animals of such complicated structure as the *Vorticellæ* for example; and these cannot be considered as entirely done away with, until the history of their development has furnished proof that at no period does a fusion of several cells take place.

In conclusion we bring together the results of the investigation as shortly as possible.

* Zwanzigster Jahresbericht der schlesischen Gesellschaft für vaterländische Cultur, 1852, p. 46.

1. *Polytoma* is an animal.

2. It is characterized by a clear investing membrane, which does not consist of cellulose; two contractile spaces in the substance of the body; a nucleus with a nucleolus; two filaments; and by the deposition of layers of starch-like granules.

3. The starch-granules may become converted into a blue or green colouring matter.

4. *Polytoma* divides within the investing membrane into two, four, or eight parts, and propagates itself in this manner.

5. It passes into a state of repose.

II. *Difflugia Enchelys*, Ehrenberg.

A Rhizopod occurred in company with *Polytoma* in all infusions, the description of which will show, how very readily it might be supposed to be produced by a metamorphosis of the latter animal. Unfortunately I cannot confirm this supposition, and must confine myself to recording the fact. From its extraordinary transparency the examination of this creature was not without interest.

The Rhizopod in question has a transparent, membranous case, of an oval form, somewhat spherical on one side. The substance of the body is either attached uniformly to the interior of this case, or lies detached from it in various forms (figs. 16, 17, 18, 19). The substance of the body projects from the narrower end of the case, forming that moveable portion, which may be shortly characterized as the *foot*. In the hinder end there is a round, reddish nucleus, with a white nucleolus, which is only distinguished from that of *Polytoma* by the greater breadth of the reddish halo. The *foot* can exhibit the most various forms. In its simplest state it is nothing but a transparent globule, which afterwards divides into two or more smaller ones. From these smaller processes are given off, and sometimes an indefinite number of tentacles with acute or rounded extremities is formed. These tentacles are frequently drawn out to such an extent as only to present the appearance of thin rays. Sometimes also the foot is branched, and then usually encloses granules of foreign matter in its ramifications. The reception of nourishment is probably effected by means of the foot, in exactly the same manner as in *Amœba*. The granules of food occur at first only in the anterior portion of the substance of the body, which then usually has a folded appearance, while the hinder portion remains full and round. By degrees the whole body becomes filled, and the nucleus almost concealed. Vacuoles are seen in all parts. The contractile spaces are probably only concealed from sight, but I was unable to discover them.

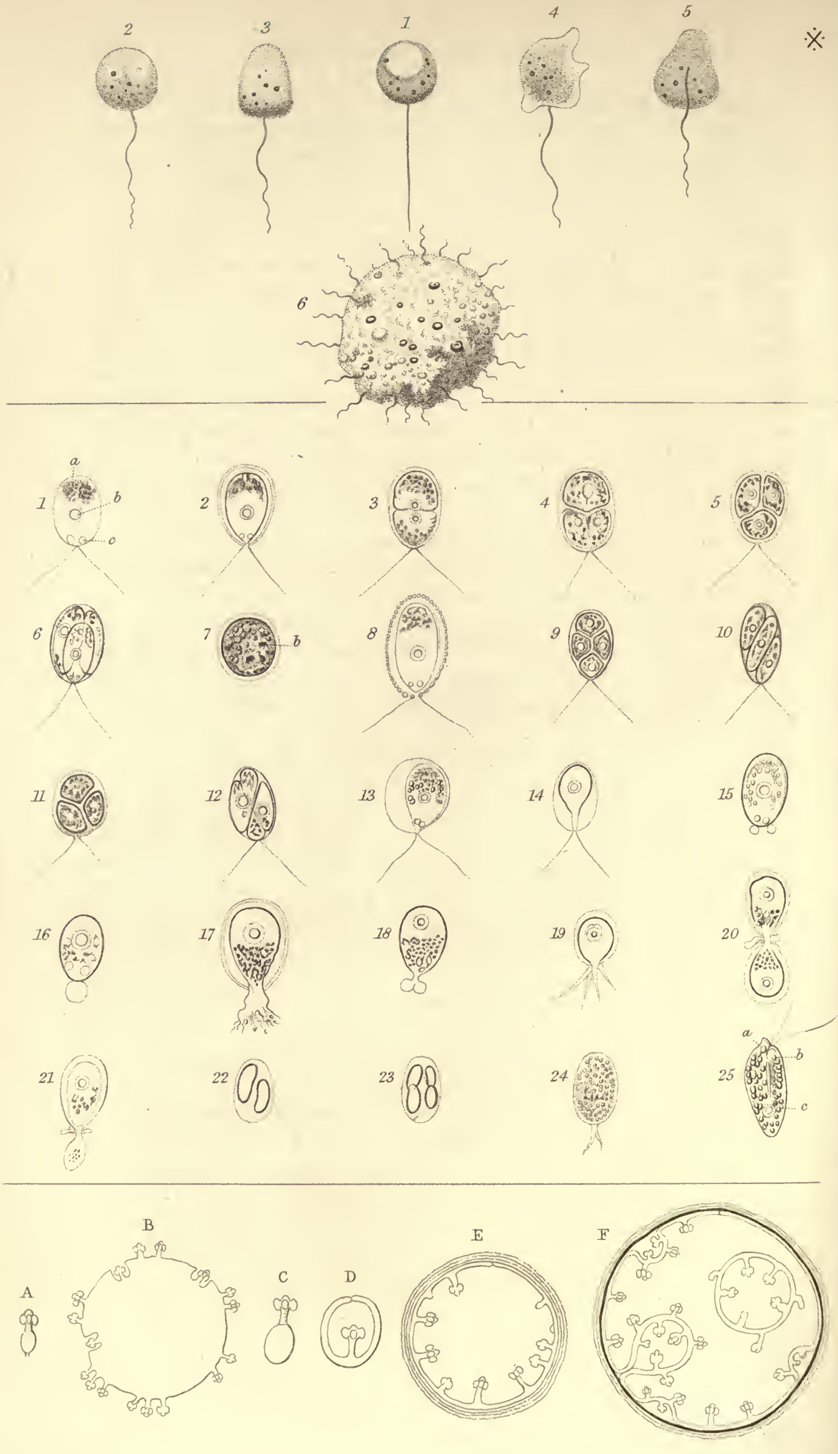
The Rhizopod just described is probably identical with Ehrenberg's *Difflugia Enchelys*. This is characterized as follows:—"D. minima, lorica ovata, dorso rotundato, glabra, pellucida, hyalina, 46 tam lineæ partem longa, processibus hyalinis, tenuibus, parvis, apertura laterali." This description, as well as the figure (tab. IX. fig. iv.), agrees very well with our animal, except the "lateral opening." The form or position of the foot may, however, cause the opening to appear as lying more towards one side.

True double animals of our *D. Enchelys* are frequently met with,—two bodies with membranous cases and nuclei being attached to a common foot (fig. 20). The foot very often consists only of a thin thread, but in other cases it exhibits all the forms which have been described as belonging to the foot of the simple animal. Both bodies are well filled with food. Three, four or five bodies are frequently seen hanging together in the same manner; these however are by no means in the same plane, but stand out from the foot in various directions. If these animals are obtained in considerable numbers, the formation of these colonies by gemmation may easily be observed. The foot is seen gradually to increase in size and acquire an oval form. A new investing membrane and nucleus are then formed. The offset is always equal to the parent animal in size. Like the foot of a single animal, the common foot of two or more is, as might be supposed, still in a condition to form offsets.

A similar adhesion of Rhizopoda has already been frequently observed. Cohn, in his 'Beiträge zur Entwickelungsgeschichte der Infusorien *,' has brought together the instances of this in a note, and conjectures that this adhesion is preparatory to a copulation; but may we not rather suppose that a gemmation like that of *D. Enchelys* also takes place in other Rhizopoda? With Perty and Cohn I have also seen a pair of *Arcella vulgaris* attached to one another by their openings, of which one, exactly as was observed by those naturalists, was provided with a white, the other with a yellow shell. The white shell is probably newly formed, and therefore indicates the young specimen produced by gemmation from its companion.

I have observed another mode of propagation in our *Difflugia*, and although my observations have certainly not been frequent, they have been sufficiently satisfactory. After I had kept a great number of these creatures for some weeks in a clayey sediment, the substance of the body, in all the individuals, contracted into a ball. All foreign substances had previously disappeared. The ball, which had a fatty outline, then divided into

* Siebold und Kölliker's Zeitschrift, iv. p. 261.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J. Basire, sc.

two and four parts, but the nucleus could not be traced during this process. The investing membrane fell to pieces, and the little spheres, which may perhaps be regarded as four quiescent spores, were no more to be seen (Pl. XI. figs. 22, 23).

Whether another circumstance observed by me has any connexion with the reproduction of *Difflugia*, must be ascertained hereafter. In all the individuals of *Difflugia* contained in one vessel, the substance of the body became converted into granules closely packed together (fig. 24), the form and the investing membrane being retained. I often saw these granules in quick molecular movement in the interior of a sac, which appeared to be formed from the outermost layer of the body, but I watched in vain for any issue to this; after moving for about half an hour, the granules always became quiescent again.

If we bring together the results of this investigation, it appears that—

1. *Difflugia Enchelys* has a nucleus.
2. As other Rhizopoda, *Amœba* for example, also possess one, a nucleus probably occurs in all Rhizopoda.
3. *Difflugia Enchelys* propagates by gemmation.
4. It is probable that other Rhizopoda also propagate by gemmation.
5. *Difflugia Enchelys* forms four quiescent spores.

EXPLANATION OF PLATE XI.

Fig. 1. *Polytoma Uvella,* magnified 300 times:—*a*, the starch-like granules; *b*, the nucleus with its nucleolus; *c*, the contractile vesicles.
Fig. 2. The same after long action of chromic acid.
Fig. 3. The same bisected.
Fig. 4. The commencement of the constriction for quadrisection. The direction of the constriction of the other half lies in the plane of the paper.
Fig. 5. The quadrisection completed.
Fig. 6. The divisions have acquired the oval form.
Fig. 7. Quiescent state:—*b*, nucleus.
Fig. 8. The investing membrane divided into granules.
Fig. 9. Another mode of quadrisection. The portions have nearly acquired the oval form before quadrisection.
Fig. 10. Position of the fully-developed young in this mode of division.
Fig. 11. The two halves have slightly changed their position before quadrisection.
Fig. 12. Position of the young in this mode of division. The two lower ones lie across the upper, and appear through them.
Fig. 13. The body occupying only one side of the investing membrane.
Fig. 14. The body is contracted into the hinder portion of the membrane, and only connected with the filaments by a thin thread.
Fig. 15. The filaments contracted into two little knobs.
Figs. 16, 17, 18, 19. Different forms of *Difflugia Enchelys*.
Fig. 20. Adherent specimens of *Difflugia*.

Fig. 21. Commencement of gemmation.
Figs. 22, 23. The body of *Difflugia* divided into four spores.
Fig. 24. The body divided into granules.
Fig. 25. *Chilomonas paramecium*:—*a*, reddish vesicle; *b*, lines indicating the furrows of bisection; *c*, nucleus. The dark granules are starch.

XXX.—*Zoosperms in* Spongilla. By H. J. Carter, Esq.

[With a Plate.]

Having resolved to watch for the antheridia and their spiral filaments, as they became developed this monsoon in the mosses and smaller cryptogamic plants of the island of Bombay, the thought struck me that I might include *Spongilla*, which also grows rapidly a few weeks after the commencement of the rains. I therefore, about the 1st of July, threw several handfuls of *Spongilla*, previously broken up for the purpose, on the surface of the water of a tank which had been dry for some weeks before the monsoon began, and which was now filled.

On the 20th July I visited the tank, and found these portions of *Spongilla* in many places attached to the under sides of dead leaves, and matting up bits of straw and other floating substances under a superficial layer of green, slimy conferva. Some of the portions were an inch long in their new, projecting, mammiform parts.

On examining the structure of the latter internally, I found the old deciduous capsules at the base, but could discover no new ones sufficiently developed to be recognized.

A mammiform projection was then selected, which from its light colour appeared to possess no foreign material, and from this a small piece was cut out, which, having been washed to clear it still further from all impurities, was torn to pieces as much as possible in water, and the whole placed under a magnifying power of 500 diameters.

Here the trembling motion of the fragments of *Spongilla*, always present under such circumstances, was immediately perceived, and on searching more narrowly for the cause of this, it was seen to be owing to minute hair-like filaments in rapid motion, which projected outwards from the sides of the principal masses, very much like cilia. On endeavouring however to find out if these filaments were attached to any definite forms, and selecting for this purpose the smallest and most isolated fragments which presented the tremulous motion, I saw that they consisted in each instance of a spherical cell, to which was attached the hair-like appendage mentioned (Pl. XI*. fig. 1).

On further examination, the cell appeared to be formed exactly like the sponge-cell itself, but proportionally minute in every respect—that is, that granular matter, interspersed with a few granules of much larger size, is spread over more or less of the internal surface of the cell, giving it the appearance at one time of being entirely granular and at another of being only partially so, according as the granular matter is wholly or partially uppermost (figs. 1, 2). Moreover, the cell frequently changes its shape, which shows that, like the sponge-cell, it is also metamorphic (figs. 3, 4, 5). One hair-like appendage only projects from its surface, which, in length, is about three times the diameter of the cell, and occasionally appears to widen at the base, as if it were a prolongation of the cell-wall itself; its motions might be likened to those of a rope, so shaken at one end that the undulations extend throughout, and therefore when used in progression this filament gives to the cell a "serpentine creeping" course.

At first the polymorphism of the cell and movements of the tail are so rapid, that literally, neither "head nor tail" can be made out of the little mass. Presently, however, its power of progression and motion begins to fail, and if separated from other fragments it soon becomes stationary, and after a little polymorphism assumes its natural, passive form, which is that of a spherical cell (fig. 1). During this time the motions of the tail become more and more languid and at length cease altogether.

If, on the other hand, there be very large fragments in the immediate neighbourhood, or an active sponge-cell under polymorphism sweeps over the field, it may attach itself to one or the other of these, when its cell becomes undistinguishable from the common mass, and the tail, floating and undulating outwards, is all that remains visible. Hence many of the larger fragments present more or less of these filaments on their circumference (fig. 6).

To see if any existed on the investing membrane of the surface, or on the lining membrane of the canals of *Spongilla*, a slice including portions of both was placed under the microscopic power mentioned, but none presented themselves, neither was there any motion in the surrounding particles indicative of the presence of cilia.

This cell, which is by far the most active in its movements of any part of *Spongilla*, makes the whole of the fragments tremble, when a portion of the latter is first torn to pieces, after the manner of the swarming, vibrating movements observed in the sperm-cells of mosses, when the fully-developed mass just quits the antheridium. They are about the 1-4300th part of an inch in diameter, and the tail about three times this diameter in length.

Dujardin saw and has figured these cells and their filaments *en masse*, and observed polymorphism in the former, from which he compared them to a *Volvox*, and inferred that the use of the filaments was "pour déterminer à la surface le déplacement de l'eau et par suite les courans dans les oscules" (Ann des Sc. Nat. 2nd ser. t. x. pp. 9, 10). But he did not see these filaments on the surface of *Spongilla*, nor on the lining membrane of its canals, neither have I been able to detect them in either of these situations. Huxley has also described and figured similar bodies in a species of "*Tethya*" (Ann. and Mag. of Nat. Hist. vol. vii. p. 373, 1851), which he considers "spermatozoa;" and I know not what else to consider those above described, if they are not the spermatozoa or zoosperms of *Spongilla*.

The portions of *Spongilla* which were thrown into the tank I had had by me for seven or eight years, and the period during which the ova while in their capsules will retain their vitality, if not some parts of the dried skeleton also, seems almost indefinite.

Bombay, 28th July 1854.

EXPLANATION OF PLATE XI*.

Fig. 1. Zoosperm of *Spongilla* about 1–4300th inch in diameter, magnified; passive condition.
Fig. 2. Ditto ditto active; stationary or progressive.
Figs. 3, 4. Ditto ditto polymorphic.
Fig. 5. Ditto ditto ditto, showing the insertion of the tail drawn forwards by the polymorphism of the cell.
Fig. 6. Portion of Spongilla, magnified, presenting tails of zoosperms in active motion. Natural size about 1000th of an inch in diameter.

XXXI.—*On the Genus* Lycium. By John Miers, Esq., F.R.S., F.L.S. &c.

[Concluded from p. 194.]

3. Macrocope. *Corollæ tubus laciniis limbi brevior: stamina longe exserta.* Species omnes *Neogeæ*.

* *Filamenta imo glandula lineari carnosa margine ciliata donata.*

60. *Lycium filifolium*, Gill.;—inerme, glaberrimum, ramosissimum, ramulis virgatis, cinereis, striatis, nodis cupulatis; foliis alternis, vel subfasciculatis, longe et anguste linearibus, utrinque acutis, crassiusculis; floribus solitariis, gracile pedunculatis, calyce poculiformi, subpubescente, membranaceo, 5–6-costato, 5–6-dentato, dentibus obtusiusculis, ciliatis;

corollæ tubo calyce 3-plo longiore, infra medium coarctato, cylindrico, imo incrassato annulo barbato cincto, fauce ampliato, limbi laciniis 5–6, oblongis, tubo sub-brevioribus, margine ciliatis, staminibus 5–6, in coarctationem insertis, filamentis imo geniculatis, glandula elongata margine dense barbata donatis, superne lævibus, subæqualibus, exsertis; stylo staminibus excedente.—Prov. "Buenos Ayres" Argentinorum. —*v. s. in Herb. Hooker.* (Bahia Blanca) *Darwin,* no. 509. (Pampas, ad Monte de Loro) *Gillies.*

This is evidently a shrub with long slender branches, much resembling *L. vimineum* in habit, but distinguished by a different floral structure: the leaves are 4 to 9 lines long; in Dr. Gillies' specimen they are not more than $\frac{1}{4}$ line broad, in Mr. Darwin's they are $\frac{1}{4}$ to $\frac{3}{4}$ line broad: the very slender pedicels are $1\frac{1}{2}$ line long; the calyx is narrow, somewhat pubescent, and 1 line in length; the tube of the corolla is $1\frac{1}{2}$ line, the border 1 line long; the stamens reach the length of the segments of the border *.

Var. β. minutifolium;—ramulis multo gracilioribus, foliis brevioribus, fasciculatis aut alternis, glaberrimis; calycis dentibus ciliatis; corolla pentamera; bacca parvula, globosa, coccinea, calyce immutato suffulta.—Patagonia (*Tweedie*).

The branchlets here are almost filiform, the leaves 2 to $2\frac{1}{2}$ lines long, $\frac{1}{4}$ line broad, the peduncle is $1\frac{1}{2}$ line, the calyx of similar length, the corolla 3 lines long, and the berry 2 lines in diameter.

61. *Lycium salsum,* R. & P. Fl. Per. ii. 46. tab. 183 *a*; Dunal in DC. Prodr. xiii. 519. L. gracile, *Meyen? Nov. Act. Ac. Cæs. Leop.* xix. *Sup.* i. 389;—biorgyale, subscandens, omnino glaberrimum, ramulis gracillime virgatis, angulato-costatis, spinis acicularibus sæpe munitis: foliis subfasciculatis, spathulato-linearibus, glaberrimis: floribus solitariis pendulis, pedunculo capillari folio longiore, calyce parvo, poculiformi, 5-costato, inæqualiter 5-dentato, dentibus apice ciliatis; corollæ albo-purpureæ tubo brevi calyce longiore, extus glabro, infra medium coarctato, fauce ampliato, limbi laciniis tubo sublongioribus, oblongis, margine ciliatis; staminibus 5 æqualibus, longe exsertis, filamentis in coarctationem tubi sistentibus, circa basin geniculatam fascicula densa oblonga pilorum donatis, istis cum fasciculis totidem tubo adnatis alternantibus.—In Peruviæ litoribus.—*v. s. in herb. Hook.* Lurin et Pachacamac (*Mathews,* no. 450).

* This species with floral analysis is shown in the 'Illustr. South Amer. Plants,' vol. ii. plate 72 B.

This is a trailing shrub with long slender pendulous branches, growing in saline places near the sea, and having much the habit of *L. pendulinum.* The leaves have a saline taste, whence its specific name; they are about 4 lines long, 1 line broad, and veinless; the peduncle is slender, filiform, $2\frac{1}{2}$ to 3 lines long; the tubular calyx is 1 line long, smooth, with five unequal, short, pubescent teeth; the tube of the corolla is $1\frac{3}{4}$ line in length, the segments of the border are somewhat longer, narrow, oblong and subciliated on the margins: the filaments are inserted at a quarter the length of the tube from the bottom, and a little above their smooth geniculated base are furnished with a dense oblong brush of hairs; they reach the extremity of the segments of the border, and are therefore much exserted when the flower is expanded *.

62. *Lycium Chilense*, Miers, Trav. ii. 531; Bertero, Mem. Tur. xxxiii. 133. tab. 44; Dunal in DC. Prodr. xiii. 514. L. nutans, *Pöp.* L. canum, *Gill. MSS. Walp. Rep.* iii. 112;—subinerme, rarissime spinescens, ramulis inermibus pubescentibus, angulato-costatis, lineis helvolis e nodis cupularibus utrinque decurrentibus, foliis alternis, raro subfasciculatis, ovatis vel oblongis, sæpe angustis, subacutis, aut interdum obtusiusculis, imo in petiolum brevissimum attenuatis, integris, utrinque breviter pubescentibus, pilis brachiato-articulatis; floribus solitariis, pedunculo piloso, calyce ad medium æqualiter 5-fido, utrinque glauco-piloso, dentibus acutis, ciliatis; corolla extus valde griseo-pubescente, tubo subinfundibuliformi, 5-sulcato, flavido, paullo supra basin constricto, annuloque dense barbato cincto, limbi laciniis 5, oblongis, patentibus, tubo flavido parum longioribus, intus glabris, versus marginem pallescentibus, centro lilacinis, lineis purpureis notatis; staminibus 5 e medio tubi ortis, subæqualibus, filamentis supra geniculum basalem lævem glandula lineari glabra margine densiter villosa donatis, et cum fasciculis totidem tubo adnatis alternantibus hinc faucem claudentibus, superne glaberrimis, attenuatis et longe exsertis, ovario tubi circumscissi reliquo semi-involuto, stylo staminibus paullo longiore, stigmate sub-2-lobo; bacca ovali, coccinea, apiculata, calyce suffulta.—Chile, præsertim in litoribus.—*v. v.*†

This may be considered as the type of the many South American species, which form a well-marked group, distinguished principally by their peculiar brachiate pubescence, the

* A drawing of this plant with analytical details is given (*loc. cit.*) in plate 72 C.

† This plant with sectional details is shown (*loc. cit.*) in plate 72 D.

hairs being always articulated, often short, and sometimes only visible under the lens: they are also remarkable for the peculiar glandular long adnate scale with fimbriated or barbated margins attached to the lower portion of the stamens, and which by the geniculation of the filaments at their origin, compose a fornix that closes the tube of the corolla: they might almost form a distinct section or subgenus (*Celidophora*). The angles of the branchlets generally exhibit raised reddish-coloured ribs which spring from each side of the bony cupular or bracket-shaped node seen at the origin of each branch or leaf. In this species the leaves are often small, in some cases almost linear, in others ovate, varying from 4 to 8 lines in length, and 1 to 3 lines in breadth: the petiole is almost obsolete: the peduncle is 3 lines, the calyx 2 lines long, which offers the peculiarity of being thickly pubescent within as well as outside; the pointed reflected teeth are a line in length: the tube of the corolla is 2 lines long, the segments of the border 3 lines; the stamens are $2\frac{1}{2}$ lines in length: the scarlet berry is nearly $3\frac{1}{2}$ lines long and $2\frac{1}{2}$ lines broad, and contains numerous small flattened reniform seeds, in which the slender terete embryo makes a gyration and a half, in a spiral form; the radicle, nearly equal in length to the cotyledons, points to the basal angle of the seed, avoiding the lateral hilum. This shrub is very common along the coast of Chile, where it is called *Piquillin*: it is no. 367 of Cuming's collection. I have not seen *L. gracile* of Meyen from the neighbourhood of Coquimbo, referred to this species by M. Dunal, which from the description appears to me to accord better with *L. salsum*, R. & P.

63. *Lycium pubescens* (n. sp.);—ramosissimum, omnino pubescens, ramulis approximatis, horizontaliter divergentibus, spinosis, valde foliosis; foliis minimis, fasciculatis, anguste linearibus, imo spathulatis, utrinque pubescentibus, pilis mollibus articulatis glutinosis fere tomentosis; floribus paucis e fasciculis solitariis, brevissime pedunculatis; calyce urceolato, 5-fido, dentibus linearibus, acutis, corollæ tubo glabro, calyce 2-plo longiore, intus paullo sub faucem fasciculis 5 pilorum staminibus alternantibus donato, limbi laciniis 5, oblongis, margine vix ciliatis, tubo longioribus, staminibus 5, inæqualibus, exsertis, filamentis sub medium tubi insertis, hinc glabris et geniculatis, mox usque ad medium glandula lineari margine hirsuta donatis, superne glabris, 2 longioribus apicem laciniarum attingentibus; bacca parva, coccinea, calyce (laciniis summo conniventibus) cincta.—In Bonaria australi.—*v. s. in herb. Hook. Tweedie* (Patagonia).

This plant was collected by Tweedie in the southern portion of the province of Buenos Ayres, towards the Rio Colorado and Bahia Blanca—a country always denominated by him "Patagonia." It is wholly covered with a dense yellowish pubescence; the leaves are about $1\frac{1}{2}$ line long, $\frac{1}{4}$ line broad, the peduncle 1 line long, the calyx 1 line, the tube of the corolla $1\frac{3}{4}$ line, the segments of the border a trifle longer; the berry is $1\frac{1}{2}$ line in diameter, enclosed by the embracing lobes of the calyx*.

64. *Lycium Patagonicum* (n. sp.);—subinerme, subglabrum, ramosum, ramulis glabris, angulato-costatis, costis helvolis e cupula conspicua axillari utrinque decurrentibus; foliis alternis, rarius fasciculatis, parvis et ovatis, aut longiusculis et spathulato-linearibus, carnosulis, margine incrassatis, interdum glabriusculis et glanduloso-punctulatis, vel sparse pubescentibus, pilis brevissimis rigidis articulatis aut brachiatis, brevissime petiolatis; floribus solitariis, calyce 5-dentato, pedunculoque pubescente; corollæ tubo infundibuliformi, calyce fere duplo longiore, inferne e medio cylindrico, et hinc annulo carnoso crebre piloso extus donato, limbi laciniis 5, oblongis, margine ciliatis, tubo sublongioribus; staminibus in contractionem tubi insertis, filamentis imo geniculatis, et hinc glandula lineari plana glabra margine fimbriata signatis, subæqualibus, exsertis; bacca ovata, coccinea, calyce suffulta.—Patagonia.—*v. s. in herb. Hook.* (St. Elena) *Capt. King.*

A plant much resembling in appearance *L. infaustum*, but decidedly different in its floral structure. The leaves are from 2 to 5 lines long, 1 line broad; the pedicel is $2\frac{1}{2}$ lines, the calyx 2 lines, and the corolla $3\frac{1}{2}$ lines in length; the tube of the latter has five small tufts of hair alternating with the ciliated glands of the filaments; the berry is $2\frac{1}{2}$ lines long and 2 lines broad†.

65. *Lycium scoparium* (n. sp.);—inerme, divaricato- et virgato-ramosum, pilis brevissimis rigidis articulatis et brachiatis ubique hirtulum; ramulis angulato-costatis, glauco-roridis, axillis approximatis, cupulari-nodosis; foliis fasciculatis, anguste vel latiore linearibus, utrinque pubescentibus, in petiolum brevissimum attenuatis; floribus solitariis, breviter pedunculatis, calyce hirsuto, dentibus 5, lineari-acutis, tubo duplo longioribus, sinubus rotundatis, corollæ extus pubescentis laciniis 5, oblongis, patentibus, tubo infundibuliformi paullo longioribus, staminibus exsertis corollæ æquilongis, stylo istis longiore, bacca globosa, coccinea.—In Provinciis Mendozæ et S. Ludovicæ Argentinorum.—*v. v.*

* A representation of this plant with analysis of its flower is shown (*loc. cit.*) in plate 72 E.

† This species with floral section is given (*loc. cit.*) in plate 72 F.

This is an extremely polymorphous species, under which I have united many forms which I formerly considered as distinct species, but as there is little apparent difference in their floral structure they must be regarded as mere varieties. They are all widely spread over the extensive desert plains that skirt the eastern side of the Andes; many even reach the Atlantic: they vary greatly in the shape and size of the leaves even in the same plant, in their more glabrous or pubescent habit, or in a greater abundance or paucity of leaves and flowers. This species is closely assimilated to *L. salsum* and *L. Chilense,* but still more approaching *L. Grevilleanum.* In that variety which I have taken as the type of the species, the whole plant is more pubescent, the leaves linear, somewhat acute, 2 to 5 lines long, $\frac{1}{2}$ to $\frac{3}{4}$ line broad, tapering into a short slender petiole: the peduncle is $\frac{3}{4}$ line long; the tube of the pubescent calyx is $\frac{1}{2}$ line long, its pointed linear teeth 1 line in length; the tube of the corolla is pubescent externally, $1\frac{1}{2}$ line long, the lobes of the border $2\frac{1}{4}$ lines long and $1\frac{1}{4}$ line broad; the nearly equal stamens, 3 lines in length, attain the ends of the segments: the ovary and style are $4\frac{1}{2}$ lines long. I found this plant on the Alto del Yeso, a low mountain range in the province of San Luiz, bordering on that of Mendoza. In this, as in all the other varieties, the stamens exhibit the same peculiar linear gland with fimbriated margins which I have described in the foregoing species, and similar tufts of hair upon the inner face of the tube, alternating with the staminal glands*.

Var. β. *lineare*: the leaves are here more copious, not so pubescent, 6 to 12 lines long, $\frac{1}{2}$ to 1 line broad, but in the same specimen often not more than 3 lines in length: this I collected also on the Alto del Yeso as well as the Coral de Desaguadero in the same province†.

Var. γ. *confertifolium*: here the leaves are broader, oblong, and more glandularly pubescent, 4 to 6 lines long, $1\frac{1}{2}$ line broad; the axils are closely approximated at the extremities of the branchlets, so that the fascicles of leaves appear crowded: the branchlets issue from the branches at right angles, or sometimes curving downwards; the cup-shaped nodes are unusually prominent. I found this variety in the province of Mendoza: it is the same as a specimen in Sir Wm. Hooker's herbarium collected by Dr. Gillies (*L. Hookerianum,* Gill. MSS.‡).

Var. δ. *divaricatum*: a variety greatly resembling the last in its

* This plant with floral analysis is shown (*loc. cit.*) in plate 73 A.

† A figure of this variety with details is given (*loc. cit.*) in plate 73 B.

‡ A representation of this plant with details is given (*loc. cit.*), plate 73 C.

spreading branches and pale stem, with raised costate lines decurrent from each margin of the cupular nodes; the leaves are similar in form, less dense, quite glabrous, with the exception of the younger leaves, which are slightly pubescent; they are 4 to 7 lines long, 1 to 2 lines broad; the berry is globular, of a crimson colour, and supported by the cup-shaped toothed calyx. I found this growing abundantly in the Travesia or desert tract of Mendoza*.

Var. ε. *affine*: ramulis subvirgatis, strictis, pallide pubescentibus, nodis axillaribus valde prominentibus; foliis fasciculatis, oblongis, utrinque acutis, rigidis, pallide flavescentibus, pilis brevibus brachiatis fere stellatis pubescentibus; floribus solitariis aut geminis, longiusculis, pedunculatis, calyce obconico, acute 5-dentato, pubescente, corolla pilosa.—*v. s. in herb. Hook.* (Mendoza) *Gillies sub nomine* L. affine *MSS.*

The leaves have a yellowish hue when dried; they are from 5 to 7 lines long, $1\frac{1}{2}$ to $1\frac{3}{4}$ line broad, the petiole being almost obsolete: the peduncle is erect, 2 lines long, the very pubescent calyx $1\frac{1}{2}$ line long; the tube of the corolla is $1\frac{1}{2}$ line long, thick, and contracted at base, where it is surrounded by a densely tomentose ring; the segments of the border are 2 lines long, oblong, and extremely pubescent†.

66. *Lycium Grevilleanum,* Gill. MSS. (n. sp.);—inerme, ramis griseis, ramulis pallidis, striatis, pubescentibus; foliis e nodis cupulatis fasciculatis, vel solitariis, spathulato-lanceolatis, vel linearibus, apice calloso submucronatis, margine cartilagineo, carnosis, utrinque ramulisque pilis brevissimis rigidiusculis brachiatis pubescentibus; floribus e fasciculis solitariis, pubescentibus, pedunculo tenui, calyce poculiformi, 5-dentato, dentibus acutis, corollæ tubo imo coarctato annulo barbato cincto, infundibuliformi, limbi laciniis ovato-oblongis, staminibus inclusis, inæqualibus, filamentis in coarctationem tubi insertis, hinc glandula lineari lævi margine dense fimbriata donatis, imo geniculatis, inde glabris, 2 faucem attingentibus, 3 paullo longioribus; stylo subexserto; bacca ovata, sicco fusco-brunnea, calyce suffulta.—In Provinciis Mendozæ et Tucuman Argentinorum.—*v. s. in herb. Hook.* (El Tortoral. *L. Grevilleanum, Gill. MSS.*)

This plant is of straggling bushy habit, and grows abundantly in the moist pasturages to the southward of Mendoza. It much

* This is shown with floral analysis (*loc. cit.*), plate 73 D.

† A figure of this variety with sectional details is given (*loc. cit.*), plate 73 E.

resembles *L. scoparium*, and might almost be considered as a variety of that species, which is equally abundant in drier places; it differs however in having the stamens and style much shorter. The leaves are 5 lines to 1 inch long, 1 to $1\frac{3}{4}$ line broad: the peduncle measures 3 lines; the calyx, $2\frac{1}{2}$ lines long, is divided nearly half-way into five narrow acute erect teeth; the corolla much resembles that of *L. Chilense* in form, size, and colour, and is equally pubescent externally, the tube being $1\frac{1}{2}$ line, and the segments of the border 2 lines in length; the tube a little above its base is much constricted, fleshy, and clothed by a densely barbate ring: the stamens are inserted a little above the constricted portion of the tube, where they are geniculated and glabrous; above this they are each furnished with an adnate fimbriated linear gland, forming together a fornix, that closes the mouth of the corolla over the ovary; the berry is nearly 4 lines long and 3 lines broad*.

67. *Lycium erosum* (n. sp.);—inerme, ramosum, ramulis gracilibus, virgatis, pallidis, striatis, nodis cupuliformibus; foliis alternis, lanceolato-ellipticis, acutiusculis, versus basin attenuatis, vel interdum rotundatis, breviter petiolatis, margine erosis, pilisque glandulosis ciliatis, vetustioribus utrinque glabris et punctis minutissimis elevatis albidis rugosis, junioribus pubescentibus; floribus solitariis pedunculatis, calycis laciniis 5 acutissimis subulato-linearibus tubo brevi costato duplo longioribus, margine ciliatis, sinubus rotundatis, membranaceis, corolla cærulea, lineis violaceis venosis, tubo brevi imo coarctato et annulo dense barbato extus cincto, limbi laciniis 5 oblongis tubo 3-plo longioribus, staminibus 5 longe exsertis, filamentis e coarctatione basali orta, hinc infra glandulam dilatatam crassam margine dense barbatam geniculatis, 3 limbo æquilongis, 2 paullo brevioribus; bacca oblonga, calyce suffulta.—Frayle Muerto, Prov. Buenos Ayres.—*v. v.*

Specimens of this very distinct species exist also in Sir Wm. Hooker's herbarium, collected by Tweedie in Buenos Ayres, Uruguay, Entre Rios, Banda Oriental, and the banks of the river Parana. It is readily distinguished by its rather large alternate leaves covered with minute white spots, with its margins always unevenly jagged; they are from 4 lines to $1\frac{3}{4}$ inch long, including the short petiole, and from 3 to 6 lines broad; they are sometimes small and more ovate; the older leaves are glabrous, those in the younger axils are large and generally alternate: the peduncle is $2\frac{1}{2}$ or 3 lines long; the calyx including its segments

* This plant, with analytical structure of the flower, is shown (*loc. cit.*) in plate 73 F.

is 2 lines long; the tube of the corolla is 2 lines, the lobes of its border 3 lines long; the tube is encircled in its constricted part by a narrow densely pilose ring, and is bearded internally between the insertion of the stamens; the filaments are thick, fleshy, and geniculated at their origin below the fleshy glands, which form a fornix closing the mouth of the corolla: the berry is crimson, oval, supported by the cup-shaped calyx with its teeth reflexed; it is 3 lines long and 2 lines broad*.

Species incertæ sectionis.

68. *Lycium Gilliesianum* (n. sp.). L. rigidum, *Gill. MSS. non Thunb.*;—imbricato-ramosum, spinosum, ramulis valde flexuosis, griseo-glaucis, spinis validis, longiusculis, divaricatis, approximatis, foliiferis; foliis fasciculatis, glaberrimis, carnosis, spathulato-oblongis, obtusis, in petiolum brevissimum attenuatis; floribus solitariis aut geminis, pedunculo glabro, folio tertio vel dimidio breviori; bacca ovali, calyce 5-dentato suffulta.—Prov. Mendozæ.—*v. s. in herb. Hook.* Copuncoa (*Gillies MSS.*).

This is a very distinct species, much resembling *L. fuscum*, and in all probability is referable to the same section: the branchlets are very flexuose and thick; the strong axillary spines, which are about $\frac{1}{2}$ an inch apart, and 1 or $1\frac{1}{2}$ inch long, bear fascicles of leaves at intervals of every 2 or 3 lines; the leaves are 4 to 7 lines long and 1 line broad; the peduncle is 2 lines long, the calyx about $1\frac{1}{2}$ line in length; the dark-coloured berry 3 lines long and 2 lines in diameter: flowers are wanting in the only specimen I have seen†.

69. *Lycium Americanum*, Jacq. Stirp. Amer. 50;—frutex orgyalis, elegans, diffusus, ramis teretibus, tenuibus, longissimis, leucophæis, spinis axillaribus, validis et foliiferis; foliis in axillis fasciculatis (3–7), cuneato-oblongis, sessilibus, crassiusculis; floribus solitariis, rarius binis, pedunculatis; calyce campanulato, æqualiter 5-dentato, corolla pollicari, purpureo-albida, tubo infundibuliformi calyce duplo longiore, limbi laciniis 5, rotundato-ovatis, patentissimis, tubo duplo brevioribus, staminibus infra faucem insertis, paullo exsertis, filamentis imo hirsutis, stylo longitudine staminum; bacca pisello minore, obcordato-turbinata, nigra, nitidissima, calyce dimidio breviore suffulta.—San Domingo, in arenosis maritimis.

* A drawing of this species with sectional details is given (*loc. cit.*) in plate 74 A.

† A figure of this plant is given (*loc. cit.*), plate 74 B.

This species seems to have escaped the notice of botanists, although published ninety years ago, as I do not find it included in the lists of any of the earlier authors, nor in Steudel, Walpers, or yet more modern arrangements. The characters given by Jacquin appear to conform with those of *Lycium*: the only genus with which it is likely to be confounded is *Dunalia*. It is described as a handsome shrub with crowded leaves, and its flowers must be the largest in the genus. From 5 to 7 leaves are fasciculated in each axil; they are sessile, tapering from the summit to the base, quite smooth, fleshy, nearly an inch long; the calyx is 3 lines long, the corolla is slender and an inch in length.

Lycia exclusa.

L. aggregatum, *R. & P.*	= Acnistus aggregatus, *Miers.*
L. angustifolium, *Mill.*	= Lycium tenue, *Willd.*
L. apiculatum, *Dun.*	= Lycium cinereum, *Thunb.*
L. arborescens, *Hook.*	= Acnistus aggregatus, *Miers.*
L. Barbarum, *Lour.*	= Lycium vulgare, *Dun.*
L. barbatum, *Thunb.*	= Plectronia ventosa, *L.*
L. Boerhaavifolium, *L.*	= Grabowskya Boerhaavifolia.
L. campanulatum, *E. Mey.*	= Lycium Afrum, *L.*
L. canum, *Gill.*	= Lycium Chilense, *Miers.*
L. Capense, *Mill.*	= Lycium tetrandrum, *Thunb.*
L. capsulare, *L.*	= a genere et ab ordine certe expellendum.
L. Chinense, *L.*	= Lycium vulgare, *Dun.*
L. ciliatum, *Schl.*	= Salpichroma ciliatum, *Miers.*
L. Cochinchinense	= Lycium vulgare, *Dun.*
L. cordatum, *Mill.*	= certe non Lycium ob foliis oppositis cordatisque.
L. cornifolium, *H. B. K.*	= Chænesthes cornifolia, *Miers.*
L. distichum, *Mey.*	= e genere et forsan ab ordine repellendum *.
L. fœtidum, *L.*	= Lerissa fœtida.
L. floribundum, *H. B. K.* (*non Dun.*)	= Acnistus floribundus, *G. Don.*
L. fuchsioides, *H. B. K.* L. fuchsioides, *hort.*	= Chænesthes fuchsioides, *Miers.*

* This plant, found by Meyen in the Cordillera of Southern Peru, has been referred to *Lycium* and *Grabowskya*, but it appears to me that it cannot belong to either: its long simple distichous patent branches, terminating in a spine, indicate an opposition, not an alternation of its axils and leaves; its leaves are described as minute, but not as being clustered or fascicled; the corolla of its solitary flowers is cæruleous, with a large funnel-shaped limb and small erect segments, together with included stamens. There is little here conforming to *Lycium* or *Grabowskya*. In its peculiar habit, its minute leaves, its calyx, the colour and shape of its flowers, it approaches more closely to the curious Bignoniaceous plant which I found in the Cordillera of Mendoza, and which I described under the name of *Oxycladus aphyllus*, a supposition rendered still more probable from the analogous locality of its origin.

L. gesnerioides, *H. B. K.*	= Chænesthes gesnerioides, *Miers.*
L. gracile, *Meyen*	= Lycium salsum, *R. & P.*
L. grandiflorum, *Willd.*	= Acnistus grandiflorus, *Miers.*
L. Guayaquilense, *H. B. K.*	= Acnistus Guayaquilensis, *G. Don.*
L. halimifolium, *Mill.*	= Lycium barbarum, *L.*
L. heterophyllum, *Murr.*	= Grabowskya Boerhaavifolia, *W.-Arn.*
L. horridum, *Thunb.*	= Lycium tetrandrum, *Thunb.*
L. horridum, *H. B. K.*	= Lycioplesium horridum, *Miers.*
L. Indicum, *Retz.* (*non R. Wight*)	= Lerissa fœtida, *Comm.*
L. inerme, *L. f.*	= Plectronia ventosa, *L.*
L. Japonicum, *Thunb.*	= Lerissa fœtida, *Comm.*
L. lanceolatum, *Poir.*	= Lycium vulgare, *Dun.*
L. Loxense, *H. B. K.*	= Chænesthes Loxensis, *Miers.*
L. macranthum, *Buching.*	= Rhizogum trichotomum, *Burch.*
L. macrophyllum, *Benth.*	= Acnistus Benthami, *Miers.*
L. Mediterraneum, *Dun.*	= Lycium Europæum, *L.*
L. megistocarpum, *Dun.*	= Lycium vulgare, *Dun.*
L. Meyenianum, *N. ab E.*	= Lycioplesium Meyenianum, *Miers.*
L. microphyllum, *H. B. K.*	= Lycioplesium horridum, *Miers.*
L. microphyllum, *Duh.*	= Lycium carnosum, *L.*
L. nutans, *Pöp.*	= Lycium Chilense, *Miers.*
L. obovatum, *Buching.*	= Ehretia Capensis, *Meisn.*
L. obovatum, *R. & P.*	= Lycioplesium obovatum, *Miers.*
L. obtusum, *Willd.*	= Chænesthes umbrosa, *Miers.*
L. ovale, *Willd.* L. ovatum, *Willd.*	= Chænesthes cornifolia, *Miers.*
L. ovatum, *Duh.*	= Lycium vulgare, *Dun.*
L. parvifolium, *R. & Sch.*	= Lycioplesium pulchellum, *Miers.*
L. propinquum, *G. Don*	= Lycium Afrum, *L.*
L. pulchellum, *Mart. & Gall.*	= Lycioplesium pulchellum, *Miers.*
L. Quitense, *Hook.*	= Pœcilochroma Quitense, *Miers.*
L. quadrifidum, *Moçino et Sessè*	= Lycium Carolianum, *Mich.*
L. Ruthenicum, *Dun.* (*non Murr.*)	= Lycium Tataricum, *Pall.*
L. scabrum, *N. ab E.*	= Lycium scoparium? *Miers.*
L. salicifolium, *Mill.*	= Lycium Europæum, *L.*
L. salsum, *Bartr.* (*non R. & P.*)	= Lycium Carolianum, *Mich.*
L. serpyllifolium, *Dun.*	= Peliostomum serpyllifolium, *Miers.*
L. Shawii, *R. & Sch.*	= Lycium barbarum? *L.*
L. Sinense, *hort.*	= Lycium ignarum, *Miers.*
L. spathulatum, *R. & P.*	= Acnistus spathulatus, *G. Don.*
L. spathulatum, *Math.*	= Dunalia acnistoides, *Miers.*
L. subglobosum, *Dun.*	= Lycium vulgare, *Dun.*
L. Thunbergii, *G. Don*	= Lycium oxycarpum? *Dun.*
L. Trewianum, *Duh.*	= Lycium vulgare, *Dun.*
L. turbinatum, *Duh.*	= Lycium vulgare, *Dun.*
L. umbellatum, *R. & P.*	= Acnistus umbellatus, *Miers.*
L. umbrosum, *H. B. K.*	= Chænesthes umbrosa, *Miers.*

XXXII.—*On the Occurrence of the Bottle-headed Whale,* Hyperoodon bidens, *Flem., and Remarks thereon.* By William Thompson, Esq.

I have lately had an opportunity of carefully examining two specimens of the Bottle-headed Whale, an old female and a young female, and now forward you a copy of my notes made on the spot. The only work on the British Cetacea to which I have access is that by Professor Bell on the British Mammalia, which includes the Cetacea. In that work I find that the occurrence of the Bottle-head on the English coast is very rare, and British naturalists are enjoined to be very careful in examining any specimens they may have the good fortune to meet with. The pleasant task has fallen to my lot, and I trust the trouble I have taken and the accuracy of my measurements will leave nothing to be wished for on this point. I first carefully measured the larger of the two, and the following results I confidently offer to the notice of naturalists. The whole of the measurements were taken with a tape, and also a two-foot rule. In all cases, unless otherwise particularly mentioned, the measurements were taken from point to point; for instance, in computing the distance from the snout to the blowhole, the tape was drawn from one point to the other, and was not laid along the facial angle. With these remarks I lay before you the measurements.

	ft.	in.
Extreme length from the end of the snout to the fork of the caudal	24	0
Length of the tips of the caudal beyond the fork	0	8
(Thus making the length 24 ft. 8 inches.)		
Length from the end of the snout to the eye	3	10
Length from the end of the snout to the pectoral	6	2
Length from the end of the snout to the dorsal	14	6
Length from the end of the snout and following the line of the belly to the vulva	16	4
Length from caudal to the back edge of the dorsal	7	5
Length from caudal to the vulva	7	6
Length of upper mandible from the tip of the snout to the angle of the mouth	2	4
Length of under mandible from the tip of the snout to the angle of the mouth	2	6
Length of blowhole from tip to tip	0	6
Distance of blowhole from the tip of the snout	4	10
Extent of caudal from tip to tip	6	0
Length of dorsal at its base	1	11
Height of dorsal along its front edge	1	11
Height of dorsal at its back edge	1	2
Length of pectoral, including the portion that is not free	2	10
Breadth of pectoral in its widest part	0	10
(The widest part is 1 ft. 4 in. from the tip of the fin.)		
Length of vulva	2	0

	ft.	in.
Length of eye-opening	0	2
Width of eye-opening	0	$0\frac{3}{4}$
Distance from eye to ear	0	$7\frac{7}{8}$
Depth of the mandibles at the base	0	9
Depth of forehead	1	9
Height of head	2	8
Width of palate	0	5
Width of lower mandible	0	5
Circumference of upper mandible	1	6
Circumference of lower mandible	1	8
Circumference of body at the pectoral	11	10
Circumference in front of the dorsal	11	4
Circumference behind the dorsal	9	10
Circumference at base of the caudal	3	2
The greatest circumference, which was exactly 9 ft. 3 in. from the tip of the snout	13	8

The measurements are very numerous, but I was most anxious to leave nothing undone or in doubt.

In the specimen I am now describing, which is the larger of the two, the forehead is very high and more perpendicular than in Mr. Bell's figure in the 'British Mammalia,' but which otherwise gives a very good idea of the animal; it reminded me of that part in a King Charles's spaniel. The snout was 14 inches in length, rounded at the end; the sides of it were appressed. The palate, as well as the surface of the lower jaw, were crowded with small tubercles, which, as well as the whole of that portion, were extremely hard to the touch; but as the animals were caught the day previous to that on which I examined them, the hardness might have partly arisen from their having become dry: I could not detect anything that would induce me to suppose them to be rudimentary vestiges of whalebone. I sought carefully for teeth, but could find none whatever, neither could I feel any in the gums; they were in fact wanting. Under the lower jaw, the position of the inferior maxillæ is marked by a suture running their whole length and united together at the chin. The tongue was very large, short, and rounded, and reaches to within 13 inches from the tip of the snout; it appears to be a bag of skin, containing blubber and not flesh, and was of a purplish colour. The blowhole is in the shape of a crescent *with the horns turned forwards,* and not backwards as stated in Bell and Jenyns; the orifice is covered with a skin valve. The dorsal, which is very small for the size of the animal, and which can be of but little if any use, is placed considerably nearer the tail than the head; it inclines backwards at an acute angle, and has its posterior edge (which is on a line with the centre of the vulva) much hollowed out. The body for the distance of about 4 feet from the base of the caudal is compressed at the sides, and runs off to a keel on both back and belly. The caudal, which as in all whales is placed horizontally, is not hollowed out to any great extent: by means of a line stretched from tip to tip, I found that in the middle it was hollowed out to the depth of 8 inches. The pectorals are also very small and terminate in an acute angle; they are placed on a line with the under side of the mandibles, and are 3 feet apart; the length of the free portion is about 18 inches. The vulva and the anus are *externally* apparently in one, but in the calf they are quite distinct. The mammæ were small, and measured longitudinally 3 inches; in the middle of each was a hole in which you could insert a finger; they were very short, not half an inch in length, and appeared composed of wrinkled skin; they were placed one on each side of, and in immediate proximity to, the anus. That portion of the vulva which was exposed to view measured 2 feet in length, and was composed of soft wrinkled skin, very baggy and of a deep lead-colour. Milk was oozing from the teats, from which we may infer that the calf was not completely weaned; the milk was creamy and yellowish, apparently very rich. The belly was blackish-gray, deepening to half-way up each side; the remainder of the body was of a dark brown, nearly black; the head and snout are of a much lighter brown than the rest of the body, and have a yellowish tinge. The eye, which is small in comparison with the size of the animal, is of the same size as in the young one. At the base of the snout and of the forehead I noticed some extraordinary markings. The marks consisted of several circles about half an inch in diameter; on the outside these circles were placed most irregularly, some being an inch apart, and others being clustered together and overlying each other. Each circle was composed of eight or ten small circles about the size of a pin's head: the regularity displayed in each circle was such, that at the first glance it appeared as if they had all been made by one and the same stamp; on consideration it struck me that the marks might have been caused by the whale louse, one of which I found on the younger whale.

The whale calf measured 16 ft. 8 in. in length; from tip of snout to eye 2 ft. 6 in.; snout to blowhole 2 ft. 10 in.; snout to blowhole, measured along the curve of the forehead, 2 ft. $11\frac{1}{2}$ in.; blowhole to dorsal 7 ft. 8 in.; the attached end of the pectorals are 1 ft. 7 in. apart; length of vulva 8 in.; distance from vulva to anus $8\frac{1}{2}$ in. No appearance of mammæ. The eye is the same size as in the old whale. The snout is shorter in proportion, and the body darker. The whales had unfortunately been kept too long before they were cut up; one in fact burst, from the quantity of gas that had accumulated, and this was rendered worse in consequence of its not having been bled. The flesh was of a deep red, nearly black, but as it had not been bled, this might have made some difference. The intestines I did not see, but was informed they were not of very great bulk and scarcely filled a wheelbarrow. The blubber laid the thickest at the middle of the body, where it was 3 inches in depth. The forehead under the layer of blubber consisted of a fatty substance very rich in oil; from it ran a large quantity of pure and limpid oil. A quantity of oil ran from the mouth, and falling on the ground coagulated, and had the appearance of salad oil in a frozen state.

They were both caught on the 2nd of October, having run ashore within a few hundred yards of each other in Portland Roads; the calf was first secured.

Weymouth, Oct. 13, 1854.

XXXIII.—*On the Primitive Diversity and Number of Animals in Geological Times.* By L. Agassiz*.

There is a view generally entertained by naturalists and geologists, that genera and species of animals and plants are far more numerous in the present age of the world than at any previous geological period. This seems to me an entire misconception of the character and diversity of the fossils which have been discovered in the different geological formations, and to rest upon estimates which are not made within the same limits and with the same standard. Whenever a comparison of the diversity and number of fossils of any geological period has been made with those of the living animals and plants belonging to the same classes and families, it has been done under the tacit assumption, which seems to me entirely unjustifiable, that the fossils formerly inhabiting our globe are known to the same extent as the animals which live at present upon its surface; while it should be well understood, that however accurate our knowledge of fossils may be, it has been restricted, for each geological formation, to a few circumscribed areas. Comparisons of fossil with living animals ought, therefore, to be limited to geographical districts corresponding in extent to those in which the fossils occur; or, more properly, a fossil fauna with all its local peculiarities ought to be compared with a *corresponding* fauna of the present period, and not with *all* the animals of the same class living at present *upon the whole surface* of the globe. And when this is done with sufficient care, and proper allowance is made for the limited time during which investigations of fossils have been carried on com-

* From Silliman's American Journal of Science and Arts for May 1854.

pared with that which has been almost everywhere devoted to the careful study of living animals, it will be seen that the number and diversity of species peculiar to each special fossil fauna is, in most instances, equal to those found to characterize zoological provinces of similar boundaries at the present day. And this may be said of the fossil faunæ of all ages. In many instances the result is even quite the reverse of what is generally supposed to be the fact, for there are distinct fossil faunæ which have yielded much larger numbers of species, presenting a greater variety of types than any corresponding fauna in the present age. Some examples will justify this perhaps unexpected statement.

The number of species of shells which are found living along the shores of Europe does not exceed 600. About 600 species, again, is the number assigned to the whole basin of the Mediterranean, including both the European and African coasts. Now the most superficial comparison between them and the fossil species which occur in the lower tertiary beds in the vicinity of Paris, shows the latter to exceed twice that number; in fact, 1200 species of fossil shells are now known from the eocene beds in the immediate vicinity of Paris, affording at once a very striking evidence of the existence of a greater diversity and greater number of species at that geological period, even when compared with those of a wider geographical area, than at the present day.

If it be objected that the variety of forms which occur in tropical faunæ is greater than that which we observe on the shores of our temperate regions, and that the temperature of the tertiary period having been warmer we may expect a larger number of fossil species from those deposits, I would only refer to local enumerations of marine shells from several tropical regions to sustain my assertion, that the number of fossil shells from the eocene beds of the *immediate vicinity of Paris,* is much greater than that of any local fauna of the present period, even within the tropics. A catalogue of not quite 300 species of shells given by Dufo as occurring around the Seychelles Islands, the extent of which may fairly be compared with that of the lower tertiary beds around Paris, will suffice to show, that, in a tropical local fauna, the number of species known to exist in the present day is far inferior to the number of species known to have existed during the deposition of the lower tertiary beds in the vicinity of Paris. Another catalogue by Sganzin, of the shells found about Mauritius, Bourbon and Madagascar, gives also less than 300 species for the extensive range of seas surrounding those islands. Let us further compare the results of the investigations of the shells of the Red Sea by Hemprich, Ehrenberg and Rüppell, and there again we find a smaller number, and a more limited variety of types, than are found in the tertiary of Paris; for the whole basin of the Red Sea has hitherto yielded only 400 species of shells. Let us finally take the most accurate survey of this kind that we have of any shore, that of Panama by Prof. Adams, extending over 50° of latitude, 28° N. of the equator and 22° S. of it, including the most favourable localities for the growth of shells in the Pacific under the tropics, and yet we shall find his list exceeding but little the number of 500 species. In this instance, again, we find that the advantage in number and variety is in favour of the tertiary period, and not of the present age. If a different result has been obtained by the estimates made before this, it is owing to the circumstance that the *fossils known from a few localities within narrow geographical limits* were compared with the *living species known to occur upon the whole surface of the globe*. But let us trace these comparisons through other geological periods, with reference to other classes also, and we shall find in every instance similar results. The tertiary fossils of Bordeaux, though less numerous in species than those of the eocene in the vicinity of Paris, will compare with any local fauna of the present period as favourably for variety and number of species as those of the lower tertiaries. This may be said with the same certainty of the tertiary shells of the Subapennine hills, or of those of the English Crag, of which we now possess a very complete list.

If from the tertiary periods we pass down to the cretaceous, do we not find in the deposits of Maestricht, or in those of the age of the white chalk, a number and variety of shells as great as that which may be found on any shore or in any circumscribed marine basin of an extent at all comparable with that of the cretaceous beds within similar limits? Do we not find in the lower cretaceous strata, such as the greensand or the Neocomian, other assemblages of the remains of mollusks, which in number and variety are not inferior to those of the white chalk? The oolitic series, again, will stand a similar comparison quite as well. We need not even take the whole group of those deposits, but consider each subdivision of the jurassic period by itself, and still we find in every one, local faunæ of mollusks, assuming, of course, a different character from those of the cretaceous or tertiary, but nevertheless sufficiently diversified to admit of an estimate, as advantageous, with respect to the points under consideration, and to the local faunæ of the present day, as the cretaceous assemblages of fossils, or those of the tertiary period. Of course, in accordance with the peculiar character of the age, different families prevail in these different periods; the Cephalopoda are extremely numerous, and surprisingly diversified during the cretaceous and oolitic periods; while they dwindle down to a few representatives in the tertiaries, and so with other families. The shells found in the deposits of the new red sandstone period, of the coal period, and of the still earlier ages, are perhaps less numerous on the whole, though they can hardly be said to be less diversified; for the extinct forms which occur among them are quite an equivalent to the variety of families which have lived during more recent periods; and the daily increase of the species found in the different palæozoic deposits shows that, even in point of numbers, those ancient faunæ may, even in the present state of our knowledge, be compared with local faunæ of similar extent at the present day.

Desirous of making the most accurate comparison possible between the *subdivisions* of the palæozoic formations of the State of New York with *local faunæ of similar extent* in the present seas, I have requested Professor J. Hall to furnish me with summary indications respecting the results of his extensive investigations in this field, and I have obtained from him the following statement:—

"I regard the Potsdam and Calciferous sandstone as disconnected with the groups above, forming of themselves with their fauna (not yet well known in this country) a distinct geological period. The entire number of species thus far known in these rocks, admitting all of Owen's species, is, however, only twenty-six.

"The Chazy limestone has 45 species restricted to itself, and one other species which is also known in the Black River limestone. The Birdseye limestone has 19 species restricted to itself, and two others which pass upwards. The Black River limestone has 13 species restricted to itself, and one common to it and the Chazy limestone, one common to it and Birdseye, and one common to it and the Trenton; and one other, which is common to the beds below and above, extending into the Hudson River group," making together 81 species for these three sets of beds.

"The Trenton limestone has 188 species restricted to itself, and 30 species passing upwards into the Hudson River group. The entire number of species known as occurring in the Trenton limestone, including those which occur in rocks above and below, is about 230. This statement includes some species discovered since the publication of the first volume of the 'Palæontology of New York,' and which would make the restricted species about 200.

"The Hudson River group, including Utica slate, has about 60 restricted species, besides those which are common to it and the rocks below, making altogether about 100 species.

"You will observe that the development of life at the Trenton period has been far the most marked, though it is true that this formation is much thicker than either of the preceding limestones, the Chazy being the thickest, and the Black River the thinnest of the three below the Trenton.

"In that portion of the upper Silurian period included in the second volume of the 'Palæontology of New York,' the fossils of the Medina sandstone, Clinton group, Niagara and Onondaga salt groups, amount to 341. Medina and Clinton groups, 123 species. Niagara and Onondaga salt group, 218 species.

"The Medina sandstone and arenaceous beds of the Clinton group contain 50 species, leaving for the calcareous beds of the Clinton group 73 species, which, added to the 218 species of the Niagara and Onondaga salt groups, give 291 species as the total number of species of the calcareous beds of these groups. The Niagara is here the more important period, and though not thicker than either of the others, contains about 200 species restricted to itself. Of the Niagara group 67 species are Corals and Bryozoa. Of the 73 species from the calcareous beds of the Clinton group, 19 are Corals and Bryozoa.

"In the lower Helderberg group, including the Water lime, Pentamerus limestone, Delthyris shaly limestone, and upper Pentamerus limestone, I expect to describe about 200 species, exclusive of Corals and Bryozoa, of which I know already about 50 species.

"The Oriskany sandstone may contain about 60 species of fossils altogether, perhaps less.

"In the upper Helderberg group, which is the next great calcareous formation, I anticipate a less number of species except Corals and Bryozoa, of which there are more than 100 species in New York and the western localities. Of all that is yet known in these limestones besides Corals and Bryozoa, it would be unsafe for me to estimate more than 100 species.

"From the Hamilton, Portage, and Chemung groups I anticipate at least 300 species within New York, and I shall not be surprised if more complete investigations produce double that number in New York and the West.

"The number of species given here I regard as only approximative. I hope this general statement may meet your present requirements, but I regret that I cannot now give you more definite information, particularly regarding the upper Helderberg. I give you from this and the higher groups an estimate based on the species known to me at the present time, but my final investigations always reveal a greater number than I anticipate."

These statements of Professor Hall place already each of the principal groups of rocks of the State of New York in the category of distinct independent successive faunæ, each equivalent to as many local faunæ of the present period; for we may repeat, that the fauna of the Seychelles contains only 258 species, and that of Mauritius, Bourbon and Madagascar, 275. Nay, upon 3000 miles of coast along the western shores of the American continent within the tropics, only twice the number of living species have been obtained as occur respectively in each successive greater subdivision of the palæozoic system within the narrow limits of the State of New York only. (See above the results of Professor Adams's investigations upon the coast of Panama.)

It is a most unexpected and very significant coincidence, that the late admirable investigations of Elie de Beaumont upon the mountain systems have led him to the recognition of nearly ten times as many periods of great disturbance in the physical constitution of the earth's surface as he himself knew twenty-five years ago, each attended by the upheaval of as many mountain chains, differing in their main direction. The investigations of palæontologists having an entirely different character, and founded upon facts which until recently have apparently had only a remote connexion with the other series of phænomena, have nevertheless brought them at about the same time to like conclusions respecting animal life, showing that the periods of disappearance and renovation of organized beings upon the earth have been much more frequent than could be supposed even ten years ago, each set having probably been characteristic of one of those long periods of comparative rest intervening between two great successive geological cataclysms.

What is true of Mollusca may be said of all other classes. Among Radiata, are not the coral reefs of the palæozoic ages as rich in species as any coral reef of the Pacific? Let us even compare the most extensive lists of corals yet given as belonging to any circumscribed locality,—those of the Red Sea as described by Ehrenberg, those of the Feejee Islands as described by Prof. J. D. Dana,—and let us inquire whether the palæozoic rocks of the State of New York do not show as great a variety and as large a number of species in their successive reefs. Again, have not the coral reefs of the oolitic period in Normandy, or in the Jura of Switzerland, and the Alp of Wurtemberg, increased our lists of fossils as largely, and introduced into our zoological works as various forms as are known from any of the most diversified coral regions in the world at the present day?

Passing from the corals to the Echinoderms, the question may be reversed, and it may be fairly asked, whether there is any sea-shore extending over ten and tens of degrees of longitude and latitude, even under the tropics, which has yielded as large a number of those Radiata, as occur in almost any of the geological formations? The number of Crinoids found in the single set of beds known under the name of Niagara limestone, equals the whole number of Echinoderms found around all the coast of the United States. The Crinoids, Echini, and Star-fishes of the oolitic period, or any of the subdivisions of that formation, surpass the number of species of that class which may be gathered around the coast of entire continents in the present day. The diversity of forms of these animals, comparing them with those of the cretaceous periods, is equally great, though the Crinoids begin to diminish in number. But the variety of Spatangoids and Clypeastroids which come into play compensate largely for the diminution of the family of Crinoids.

The type of Articulata may seem, in the present condition of our knowledge, to form an unanswerable objection to the broad statement I have made above, for the hundred thousands of insects which are known in the present creation will hardly allow a comparison with the fossils. But let us examine, upon the principles by which we have been guided in the preceding computations, what is the true state of things respecting the occurrence of Articulata in former geological periods. We can, of course, hardly expect to find worms well preserved in geological formations, on account of the softness of their body, which will scarcely allow of preservation to a greater degree than Medusæ. But a few instances in which impressions of these animals have been found justifies the assertion that they existed as well in former periods as now. The impressions of Medusæ found in the lithographic limestone of Solenhofen, which are preserved in the museum of Carlsruhe, not only carry back the existence of this class to the Jurassic period, but justify the question whether a large number of the fossil Polypi from older periods, which have been described as belonging to that class, are not in reality nurses of Medusæ similar to the *Campanulariæ* and *Sertulariæ* of the present day, which are now known to be no Polyps, but one of the alternate generations of Medusæ. And as for the worms, we find in each geological formation, from the oldest to the most recent, fossil *Serpulæ*, or similar solid cases of worms in as large numbers as we find these animals anywhere at the present day. And where the existence of *Serpulæ* is established by such unquestionable evidence as that of their calcareous cases, are we not justified in the inference that those entirely naked worms which are found everywhere existing with *Serpulæ*, had also their corresponding representatives during former geological periods?

With the class of Crustacea the difficulty in the comparison is already less; for in the tertiary beds of Sheppey there have been found a variety of lobsters, shrimps and crabs, which would favourably compare with the crab fauna of any limited shore in the present day; and I doubt very much whether such a variety of Crustacea could be collected anywhere on a shore of equal extent to that of the white chalk of Sussex, as Dr. Mantell has uncovered in the vicinity of Lewes. For a comparison of the Crustacea of the oolitic period, I would only refer the sceptic to the monograph of the Crustacea of Solenhofen by Count Münster, who has figured from that single locality more species than are known in the whole basin of the Mediterranean, excluding the minute species which have not yet been sought for among the fossils.

In earlier geological ages, during the deposition of the coal and other palæozoic rocks, the class of Crustacea presents a very different character. The gigantic Entomostraca and the extinct family of Trilobites take the place of the lobsters and crabs of later periods. But palæontological works illustrating the fossils of Sweden, Russia, Bohemia, England and France, have made us acquainted with as great a variety of species of those families as are found of the later representatives of the class in more modern deposits. So that among Articulata, the class of Crustacea may be said to have been at all periods as largely represented, and to have shown as great a variety of forms, as occur anywhere within similar limits in the present time.

The carcinological fauna of the whole Indian Ocean scarcely exceeds in variety or number of species that of Bohemia alone, as it is now known by the admirable investigations of M. Barrande.

From their minuteness and general structure, insects might be excepted in such a comparison without affording a sufficient argument against the view I have taken of the subject, even if insects had nowhere been found in large numbers in a fossil state; for it must be plain that their preservation requires more favourable circumstances than the preservation of other animals more largely provided with solid parts. But though the fossil insects have not been sufficiently investigated in all geological formations, have we not several examples which show that in some geological periods, at least, they were as numerous as in the present day? The beautiful monograph of Behrens, of the insects which occur in amber, shows how varied these animals were during the period of the formation of that gum; and the unparalleled investigations of Professor Oswald Heer upon the insects of Œningen and Radoboj have furnished us with means of comparisons which show that, during the deposition of the Molasse of Switzerland, the insects were as numerous and as diversified there as they are anywhere in our day within similar boundaries. And the fragmentary information which we already possess upon the insects of Aix in Provence, and those of Œningen, will justify the expectation that insects will finally be found very numerous in all the geological periods from that of the carboniferous deposit to the present day; that is to say, ever since terrestrial vegetation has had an extensive development. The discoveries by Hugh Miller of true trees in the old red sandstone will justify the prophecy that insects will be found, some day or other, even among palæozoic rocks older than the coal period.

But what of the Vertebrata? Is there not evidence that, at the present day, they are more diversified and more numerous? Here, again, I answer decidedly, No; granting only that there are periods during which the higher classes of these types did not exist, and that therefore, as a type, the Vertebrata of the present day are more diversified; but the individual classes, from the time of their appearance, have been as numerous and even as various in each former period as they are at present.

Let us apply to these the same measure which we have applied to the Radiata, Mollusca and Articulata, to justify this assertion, which seems so completely at variance with our knowledge of fossil Vertebrata. Fishes occur, as is well known, in all geological formations. But should we compare the fossil fishes of each geological period, as they are known from a few localities, with the whole number of fishes which exist all over the world in our day? It would be as unphilosophical as it would be inconsistent with our knowledge of the geographical distribution of animals. Like all other living beings, fishes are located within definite boundaries, and it will be but fair to compare the fossil species of a given locality with the special ichthyological faunæ which occur in different oceans, or in different freshwater basins. Now with this rule we may institute a comparison of the fossil fishes with the living ones, with reference to their number as well as to their variety.

The number of species of fossil fishes known at present from the tertiary deposits, in a single spot, upon the Island of Sheppey, is greater than the number of fishes which have been collected around the coast of any of the islands of the Pacific Ocean, as far as we know the local ichthyological faunæ of those regions; it is as great nearly as the whole number of fishes known from the shores of Great Britain. The same may be said of the fishes of Monte Bolca, or of Mount Lebanon, or of those of the white chalk of England, or of those of Solenhofen, or of those of the lias of Lyme Regis; and if we pass to older deposits, to the old red sandstone even,—thanks to Mr. Miller, and to the investigations of other British and Russian geologists,—do we not know from that old formation as many fishes as from any of the more recent ones, or from any circumscribed marine basin? and is not the variety which occurs among them at each period as great, though of a different character in each, as the variety which occurs at the present day? So that it can be fairly said, that at all periods fishes have presented as great a variety of forms, and as numerous species, as under corresponding circumstances at the present day.

The class of Reptiles will allow similar conclusions; for though the giants of the class have chiefly been studied, do they not indicate an abundance, and a variety of these animals during the upper secondary formations as great as in any tropical region? and have we not sufficient indications among the tertiaries to be justified in expecting that they also will turn out to be more numerous than they are now known to be?

The class of Birds seems to form an exception in this view. But there seems to be particular reason why the bones of birds should be more liable to destruction and decomposition than those of other Vertebrata. And whoever has traced the discoveries made recently among the fossils of this class, will certainly not insist upon a supposed scarcity of birds in former periods, but rather be inclined to admit that the limited number now known is to be ascribed to the deficiency of our knowledge rather than to a want of these animals in earlier formations, indications of their presence having been ascertained for several tertiary formations, for cretaceous deposits, and even for deposits belonging to periods older than the chalk.

Fossil Mammalia are comparatively too well known to call for many remarks after what has been said above. Let us only remember that the number of fossil species found in Brazil alone equals the whole number of Mammalia known to live at present in that country; that the fossil Mammalia of New Holland compare already favourably with the living species of that continent; and that the locality of Montmartre alone has yielded as many large Mammalia as occur all over Europe, and the Mauvaises Terres in Nebraska as many as may be found in North America now. So that, if we grant simply that among Vertebrata the diversity has been increasing with the successive introduction of their different classes, the number and diversity of these different classes at each period have been as great as they are at present.

These facts are of the utmost importance with reference to the great question of the order of succession and gradation of animals in the different geological periods. They cut away for ever one of the arguments upon which the assertors of the development theory have insisted most emphatically. Before it could be granted that the great variety of types which occur at any later period has arisen from a successive differentiation of a few still earlier types, it should be shown that in reality in former periods the types are fewer and less diversified; and we have now shown that this is so far from being the case, that in many instances the reverse is really true. I have already attempted elsewhere to show in outlines what is the real order of succession of the great types of the animal kingdom; I need not therefore repeat here what may be gathered from the diagram at the head of the Zoological Text Book I have published jointly with Dr. Gould. I shall limit myself to a few more general remarks upon the special difficulties involved in a more thorough investigation of the subject.

The study of the order of succession and gradation of the organized beings which have inhabited our globe at different periods, presents indeed difficulties of more than one kind. Unhappily, these difficulties have seldom been all considered in their natural connexion by those who have ventured to consider the subject in its whole extent; thus presenting certain results as general which would require various qualifications to be true. In comparing fossils of one and the same, or of different geological formations, it is in reality not enough to ascertain their true geological horizon, which we may call the *chronological element* of the inquiry; it is equally important that the differences or resemblances arising from the geographical distribution over the wide expanse of the whole surface of the globe, which we may call the *topographic element* of the question, should be also considered, for it is already known that, within certain limits, the same differences and resemblances which are observed at present between the animals inhabiting different parts of the globe existed already in former geological periods. We must therefore become acquainted with the *general biological character* of the epoch as well as with the *local faunæ* of each period. The tertiary faunæ of New Holland and the Brazils, for instance, resemble more closely the living faunæ of those parts of the world than they resemble one another. Our lists of fossils teem with chronological errors of the worst kind, arising partly from false identifications of strata, which in reality belong to different periods, but the fossils of which are thus represented as having inhabited our globe simultaneously, when in reality they may have been separated by long periods of time, and existed upon the earth under very different physical conditions. This chronological confusion is further increased by the too extensive limits frequently assigned by geologists to the successive groups of rocks forming the crust of our globe. For instance, when the cretaceous or the oolitic formations are considered respectively as indivisible natural groups, and the fossils of all their subdivisions are enumerated in one single list as the inhabitants of a long period, an infinitude of anachronisms are presented to the mind, which no special mention of localities can rectify; and until the fossils of each of the natural subdivisions of these formations shall have been grouped together and compared carefully, as I have attempted to do in my Monographs of the *Trigoniæ* and of the *Myæ* of Switzerland and the adjoining countries, or as Al. d'Orbigny has done, upon a much larger scale, in his 'Paléontologie Française,' no correct ideas can be formed respecting the succession of animals and plants characteristic of these long successive periods. I do not believe there is a single palæontologist, whose opinion is worth having, who can suppose at this day that any of the animals, the remains of which are buried in the lias, lived simultaneously with those of the inferior oolite, or these with those of the Oxford clay, or these with those of the upper division of the so-called oolitic formation. The same may be said of the different natural subdivisions of the cretaceous formation, and of the subdivisions introduced of late among the palæozoic rocks, by Sir Roderick Murchison and Professor Sedgwick, and in America by Professor J. Hall.

But even after this separation of the fossils, the synchronism of which may be fully established, our task is only fairly begun, for then must begin the zoological identification of all the species, which must be correct in every respect before general conclusions can be drawn from it.

In the first place, the *specific identity* of organic remains is not so easily ascertained as many geologists would seem to suppose, if we may judge from their statements; but unless the validity of a species is sanctioned by a practised zoologist, it cannot be taken as a basis for sound generalizations in reference to questions of a purely zoological character. The number of false identifications which have been accumulated in geological works is truly frightful. It would, however, be very unjust to accuse geologists in general of inaccuracy on this account, the fault is mostly to be traced to other parties from whom the names were obtained. It should only be understood, that the materials thus accumulated are no longer fit to be used for the discussion of the questions which have been raised with the modern progress of geology, and that a thorough revision of *all* the identifications made in former years is imperatively demanded by the modern progress of palæontology. It would, however, be sometimes amusing, were it not actually distressing, to see the manner in which some geologists deal with fossils, considering them simply as the characteristics of certain rocks, and hardly yet dreaming that there may be such a thing as a special zoology of the different geological periods, and that during each, local faunæ may have existed with peculiar animals, &c. The ideas about characteristic fossils are still very crude, and nothing is more absurd than the complaints about unnecessary multiplication of genera and species; as if both genera and species had not a natural existence, independent of the estimates of naturalists. It would be just as reasonable for astronomers to complain of the great number of stars, as for geologists to object to the investigations of zoologists, on the ground that they lead to the "making" of "*too many species.*"

The difficulty with reference to the identification of species is threefold: 1. different species may be considered as identical; 2. specimens of the same species in different states of preservation, or of different age, or sex, &c., may be considered as distinct species; or 3. the same species may have been described by different authors under different names, and their identity afterwards overlooked by later writers. Who does not see what amount of error may accrue from the indiscriminate use of materials which are not first submitted to a very critical revision in these different respects, not to speak of the general difficulty of agreeing upon the limits of specific differences? With regard to this last point, however, I would say, that any one who in discussing general questions would only use materials revised candidly with the same principles, could not fail to obtain at least uniform results. And when the results of investigations made upon materials corrected in different ways by different authors are compared with one another, if these differences are kept in view, the disagreement in the results would not be found so great as it might otherwise seem. The astronomers and physicists have long learned to correct their observations before using them, and to take into consideration what they call the personal equation of different observers;—are we never to learn from them a lesson in the estimation of our respective investigations, and shall our facts for ever be used without being first corrected for all the possible causes of error and disagreement? As long as there are differences of opinion respecting the natural limits of genera and species, is it not absolutely necessary to reduce or expand the scale applied to the investigations of different authors, when using them for the same purposes, exactly in the same manner as thermometric observations made with the scales of Reaumur or Celsius or Fahrenheit are reduced to the same standard, before being compared.

In the second place, *species must be referred to genera circumscribed within the same limits,* before they can fairly be compared, or at least lead to trustworthy general results. As long as certain bivalve shells of the carboniferous and oolitic series were referred to the genus *Unio,* it could appear that the family of *Naiades* began its existence at a very early period; but since the oolitic species of this kind have been ascertained to differ essentially from our freshwater shells, and to constitute by themselves a natural genus more closely allied to *Crassatella* than to *Unio,* nobody thinks any longer of looking for Unios in *marine deposits.* As long as certain fossil fishes of the Zechstein and Lias were referred to the genera *Esox* and *Cyprinus,* the families of which these genera are the types could be supposed to have extended their range far beyond the tertiary formations, before which however no one of their representatives is to be found. Before the Spatangoids were divided into natural genera, the genus *Spatangus* was mentioned among the fossils of the oolitic as well as the cretaceous and tertiary formations; now it is restricted to the last among the fossils and found also among the living. I do not believe that a single genuine species of *Gorgonia* is found among the fossil Polypi, and yet that genus appears in the lists of fossils from the palæozoic period to the present time.

Since it is not my intention to enter here upon a special criticism of the innumerable errors of this kind still to be found even in modern lists of fossils, I shall not multiply my examples. These may be sufficient to show how important a correct *generic* identification of the fossils may be, in the estimation of the order of succession of organized beings; and I cannot but lament the utter want of consideration evinced even by many distinguished palæontologists in this respect, who seem to think that the knowledge of species is sufficient in itself to a proper appreciation of the order of creation, and that genera are arbitrary divisions established by naturalists merely for the sake of facilitating the study of species, as if the more general relations of living beings to one another were not as definitely regulated in all their degrees by the same thinking mind, as the ultimate relations of individuals to one another.

In the third place, *the natural affinities of genera should be ascertained.* Unless the genera are referred to the families to which they truly belong, unless the rank of these families in their respective classes is positively determined, unless the peculiarities of structure which characterize them are taken as the foundation of such an arrangement, and further corroborated by the mode of development of their respective types, it would be a hopeless task to attempt to determine the order of succession of the fossils in different geological formations. Before the Crinoids which Lamarck placed among the Polyps had been referred to the class of Echinoderms, nobody could have understood the beautiful gradation so fully ascertained now, which may be traced through all geological formations among these animals. Before it was ascertained that the little animal described by Thompson as a living Crinoid, under the name of *Pentacrinus europæus,* for which De Blainville established the genus *Phytocrinus,* is in reality the young of a *Comatula,* nobody could have suspected the wonderful relations which exist between the changes animals now living undergo during their growth, and the order of succession of entire classes of animals during successive geological ages. As long as the natural position of Trilobites remained doubtful in the animal kingdom, the characters of the prototypes of the class of Crustacea could not be appreciated. Who does not see how impossible it was for those who classified the Trilobites with the Chitons to arrive at any sound results respecting the gradation and order of succession of these animals? whilst now they are beautifully linked to the Macrura of the Trias, by the gigantic Entomostraca of the Devonian and Carboniferous periods. Again, the knowledge of the embryology of Crustacea gives us a key to a correct appreciation of the early appearance of the Macrura and the late introduction of the Brachyura. The removal of the Bryozoa from among Polypi to the class of mollusks, will entirely change the aspect and relations of the faunæ of the palæozoic rocks. How different, again, would the order of succession of mollusks appear, were we to adhere to Cuvier's view of separating the Brachiopods, as a class, from the other Acephala, to which they are now more correctly referred. The vexed question of the period of appearance of Dicotyledonous plants in the geological series would have been settled long ago, had it been placed upon its real foundation. It is not in reality to be argued upon palæontological evidence chiefly, for it resolves itself in the main into a botanical question, and the definite answer must depend upon the position finally assigned by botanists to the families of Coniferæ and Cycadeæ. If these natural orders of plants are really allied to the Dicotyledoneæ, then this type begins with the palæozoic rocks in the Devonian system, and there is no gradation in the order of succession of plants during geological times. But if the view of Brongniart is more correct, if the Coniferæ and Cycadeæ have to be separated from the Dicotyledoneæ as Gymnospermæ, and if moreover these latter should prove, as I believe they are, inferior even to the Monocotyledoneæ, then we may at once recognize in the vegetable kingdom a similar gradation of types as among animals. These examples may suffice to show what is required for a proper investigation of the order of succession of organized beings in the course of time, and how little confidence the investigations in this field deserve, which have not been made with due reference to all the points mentioned above. It is indeed only in the classes, the structure and embryology of which are equally well understood, that we are able to discover the laws regulating the succession of animals and plants in geological formations, and our knowledge is still too imperfect to carry the investigation into all families of the animal kingdom. Yet enough is known to leave no doubt as to the final result; we may confidently await the time when the glory of the wonderful order of creation shall be fully revealed to us, and this may stimulate us to renewed efforts, since success depends entirely upon our own exertions.

The geographical distribution of animals only began to be studied long after systematic zoology had made considerable progress, but even to this day the limits of the faunæ are nowhere circumscribed with any kind of precision, the principles upon which they might be determined are in many respects questionable, and a large number of animals are daily described without any reference to their natural distribution upon the earth; though much has already been done since Buffon to place this branch of our knowledge upon a better foundation, and especially to ascertain the laws regulating the geographical distribution of certain classes and families considered isolatedly. The point which now requires particular attention, is the combination of these different types within definite regions, and their common circumscription within natural zoological provinces. This study would be particularly important with reference to the comparison of the local faunæ of former geological periods with those of the present creation; but since the latter even are comparatively little known, we must be satisfied to wait for the time when thorough comparisons shall be possible between the local faunæ of each and all geological periods *inter se,* and with those of other periods.

In closing this digression, I may sum up my criticism upon palæontological investigations by saying, that any generalization respecting the succession of organized beings which is not based upon materials in which the synchronism and succession of species and their geographical distribution are not duly considered, and in which the identification of species is not made with reference to sound zoological principles, with due regard to the equal limitation of genera, and also with reference to our improved classifications in zoology, is not fit to be trusted. All species taken into consideration should undergo a revision with reference to their chronology, their topography, and their zoology; and in the last point of view, the range and natural limitation as well as identity of the species, their generic affinities and their zoological classification, should be equally tested.

Returning now to the main subject of this paper, I have further to say, that the very fact that certain stratified rocks, even among the oldest formations, are almost entirely made up of fragments of organized beings, should long ago have satisfied the most sceptical that both *animal and vegetable life was as active and profusely scattered upon the whole globe, at all times and during all geological periods, as it is now.* No coral reef in the Pacific contains a larger amount of organic debris than some of the limestone deposits of the tertiary, of the cretaceous, or of the oolitic, nay, even of the palæozoic periods; and the whole vegetable carpet covering the present surface of the globe, even if we were to consider only the most luxurious vegetation of the tropics, and leave entirely out of consideration the whole expanse of the ocean, as well as those tracts of land where under less favourable circumstances the growth of plants is more reduced, would not form one single seam of workable coal to be compared to the many thick beds contained in the rocks of the carboniferous period alone.

XXXIV.—*Memoranda of Observations made in small Aquaria, in which the Balance between the Animal and Vegetable Organisms was permanently maintained.* By Robert Warington, Esq.

Fresh Water.

Memorandum 1.

In my communication, dated September 1852*, I gave a detailed account of my observations on the thread or web which some species of the freshwater snail form to effect or facilitate their passage from one spot or object to another, and thus either ascending or descending by its means; and the instances noticed up to that period had reference only to the varieties of the *Limneæ*. In continuation of my observations on the same subject, I have now to state that the varieties of *Planorbis*, as also *Neritina fluviatilis* and *Physa fontinalis*, have, since that date, been noticed to possess the same power; and in the case of the latter, *Physa fontinalis*, the thread or web was so tough and strong, that on one occasion I was able, by means of a small rod introduced between the creature and its point of attachment, to move it out of its straight course a considerable distance, and by then slowly drawing the rod upwards, I succeeded in raising the snail completely out of the water a space of about 7 inches, suspended by its thread, so that, under these circumstances, the thread itself became distinctly visible.

From the observations which I have been enabled to make, I consider that I am justified in stating that all the freshwater snails are possessed of this power.

Memorandum 2.

As an evidence of the permanency of the balance capable of being established between the animal and vegetable organ-

* Annals and Magazine of Natural History, Oct. 1852.

isms by the introduction of the water-snail or other phytophagous mollusk, as I have elsewhere described*, I may state that the same water in which my original experiments were made in March 1849 has been in continual use up to the present time, several fish living constantly in it, without disturbance, and that it is now as bright and in as healthy a state as at the first period of its being employed.

Again, in a small jar of about one pint capacity, having a single plant of *Vallisneria spiralis* growing healthily in it, and with a few small water-snails as scavengers, I succeeded during the spring of 1853 in hatching and rearing a young trout. The egg was obtained from Mr. S. Gurney, jun., and had been removed from his preserves in the river Wandle; the shell ruptured the day after my receiving it, and it was maintained in a perfectly healthy state during the whole of the period required for the development of the respiratory organs, and the complete though gradual absorption of the ovum. This development was perfected in fifteen days from the bursting of the shell, till the period that the fish could sustain itself continuously in the water and was able to swim strongly. Having arrived at this stage of maturity, the vessel became far too small for the free use of its active powers of locomotion, and it was therefore transferred to a small tank containing several minnows, when to my great annoyance it was immediately seized and devoured.

As another instance of the voracity of the finny tribe and their destruction of each other, I may mention here that I had on a previous occasion placed several small trout fry overnight in an aquarium containing some gold-fish, but they must have been rapidly preyed upon, as no trace could be seen of them the following morning. These facts will demonstrate clearly the havoc which must take place in the rivers and streams among the young fry of various fish under ordinary circumstances, when they are proved to be devoured with such extraordinary rapidity even by such species as the gold-fish or carp tribe and the minnow.

Memorandum 3.

Care should be taken in the aquarium for fresh water to exclude the ordinary Polype or *Hydra fusca*, particularly where certain species of fish are to be preserved, as with the minnow (*Leuciscus Phoxinus*), for these creatures, insignificant as they may appear, after a short time cause their death, and that under most extraordinary circumstances, as the following observations

* Quarterly Journal of the Chem. Soc. for April 1850, vol. iii. p. 52.

will tend to show:—In a small aquarium that had had gold-fish kept in it for a length of time, but which had been removed into one of larger dimensions and more fully exposed to the light, an enormous number of the *Hydra fusca* were observed to have made their appearance very soon after this removal. Wishing therefore to ascertain if the appearance and rapid increase of these polypes had been prevented by the gold-fish, the following experiments were made:—Fifteen individuals of the *Hydra fusca* were placed in the aquarium containing the gold-fish, but they very soon disappeared, having I presume been devoured by the fish; a second fifteen were then introduced, but with the same result. At the same time as this experiment was made, fifteen hydras were placed in a tank containing four minnows (*Leuciscus Phoxinus*) and a pair of small eels, but as the minnows did not appear to touch them, the same number of polypes being counted over several times during a period of three weeks, they were soon forgotten altogether. After a space of about seven months had elapsed from this time, the minnows were observed to assume a most extraordinary aspect, the head appeared very much swollen, and the eyes of all of them looked as though starting out of their heads, being forced upwards and in an outward direction and much enlarged; by degrees the gills of some of them became streaked with bloody markings, and this gradually extended to the base of the pectoral fins. The whole appearance was most distressing to contemplate, particularly as it was impossible, from ignorance of the cause, to adopt any remedial measures. Judging from their appearance my impression was that they had been poisoned, and assuming that it must have arisen from something putrescent which they might have raked out of the materials at the bottom of the aquarium, the whole of the water was drawn off clear by a siphon, the gravel and sand thoroughly washed, and everything replaced in the tank with the fish; no improvement however appeared to follow, the fish got worse and ultimately died. This was in June 1853. Before this extraordinary change came on, the fish had been observed to cluster together in one particular secluded spot, and rarely came out as they had been accustomed to do, and when they did venture forth they rubbed or jerked themselves with much force against the gravel and rock-work, as though something was irritating the skin; nothing however was visible. I had had these fish for about eighteen months in the same aquarium. As the water was perfectly bright and clear, and free from all odour or unpleasant taste, I procured six fresh minnows and placed them in the tank; for about ten days they appeared to be pretty healthy; they did not however swim about freely, but herded together in one corner of the aquarium, and then the same extraordinary change gradually came on which had been observed in the others, and after lingering for seventeen days they all died. On carefully scrutinizing the different parts of the tank with a magnifying-glass, my attention was at once arrested by observing the enormous numbers of the *Hydra fusca* which were present, particularly on the parts of the aquarium where the fish had been accustomed to feed; that is, along the water-line towards the light, at the base of the plants of *Vallisneria spiralis*, about half an inch above the gravel, and on the whole of the rock-work around the space where the minnows delighted to hide; here they might have been seen stretching out from the sides, hanging down from the top, in fact in every possible direction—here then was a solution of all the evil. It now became a question how these pests were to be eradicated, and after canvassing in my mind a variety of suggestions, I determined to endeavour to remove them individually, and by this means they were speedily got rid of; from fifty to a hundred being taken out daily. The method by which this operation was effected was as follows:—A long glass capillary tube open at both ends was introduced into the water, having the finger kept tightly over the upper orifice, while, with the edge of the lower opening, the polype was detached from its hold; the moment this was effected and the hydra began slowly to fall through the water, the finger was removed, and the water with the polype was thus rapidly driven into the tube by the pressure of the external column of water; on replacing the finger the contained water and polype were removed. By persevering in this course they were caught with the greatest rapidity and dropped into another vessel before they had time to attach themselves to the interior of the tube, falling through the water like a miniature parachute. When situated in places where this mode of capture could not be employed, as on the leaves of the Vallisneria, or on the under sides of the rock-work, they were pulled off with a jerk by means of a small pair of forceps. In this manner between four and five hundred polypes were removed from a small aquarium holding about six gallons of water. Since this some small carp and also minnows have been placed in the same water, and have continued now for upwards of sixteen months in perfect health.

It is a curious problem as to the manner in which this destruction of life was brought about; my own impression is that the hydras seized on the minnows whenever their extended tentacula were touched by the swimming fish,—stinging them, and causing a great degree of irritation; and that the polypes were torn from their position by the greater strength of the fish and carried to their places of retreat, where, by consequence, the mischief was continually accumulating. A similar removal from one place to another of an analogous creature, the young of the *Actinia*, takes place in sea water, from their attaching themselves by their tentacula to some moving denizen, the hold being released very soon after they are forced from their original attachment.

Sea Water.

Memorandum 1.

In my previous experiments in this branch of the subject, commenced in January 1852*, and of which some results were communicated to the British Association at their meeting last year at Hull †, I stated that the result of my experiments to ascertain the kind of sea-weed best fitted for maintaining the balance with the animal life was, under ordinary circumstances, in favour of the Chlorosperms, and that the Rhodosperms submitted to the like conditions did not answer the purpose desired and at the same time retain their colour and beauty, inasmuch as they very soon became coated with a growth of short green and brown Confervæ (*Conferva tortuosa*?), which entirely mantled the whole surface of the fronds and destroyed their characteristic appearance. During these investigations, however, it occurred to me that it might be possible to obviate this drawback, and I have, I believe, succeeded, after a series of experiments, in overcoming this inconvenience, and can now retain them in all their natural loveliness and render them quite efficient for all the purposes required, that is, as consumers of carbonic acid and generators of oxygen.

The ground on which I have reasoned as a basis for these experiments has been the consideration, that nearly the whole of these red or pink-coloured sea-weeds are found either in deep water or under the shade of other Algæ, and from the fact that they were also often known to occur in shallow rock-pools; it was hence fair to assume that the pressure of the column of water could not be an important element in the production of these coloured growths, and therefore that it must depend upon a modification of the light. Hence my idea was that the effects of the depth of the water might be capable of being imitated by tinting the light through the interposition of coloured media, and thus all the results observed in the vegetation, and much even of the healthy animal life of deep sea water could be, under this arrangement, assimilated; and this, I am happy to state, has proved experimentally to be the case, so that, by very

* Garden Companion, January 1852; and Annals and Mag. Nat. Hist. for October 1852.

† Annals and Mag. Nat. Hist. November 1853.

simple means and with very little trouble, we shall be enabled to grow and preserve these elegant and beautiful plants in all their varied hues, as well as many of the wondrous forms of animal life usually found associated with them, for any length of time; and thus a much enlarged field for observation will be brought within the limits of our aquarium.

In order to obtain this desideratum, a medium having a blue or green tint has been had recourse to, and of such a nature as merely to colour, soften or diffuse the light, without materially diminishing its quantity. This was at first accomplished by the employment of a thin film of paint of the desired shade, of a thin silk gauze of a blue colour, by layers of tissue paper tinged blue and green, sometimes oiled to render them more transparent, at others the sheets of paper being superposed until the desired effect was produced, or by coloured varnishes, blue, and blue and yellow, and mixed to the tint required. These materials should be applied to the surface of the glass, or interposed between the source of light and the water, in such a way, that the whole of the light which directly illuminates the aquarium may be tinted of the proper colour. In proportion to the quantity of light at command and the varying aspect to the sun's rays, so must the transparency of the colouring medium be adjusted. In my own case I have been obliged partially to employ coloured glass, as the other methods were found to impede too much of the direct light; but it must be borne in mind that this is in the midst of a crowded city, in a smoky atmosphere, and surrounded by tall houses. To such an extent has this plan succeeded, that several small attached pieces of delicate red seaweed which I had received in October 1852, and had become thickly mantled with the brown and green confervoid growth already alluded to, and which had not exhibited the least signs of vitality, on being placed in a small glass jar arranged with tinted and oiled tissue paper, soon lost the whole of this parasitic growth, from its gradually decaying and being then consumed by the mollusks, the fronds assuming their deep crimson hue, becoming perfectly clear, and even after so long a period throwing out numerous young shoots or leaflets; and on one of these pieces several beautiful specimens of the *Coryne sessilis* made their appearance, together with groups of Lepralia and corallines.

Memorandum 2.

Another very interesting experiment that I have had progressing very successfully for some time past, is the preserving sea water in a perfectly transparent and healthy state without the use of vegetation of any kind, or, in some cases, even of a scavengering mollusk. The adoption of these experiments was in a great degree forced upon me from circumstances which have been already published. In the paper read before the Meeting of the British Association at Hull, I stated that in consequence of the ravenous propensities of the crabs and the varieties of rock-fish, I had been obliged to establish several small imitation rock-pools, so as to separate these various depredators from each other; and as some of these, the blennies, also attacked the common periwinkle and other mollusks which were employed as scavengers, the plant or vegetation consequently became of little use, and was therefore omitted altogether from the arrangement. It may be asked then, how can the sea water under such circumstances be possibly kept in a healthy state? Why, thus: by exposing a very extended surface of it to the action of the air, and at the same time limiting its depth. The means that I have been adopting for upwards of twelve months consist in the employment of shallow circular stone-ware pans of about eighteen inches internal diameter by five inches deep; these are filled for about two inches with water, the bottom is supplied with sand and shingle, and numerous fragments of rock-work are arranged at the sides, some close below the surface of the water, others rising in gentle slopes above, and others again grouped to form cavities of retreat, so as to accord with the habits of the crabs, blennies, &c. placed in them. The whole is covered with a sheet of common window glass, raised about one-fourth of an inch from the edges of the pan by means of slips of wood, so as to allow a free current of air over the surface of the water, and at the same time impede the evaporation and prevent the greater part of the dust and soot from settling on it. By this arrangement a very extended surface of water is submitted to the oxidizing influence of the air, and the fish and crabs by their continual movements cause sufficient motion in the fluid to expose a fresh surface frequently to its action and thus keep up its aëration. But it must be borne in mind, that the oxygenation of the water thus effected is a very delicate equilibrium, and the maintenance of a healthy aëration is liable to be disturbed by very slight interfering causes; nor do I conceive that this method would be applicable except to such marine denizens as are either of such low organization as to require but little aëration of the water, or to such as the crab tribe, the blennies, cotties, gobies, and those creatures which delight in very shallow water, or which have the power of climbing out of their liquid element. The varieties I have myself kept in perfect health for the period mentioned, are crabs, blennies, gobies, cotties, and varieties of Actinia. *Cancer Mænas* has under these circumstances cast its skin three times during the present year, having increased in its dimensions most extraordinarily each time.

Memorandum 3.

The form of aquarium which, after upwards of five years' experience and observation on the natural habits of the various animated tenants, I have now adopted, consists in a four-sided vessel having the back gradually sloping upwards from the bottom at an angle of 45 to 50 degrees, and the consequently extended top sloping slightly downwards and resting on the upper part of the back. The bottom, therefore, becomes necessarily narrow. The front for the purposes of observation, and the top for the admission of light, are to be of glass; the back, ends, and bottom being constructed of slate; the whole fixed in a stout framework.

The advantages of this arrangement are:—

First. That it allows of a most extended view of the whole interior of the aquarium.

Secondly. That it enables the occupants to resort to water of any depth they may desire, or even to ascend the sloping back and emerge from the water.

Thirdly. It admits of a much larger surface of water being exposed to the action of the light; and

Fourthly. The sloping top allows the water which condenses on the glass, from the effect of radiation, to trickle off and return to the aquarium without first resting on the zinc or iron framework.

I need hardly mention that the sloping back is to be covered with light rock-work extending to a short distance above the water line.

XXXV.—*On a Mode of giving permanent Flexibility to brittle specimens in Botany and Zoology.* By Prof. J. W. Bailey, U.S.*

The excessive fragility, in the dry state, of many plants, and particularly of those which secrete carbonate of lime, is well known to botanists. There is no herbarium in existence in which the specimens of *Amphiroa, Jania, Corallina, Halimeda, Liagora, Chara,* &c. are not in a more or less mutilated condition, which becomes worse every time the plants are examined. In studying a large collection of the stony Algæ I was led to remark their perfect flexibility while moist, which passed to great brittleness when dry, and it occurred to me that if they could be kept permanently moist they would remain permanently flexible. I then remembered that General Totten, of the U.S. Engineers, had mentioned to me, some years ago, his success in preventing the cracking and peeling-off of the epidermis of various shells, by impregnating them with chloride of calcium. I also remem-

* From Silliman's Journal for July 1854.

bered Boucherie's experiments with the same substance in giving flexibility to wood. The principle that *a substance which is flexible when moist, will remain permanently moist, and therefore permanently flexible, when impregnated with a deliquescent salt,* is so obviously true, that it needed no experiments to convince me of its applicability to the fragile plants above mentioned, and to many other specimens in natural history; but as practical difficulties often occur in the application of correct principles, I have tested the process by numerous experiments in which chloride of calcium was employed to give flexibility to various vegetable and animal products, and the results have fully equalled my expectations. My specimens of *Amphiroa, Jania, Corallina,* &c., after being impregnated with this salt, and then exposed for months to the air, can be handled as freely as if just taken from the water, and they permanently retain nearly the utmost degree of pliability they are capable of receiving. Species of dry, crisp and brittle Lichens when treated in the same way became soft, elastic and flexible, so as to bear very rough handling with perfect impunity. Many of the common Algæ which shrink much in drying, and therefore assume a very unnatural appearance, and besides are apt either to become cracked or torn, or to wrinkle up the paper to which they adhere, retain after immersion in this salt nearly their normal degree of distension, and preserve a much more natural appearance than when dried in the usual way. Many dried specimens of plants, whose leaves, flowers or fruit dropped off almost at a touch from specimens in my herbarium, became permanently pliable when immersed for a short time in a solution of chloride of calcium, and could then at any time be handled freely, while their appearance was in no degree injured.

In the animal kingdom, the results obtained in restoring permanent flexibility to dry and brittle specimens of Crustaceans, Insects, Gorgonias, Sponges, &c. were equally satisfactory, and have convinced me that almost every naturalist will, in his own department, find many useful applications for this process.

The *mode of application* which I have employed is to immerse the dry specimen for some time in a neutral saturated solution of chloride of calcium (which any one can make for himself by saturating hydrochloric acid with marble), and then after the specimen has become sufficiently softened to bend easily, remove it and let it drain in the open air. In some cases where the specimens do not imbibe the salt readily, it is well to soften them in warm water before immersion in the salt. A speedy impregnation will then take place, after which the specimens, if plants, may be subjected to moderate pressure in the usual way, and restored to the herbarium; while other specimens may be kept on shelves, or in any way usually employed for similar objects, and all will for any length of time retain sufficient moisture to prevent brittleness. The salt being neutral, no fear need be apprehended of its injuring colour or texture, while its antiseptic properties will aid in the preservation of matters liable to decay.

BIBLIOGRAPHICAL NOTICES.

A Manual of Natural History for the use of Travellers. By ARTHUR ADAMS, W. B. BAIKIE, and CHARLES BARRON. London, 1854. Van Voorst. 12mo.

"THE design of the following pages," say the authors in their preface, "is to endeavour to supply what seems to be a blank in the scientific literature of this country, for, although numerous treatises exist upon every branch, yet no work has hitherto appeared, comprising either succinctly or in detail, a comprehensive outline of natural history. It may appear presumptuous," they add, "on the part of the authors to attempt to grapple with such an extensive range of subjects"—and we regret to say that a careful examination of the book only shows us how well founded was this fear. There can be no doubt, in fact, that the authors have entirely miscalculated their strength, or they never would have attempted so arduous an undertaking. This is the more to be regretted, as we fear that a work with the above attractive title, brought out under the auspices of a publisher so well known for the first-rate character of his publications, will inevitably to a great extent preoccupy a place in our scientific literature which might be much more creditably filled.

The authors have fallen into an error in their very first step,—the general design and scope of the work. Let us first see what are the objects of travelling, or indeed of any, naturalists, and the conditions to be fulfilled by a 'Manual' intended for their use, and we may afterwards consider how far their wants are supplied in the work before us. The study of Natural History may safely be divided into two branches—the collection and arrangement of species, and the study of the structure, habits, and general classification of the numerous creatures inhabiting our planet. The same person may undoubtedly combine the study of both branches, but they may nevertheless be regarded to a great extent as distinct, and capable of being carried on independently of each other; accordingly we find that works on natural history are generally directed exclusively to one or other of them. Now the collector of species, whether for sale, or for his own personal gratification, desires, if possible, to ascertain the actual specific names of the objects which come in his way, their comparative rarity and so forth, so that nothing short of a "Species," or at all events a "Genera," with copious information as to the geographical distribution of the species, can serve his purpose. The reader need but reflect on the voluminous works devoted to description of portions only of the organic kingdoms of nature, to be convinced that an attempt to bring together all the species, or even genera of animals and plants within the compass of anything short of a small library, must prove an entire failure. The observer of structure and habit, on the other hand, requires a guide-book through the intricacies of his subject, a compendious account of the actual state of science, a something to tell him what to observe, and to prevent his falling into the errors to which isolated observers are so liable, but which the light accumulated by the labours of his predecessors may to a great extent enable him to avoid. Such a work as this is still a desideratum in English scientific literature, for the labours of the present authors have been directed to quite another result. They have in fact fulfilled neither of the conditions which we have already seen to be necessary in a 'Manual of Natural History,'—their work is a bare sketch of a classification carried as far as the natural families, dealing no further with the structure of animals and plants than as it furnishes characters for the foundation of groups; it may in fact be defined as an engine for *naming* natural objects, which carries the student just half way, and then leaves him to find the remainder of the road by himself.

This objection would have applied with less force, had the space at the commencement of each of the larger divisions (of the animal kingdom at least), now devoted to a series of desultory generalities, not always perfectly correct, been made use of to furnish the reader with some general views of the *natural history* of the creatures under consideration; but as it is, the observer who may witness any isolated fact in the history of an animal, even should he be able to ascertain the family to which it belongs from this book, can never hope to find in it any clue to the series of phænomena with which the fact observed may stand in connection.

Before proceeding to examine the details of the book, we have to protest against a piece of pedantry which pervades the whole, and for which the authors appear to consider themselves deserving of great credit,—we allude to the practice of giving what are called English names to the different groups. If indeed good genuine English names could be invented for every group and species of animals and plants, we should have nothing more to say upon the subject, but we entertain the very strongest objection to the absurdities generally palmed off upon us under this title, and in this respect the present work is not one whit superior to its predecessors. We meet with the same attempts at Anglicizing by simply altering the termination of words from *a* or *æ* into *ans*; whilst the necessity for manufacturing names for so many minor groups has produced an infinity of multi-verbal combinations, which we should think would tend rather to repel than to attract a beginner. We cannot imagine a mind so constituted as to find such names as "Long-legged herbivorous Beetles," or "Hard-skinned serricorn Beetles," more expressive and easy of recollection than the corresponding scientific terms "Eupoda" and "Sternoxi;" and in some cases the English names are positive misnomers, as for example the term "Gill-lunged Batrachians," applied to those singular members of the class Batrachia in which gills and lungs are coexistent in the mature state.

We have devoted so much space to the consideration of the general characteristics of this work, that we have but little to spare for particular instances of the authors' sins. We must however select a few, if only to show how little dependence can be placed upon their judgment, even in making use of the materials which lay ready to their hands. Thus we find amongst the Annulosa, a class of Epizoa, or Fish-parasites, including Crustacean families, *Lernæidæ*, *Caligidæ* and their allies, and a miscellaneous assemblage of Helminthoid forms. Amongst the latter are included the *Linguatulidæ*! The entire group of Radiate animals also is a most extraordinary jumble. We find the Rotifera placed in this division, between the Acalephæ and the Polyzoa!; these are followed by the Cœlelmintha, these by the true Polypes, after which we come to the Sterelmintha, or Cestode and Trematode worms. That such an arrangement as this should have occurred to any one engaged upon a Manual of Natural History, will, we should think, excite a little surprise in the reader's mind.

Amongst the Sterelmintha we find an order of Cystic worms, without a single hint of the extraordinary discoveries of Van Beneden, Vogt, Siebold and others, which have now proved the cystic worms to be merely phases in the development of the Tape-worms. In like manner the wonderful mode of reproduction prevailing amongst the Medusæ, which has given rise to Steenstrup's theory of the "Alternation of generations," is passed over without a word of notice; but as if to make up for the absence of information for which the reader might reasonably look, we are favoured with some statements concerning the Acalephæ, which certainly have the merit of novelty to recommend them. Thus we learn for the first time, and we must confess not without surprise, that *Cydippe* is "often seen . . . making its way slowly by the regular contraction and expansion of its umbrella-like body." In *Beroë* we are told, "the organs of progression are in the form of long filaments, which enable their possessors to roll along through the water in a very rapid manner;" and Mr. Huxley will be astonished to learn, that "those curious double gelatinous animals, the *Salpæ*," are placed "in the Diphydous order." These statements all occur within the compass of a single page (page 336)! We do not pretend to say that this is an average sample of the work, but there are certainly few pages of the Zoological portion in which some errors are not to be met with.

Of the Botanical portion we need say but little, the authors themselves admitting that they have employed "a slight modification of the scheme offered by the learned author of the 'Vegetable Kingdom.' The only modification that we can perceive is, that they have reversed the learned Doctor's arrangement, and raised his "Alliances" to the rank of "Orders." The characters of the families (Orders, Lindl.) appear to be copied almost verbatim, except the omission here and there of characters which we must confess seem not unfrequently to be of some importance.

It is not so easy to ascertain the source from which the system of Mineralogy is derived, but as it is undoubtedly the most useless part of the book, it is just possible that it may be the most original. We would ask any mineralogist how he would like to have no better guide in the determination of a mineral than such a character as the following :—

IV. ORDER MOLIBDEXIDES.

Minerals containing metals of the lead series, in various states of combination; solid.

1. FAMILY.—*Molibdides.*—Minerals containing lead, either native or in combination.—Occurs 1, *native*, monometric, H. 1·5, sp. gr. 11·381; very rarely; 2, as *Sulphuret* or "Galena," monometric, H. 2·5, sp. gr. 7·5, colour and streak lead-gray, easily fused, frangible in beds and veins in crystalline and uncrystalline rocks; 3, as *Oxide* or "Minium," pulverulent, in minute rhombic prisms; sp. gr. 4·6, in veins of galena and calamine; 4, as *Carbonate* or "Cerusite," in right rhombic prisms, H. 3–3·5, sp. gr. 6·4, lustre adamantine, colour white or gray, very brittle, in many lead mines; 5, as *Phosphate* or "Pyromorphite," in hexagonal prisms, H. 3·5–4, sp. gr. 7; colour green, yellow, or brown; lustre resinous, brittle, in veins with other lead ores; 6, also less frequently combined with *selenium, tellurium, antimony, arsenic, vanadic, chromic, molybdic, and tungstic acids.*—Metallic lead fuses at 612° F., its soluble salts give a black precipitate with hydrosulphuric acid.—*Symb.* Pb.

This is followed by 2. FAMILY.—*Baryides*!, but we need go no further.

In conclusion, there is one point to which we must advert, although in so doing we shall perhaps be running some risk of placing ourselves in the same category with the famous Shandean critic, who carried his rule and compasses in his pocket, and determined the merits of a book by the squareness of its corners,—we allude to its mechanical execution. We have always entertained an opinion that the great object of a "Manual" should be to furnish its readers with the greatest possible amount of information in the smallest possible amount of space, but the present work appears to have been got up on a directly opposite principle,—it is printed in a positively *large* type, with spaces between the lines, and the characters of the families are considerably indented, so that in most cases at least a tenth part of the page is actually lost. Had a type of moderate size been employed and the present absurd arrangement of the pages avoided, there is no doubt that at least half as much more information might have been got into the same space.

We have completed a most thankless task, for few things can be more distasteful to us than to speak unfavourably of the efforts of others, especially when, as in the present case, they appear to have devoted considerable labour to a mistaken attempt to aid in the diffusion of knowledge. But this book unfortunately by no means satisfies the expectations called up by its title, and there can be no doubt that, as far as it is concerned, the author of the next 'Manual of Natural History' may justly echo the authors' own lamentation, that "no work has yet appeared, comprising either succinctly or in detail, a comprehensive outline of natural history."

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

On the Anatomy and Development of Echinococcus veterinorum. By Thomas Huxley, F.R.S.

[With a Plate.]

On the 25th of November, 1852, a fine female Zebra, whilst at play within its paddock, accidentally broke its neck. The animal had always appeared to be quite healthy, and it was in perfectly good condition—but, upon examination, its liver was found to be one mass of cysts, varying in size from a child's head downwards. The liver was taken out of the body on the day succeeding the animal's death*—and on the 27th I proceeded to examine the contents of one of the largest cysts (with a portion of its wall) and one of the smaller cysts.

It was at once obvious that the cysts contained the *Echinococcus veterinorum*; and I may here mention that the *Echinococci* were in full life, and remained so for three days, until, in fact, the fluid in which they were contained had become slightly offensive.

It will conduce to clearness perhaps, if I state in successive order I. What I saw myself. II. The theory of the formation of the *Echinococcus*-cysts, and of their relation to other forms of Entozoa, which I have to offer. III. What has been done hitherto.

I. The cysts are nearly spherical vesicles having a very elastic proper wall; so elastic, in fact, as to exercise a continual tension upon the contained fluid, which, if the cyst be pierced, spurts out in a jet, for some time.

The outermost layer of the cyst is an adventitious membrane, formed by the infested animal around the *Echinococcus*-cyst, as it would be developed round any other foreign body; with this I have nothing to do. Within this, and in nowise adherent to it, follows the proper wall of the *Echinococcus*-cyst, which must be carefully distinguished into two portions. The outer is thick, yellowish and constituted by a great number of delicate, structureless laminæ composed of a substance closely resembling chitine. It is to this laminated membrane that the elasticity of the cysts is due—and it must be regarded as precisely analogous to those structureless cysts which surround the pupa forms of *Distomata* imbedded in the body of snails, or to those similarly structureless cysts which enclose the encysted *Tetrarhynchi*, and which Van Beneden saw in course of formation by a process of exudation, around the Scolex form of those worms. The innermost layer of this, which, for distinction's sake, I will call the *Ectocyst*, is whiter and softer than the others, and appears to be in course of formation.

The inner portion of the wall of the *Echinococcus*-cyst is closely

* I beg here to express my obligations to the Secretary of the Zoological Society, without whose kind recollection of a wish to examine fresh Entozoa, which I had expressed, I should not have had the opportunity of making the observations contained in the present paper.

adherent to the last-described layer of the ectocyst, but may, with great care, be separated from it, when it is at once evident that there is no organic connexion between the two; this layer may be very conveniently termed the *endocyst*—it is the only active living part of the whole wall of the cyst, and represents the proper body-wall of the animal. It is very pale and delicate, and not more than $\frac{1}{2000}$th of an inch thick. It is composed of very delicate cells $\frac{1}{2000}$–$\frac{1}{5000}$th of an inch in diameter, without obvious nuclei, but often containing clear, strongly refracting corpuscles, generally a single one only, in a cell. These corpuscles appear to be solid, but by the action of dilute acetic acid, the interior generally clears up very rapidly, and a hollow vesicle is left of the same size as the original corpuscle. *No gas is developed during this process*, and sometimes the corpuscles are not acted upon at all by the acid, appearing then to be of a fatty nature. A strong solution of caustic ammonia produces a concentrically laminated or fissured appearance in them. Under pressure, and with commencing putrefaction, a number of them sometimes flow together into an irregular or rounded mass.

The inner surface of the endocyst is sometimes irregularly papillated like a glandular epithelium in consequence of the prominence of separate cells, or its surface presents an even contour, from the presence of a structureless membrane, which varies in thickness, and seems to represent the inner portion of the blastema, elsewhere slightly granular, in which the cells are imbedded.

Solitary hooks are scattered over the inner surface of the endocyst. I thought at first that they had fallen from the *Echinococci*; but it is with some difficulty that, even by the aid of pressure, the hooks can be so detached from them; and furthermore the hooks in question had generally the appearance of those forms found in the younger *Echinococci*, from which there is still greater difficulty in detaching them. I conclude then that these hooks are developed where they are found, and that they represent a sort of attempt to develope an *Echinococcus* which has gone no further. Within the substance of the endocyst one may see here and there traces of clear delicate vessels, such as those which will be described in the secondary cysts; but probably in consequence of the granular nature of the membrane, they are rarely visible.

In describing the development of the *Echinococci*, it will be necessary to return to this endocyst—at present I pass to the contents of the cyst. This is a clear, colourless, serous liquid, in which two kinds of bodies are found floating, *a. Echinococci*, and *b.* secondary cysts.

a. Echinococci. To avoid circumlocution, I restrict this term in the present place to what are commonly called the *Echinococcus*-heads.

The *Echinococci* are minute, oval bodies, varying, according to the state of contraction in which they are found, from $\frac{1}{200}$–$\frac{1}{80}$th of an inch in their long diameter.

When fully extended, the *Echinococci* are divided by a constriction into two portions; an anterior somewhat conical part, and a posterior oval portion, notched at the extremity: attached to the posterior section, and, as it were, sunk in the notch, there is a small appendage of variable form, which usually appears to be clear and somewhat oval, or pyriform, with an irregular ragged extremity.

The body of the *Echinococcus* consists of a very clear transparent substance, slightly granular or dotted internally, and limited externally by a well-marked structureless layer. Forming a circle round the conical anterior extremity there are from twenty to thirty strong hooks, which sometimes appeared to be in a single, sometimes in a double row. In the latter case the hooks of the upper row alternated with those of the lower. A delicate longitudinal striation, as if produced by muscular fibres, extends from the circlet of hooks through the anterior portion, becoming spread out and lost in the posterior.

The hooks were about $\frac{1}{700}$th of an inch in diameter. Their outer half was formed by a strong, curved, conical claw, the inner half by a somewhat crooked process with a blunt end. From the posterior surface of the junction of these two portions a strong rounded spur passed backwards and gave the hook additional firmness in its place. The hook contained a cavity, a process of which passed into each of its portions. Altogether it was not unlike the thickened liber-cell of a plant.

Behind the circlet of hooks, the shape of a transverse section of the body is quadrilateral, and at each of the four corners a large rounded disc with a more or less flat surface is to be seen,—the sucker. In structure, when unaltered, the suckers appear to be homogeneous, with granules and two or three of the peculiar corpuscles to be described immediately, imbedded in their substance. Under the action of acetic acid, however, a radiated fibrillation frequently became visible.

Scattered through the substance of the *Echinococcus*, and giving it a very peculiar dotted appearance under a low power, a number of oval, strongly refracting corpuscles may be observed. They are very uniform in size, and have a long diameter of about $\frac{1}{2500}$th of an inch. They are what have been called the *calcareous corpuscles* of the *Echinococcus*;—inasmuch as in the *Cysticerci* and other cystic worms they have been observed to be converted into carbonate of lime; but I believe that this is entirely a result of that peculiar degeneration to which the cystic Entozoa are so liable, and that, in the young and normal adult state, these peculiar corpuscles (which are found in all the *Cestoidea* and *Cystica*) are never calcareous, but are composed of an albuminous substance.

The mistake has arisen, I think, from two causes. In the first place, because in old cystic worms these corpuscles *are* frequently converted into a calcareous substance, although they retain their transparency and strongly refracting powers; and secondly, because when acid is added to a number of *Echinococci*, gas is very commonly developed from calcareous substances contained either in them or in the fluid in which they swim; at the same time the action of the acid rapidly causes the corpuscles to become clear vesicles, so that nothing seems more natural than to connect the one circumstance with the other.

Having paid great attention to the process, however, I can decidedly affirm—

1. That acetic acid dissolves out the contents of the corpuscles in young and fresh *Echinococci*, without the least evolution of gas from them; and that the same assertion holds good of the corresponding corpuscles contained in the spirit specimens of *Tænia* and *Bothriocephalus* which I have examined.

2. That caustic ammonia produces little cavities and sometimes a concentric lamination in these bodies.

And, 3rdly, that in a spirit specimen of an *Echinococcus* from the Panther (which Dr. Hyde Salter kindly lent me), the corpuscles appeared vesicular without the action of any reagent.

It may be said then, that the peculiar strongly refracting corpuscles of the cestoid and cystic Entozoa usually contain an albuminous substance, and sometimes a fatty matter, but that this is very liable to become replaced by a calcareous substance.

Homologically, I think they are identical with the peculiar, elongated, strongly refracting, solid bodies, contained in the skin of both the *Dendrocœle* and *Rhabdocœle Turbellaria*, which in some marine *Planaria*-larvæ, according to Prof. Johannes Müller, are developed into true thread cells, similar to those of the hydroid Polypes. The thread cell of the latter is equally developed as a secondary deposit within a vesicle (nucleus?) contained in the cells of the body; the only difference would be, that whereas in the Polype the succeeding internal deposit takes place in the form of a spiral thread, in the cestoid or cystic Entozoon it takes place as a succession of simple layers, until the vesicle is full.

Aware of the discoveries that have been lately made by Siebold, Van Beneden and Guido Wagner, as to the extent to which the water vascular system is developed in the Cestoid Entozoa; and unacquainted with what had been observed by Dr. Lebert* (vide *infra*), I particularly endeavoured to detect, in the quite fresh *Echinococci*, some evidence of its existence, and I was so far successful, that I could very readily observe in several specimens (examined on the first day) a number of the peculiar flickering cilia so characteristic of this system of vessels wherever it exists. In spite of all my endeavours, however, I could trace nothing of the vessels themselves, in which, by analogy, one has every reason to believe the cilia are contained†. In one *Echinococcus* I observed six of these long flickering cilia; they were so distinct as to be perfectly measurable, their length being about $\frac{1}{3500}$th of an inch. They were excessively delicate, but broader at the fixed than at the free end, and they completely resembled the corresponding organs in the *Rotifera*‡, *Naiadæ*, &c.

* Prof. Virchow, and the colleagues before whom he laid his observations upon the occurrence of cilia in the pedicle of *Echinococcus* (vide *infra*), appear equally to have overlooked Dr. Lebert's excellent paper, although it is contained in Müller's Archiv for 1843.

† In the *Planaria torva* I have similarly observed the cilia but not the vessels.

‡ See the essay by the author on "*Lacinularia socialis*, &c. &c." in the Quarterly Journal of Microscopical Science, No. 1, 1852.

Professor Owen has stated (article *Entozoa*, Todd's Cyclopædia, 1839) that the *Echinococci* (from the Pig) which he examined, moved "freely by means of superficial vibratile cilia," p. 118. There were certainly no such cilia upon the *Echinococci* of the Zebra.

The movements of the *Echinococci*, so far as I witnessed them, were confined to slow, undulatory, peristaltic contractions. I found numbers in every stage of contraction, but I could not observe any actually performing the process. The head with the hooks is drawn in first, as one meets with many forms in which the suckers only protrude at the extremity, like four knobs. The suckers then follow and are turned completely in, so that their proper outer surfaces look towards one another, the coronet of hooks lying beneath them. In this state, which has been so often described, the animal has not more than half its previous length, and takes on a great variety of forms, oval, rounded, heart-shaped, &c.

b. The secondary cysts.—When the fluid contained within one of the large *Echinococcus*-cysts is emptied into a glass vessel, it is at first turbid with minute white bodies, but these rapidly subside and form a sediment at the bottom of the vessel. These white bodies vary in size from $\frac{1}{30}$th of an inch in diameter downwards to $\frac{1}{100}$th. They are the secondary cysts.

Under the microscope these bodies are seen to be delicate spheroidal sacs, containing *Echinococci*. The largest examined had at least thirty of these in its interior. It consisted of a very transparent structureless membrane, apparently lined by a delicate granular film, which was most distinct near the pedicles of the contained *Echinococci*. These *Echinococci* in fact were not free like those contained in the primary cyst, which I have previously described, but each was attached by a delicate cord, more or less resembling the "appendage" of the free *Echinococcus*, to the inner wall of the secondary cyst, and radiated thence inwards. These *Echinococci* resembled in all respects those previously described, except that I could observe no ciliary motion in them*; they were in all conditions of protraction or retraction, and exhibited the ordinary movements. None were ever found free in a secondary cyst, and the members of each cyst, as well as those in different cysts, were as nearly as may be of the same size and degree of perfection.

The space left between them in the interior of the secondary cysts was sometimes filled with a clear fluid, and at others more or less obscured by granules. In none of those observed by me was there any trace of the peculiar mode of development of the contained *Echinococci* from the granular contents of the secondary cysts described by Von Siebold (vide *infra*).

The membrane of these cysts was traversed by a meshwork of fine clear delicate vessels, with distinct walls and about $\frac{1}{10,000}$th to $\frac{1}{16,000}$th of an inch in diameter. These were not folds, as their lumen could be

* This may well arise from my not having examined them till the 28th. Lebert appears to have found the observation of the cilia to be favoured by the interposed membrane of the secondary cyst (vide *infra*).

clearly seen at the edge of a cyst. They terminated in a somewhat wide space at the base of the pedicle of each contained *Echinococcus*, and in one instance I traced a vessel for some distance into this pedicle. There were no cilia nor granules contained in these vessels, but they precisely resemble those canals of which traces were seen in the Endocyst, and their development will, I think, show that they are identical with them.

I may anticipate so far as to say that I believe that these vessels represent the water vascular system of the parent-cyst.

When such a sac as this is burst the *Echinococci* become everted, and the secondary cyst turns itself inside out, so that the *Echinococci* appear to be seated like Polypes upon a central stem. This curious peculiarity has led to much misconception as to the mode of their attachment *within* the cyst. Von Siebold, however, pointed out the true nature of this process as far back as 1837* (vide *infra*).

The smallest free secondary cysts varied in size, as I have said, down to $\frac{1}{100}$th of an inch, when they contained only four *Echinococci*. These, however, were quite as large as those in the largest secondary cysts.

The structure of the middle-sized and small vesicles was in most respects the same as that of the large ones, but there was this difference, that they possessed, attached to their outer surface, by pedicles, a variable number of oval bodies of the same average size as the *Echinococci* or less, but presenting a yellow wrinkled appearance, containing very few corpuscles, often none, and either exhibiting no trace of the circlet of hooks, or offering only a few, dark irregular and withered-looking ones. It was impossible to confound these *external* bodies with accidentally everted *internal* heads, the appearance of the two being markedly different.

I cannot help thinking that these withered *Echinococci*—for that, as will be seen presently, is what they really are—are what Mr. Erasmus Wilson has figured as developing forms (*loc. cit.*).

Development.—We have found free *Echinococci* and free secondary cysts contained in the fluid of the primary cyst: how do they come there? To answer this question we must return to the endocyst. I found adherent to, and growing from it, *a.* fixed *Echinococci*, and *b.* fixed secondary cysts.

a. Fixed Echinococci.—These, in various stages of development, are scattered all over the inner surface of the endocyst, as in the diagrams E. and F. Plate XI.

Elongated elevations of the endocyst are first seen: within these the circlet of hooks and then the corpuscles make their appearance: the elevation becomes a papilla, and the papilla, gradually constricting itself at the base, becomes the oval *Echinococcus*, attached by a narrow pedicle. In this state the slightest touch is sufficient to separate the pedicle from the endocyst, and then the *Echinococcus* is

* The *Echinococci* are figured in this everted state by Chemnitz (quoted by Siebold, art. *Parasiten*, Wagner's Encyclopædia, &c.), by Erasmus Wilson (Medico-Chir. Transactions, 1845), and by Busk (Microscopical Transactions, 1846).

set free. The pedicle contracts upon itself so as to have a rounded form, but it very often betrays its previous adherence by the ragged fragments of the endocyst, which it carries with it.

Whether this is properly a normal process in the *Echinococcus* it is difficult to say, but as Dr. Guido Wagner and Van Beneden have shown, it occurs normally in the *Tetrarhynchidæ,* and it exactly resembles that detachment of the "tail" from the *Cercaria,* which takes place in the *Distomata.*

As little is it known whether the *Echinococci* undergo any further development. The suggestion first made by Delle Chiaje, that they may dilate into cysts and develope young *Echinococci* within themselves, appears to me highly improbable; and it is an hypothesis which is not needed to account for the secondary cysts.

b. Fixed Secondary Cysts.—The development of these indeed takes place in such a manner as to preserve the homological relations of the *Echinococci* to the exterior of the parent. The secondary cysts, in fact, are thus formed: *Echinococci* are developed not only from the inner surface of the endocyst, but from its outer surface. Their growth is probably accompanied by that of the endocyst itself, which thus becomes raised up from the ectocyst and projects into the general cavity. Of course any internal *Echinococci* which happen to be attached to this part of the endocyst are raised up with it: they may be fewer or more according to circumstances. The neck of attachment of the secondary cysts gradually narrows, and at last the secondary cyst, whose size depends entirely upon the number of *Echinococci* developed under the endocyst at one spot, is detached and falls into the cavity. So long as the secondary cyst remains attached, its external *Echinococci* have the normal clear appearance, and are in full health; but when once it is separated, they appear rapidly to wither away and become yellow, losing their hooks and their corpuscles, and eventually disappearing. The original point of attachment of the sac remains as an obtuse cicatrix.

Von Siebold, who has beautifully described the development of the secondary cysts, has, I think (vide *infra*), mistaken the *one* mode of development of the *Echinococci* outside the endocyst for the *only* mode. He appears to have seen the endocyst, when he describes the "delicate membrane in which the young *Echinococcus*-heads are enclosed," and to *assume* merely, that this membrane bursts and sets the *Echinococcus* free upon the inner surface of the parent cyst. Understanding the mode of development to be as stated above, it is easy to comprehend how it is, that the *Echinococci* are so nearly at the same stage of development in all the secondary cysts; and that this stage has no relation to the size of the cysts. The existence of the external *Echinococci* upon the secondary vesicles in this way also, becomes not only intelligible, but almost necessary.

II. The theory which I have to offer of the nature of the *Echinococcus,* is based upon three facts which are now well established. 1st. That young Cestoid Worms, which, from some cause or other, have passed into any other part of the organism of the animal upon which they are parasitic, than the intestine, become abnormally dilated, at their posterior extremity; and the anterior end may be retracted into the sac thus formed, which then invests it like a double serous sac—a structureless investment may be excreted round this encysted worm or it may not. Such an altered Cestoid Worm as this is called a *Cysticercus.*

2ndly. A dilated Cestoid worm, such as has been just described, may develope new "heads" with suckers and hooks all over its outer surface, never developing any upon its inner surface. Such a Cestoid worm is the *Cœnurus cerebralis.*

3rdly. The Cestoid worms all possess the power of gemmation (or it may be called fission) in their unaltered state: and Bendz (Isis, 1844) has distinctly shown that the vesicular extremity of the *Cysticercus* gemmates. Processes are formed and thrown off, and these develope appropriate heads and hooks, becoming complete *Cysticerci.*

Bearing these facts in mind, it is I think very easy to account for the *Echinococcus*-vesicles. The surfaces which produce the *Echinococci* must be *both external*; the *Echinococcus*-cyst therefore does not answer to the simple cyst of the *Cœnurus*, or of the protruded *Cysticercus*; but to the double cyst of the retracted *Cysticercus*, the upper half of whose proper outer surface forms the inner wall of the cyst in the retracted state (see Diag. D. Pl. XI.).

Suppose the cyst, thus formed, to dilate and to develope a multitude of heads upon this upper half of the outer surface, after the analogy of *Cœnurus*; then the two walls being pressed together into one, it will appear like a simple cyst covered with heads internally (Diag. E.).

If, however, at the same time, in complete correspondence with *Cœnurus*, heads have been developed over the whole outer surface, we have the primary *Echinococcus endocyst* (Diag. F.).

Now the cyst may grow out at a particular point, and so form a bud, which is cast off externally. This takes place in the *Echinococcus* of Oxen. But if it have surrounded itself with a dense cyst, analogous to that of the encysted *Tetrarhynchidæ*, such external budding cannot take place; and if the local growth takes place at all, it will produce a projection internally, and the internal fixed secondary cysts will be produced. These, narrowing at the neck and detaching themselves, become the free secondary cysts, as was shown above.

The *Echinococcus* then is a species of *Tænia* which has become dilated and encysted; which has subsequently produced heads all over its external surface, and finally, budding, casts off its vesicular processes internally, because it has no exit for them externally.

Echinococcus is thus the most complex form of that change which young Cestoid Worms are liable to undergo if they wander from their proper nidus; the combination of hooks with suckers refers it to the genus *Tænia*, to which *Cœnurus* and *Cysticercus* may by similar reasoning be shown to belong; and, therefore, like these two latter genera, it must, as a genus, be abolished. It is probable however that *Cysticercus*, *Cœnurus* and *Echinococcus* are modifications of distinct species, or groups of species, of the genus *Tænia*; and are not mere varieties of one species produced by difference of locality. They are all three found in the brain, for instance.

As to the genus *Acephalocystis,* there is good reason for believing, that all genuine specimens of it are *Echinococcus*-cysts which have either not developed heads, or in which they have been overlooked.

The converse of the anatomical evidence as to the identity of *Echinococcus* with a modified *Tænia,* has just been supplied by some very beautiful researches of Von Siebold's, published in the Annales des Sciences for 1852 (or Annals of Natural History, December 1852). Von Siebold gave to young puppies spoonfuls of *Echinococcus*-cysts in milk. Upon opening them after a short time, he found *innumerable Tæniæ attached all over the surface of the intestine.* The cysts had been digested, but the living *Echinococci* had resisted the action of the stomach, and, freed from their imprisonment, had begun to develope joints. Growth had not gone on sufficiently to enable the learned Professor of Breslau to determine the species. He promises, however, a continuation of his researches; and it is to be hoped that we may soon have a complete clearing up of the difficulties with which helminthologists have so long been puzzled, from his able pen*.

III. The literature of *Echinococcus* exhibits a singular instance of the manner in which naturalists delay their own progress, by not attending to what has been done by their predecessors. Goeze wrote in 1782, and effectually demonstrated the cestoid relations of the *Echinococci,* as may be seen by the following extracts from his beautiful work (Versuch einer Naturgeschichte der Eingeweidewürmer); nay, before his time, Pallas had on very good grounds conjectured the same thing, and yet half a century afterwards we find this all forgotten, and speculation rife as to the nature of the *Echinococci.*

Goeze thus describes the *Echinococcus*-vesicles (*op. cit.* p. 258 *et seq.*):—

"C. The small social granular Bladder tape-worm (Blasen-bandwurm): *Tænia visceralis socialis granulosa.*

"This is as it were an intermediate form between the great globular Bladder tape-worm (*Cysticercus*), and the many-headed worm found in the brain of staggering Sheep.

"I had already read what Pallas supposes on this subject in the 'Neue Nordische Beyträge,' i. p. 85, when, by a lucky discovery, I made the whole matter out.

"Upon the 1st of Nov. 1781, I met with an excessively distorted Sheep's liver, which was so beset and penetrated by large and small watery vesicles,—the former as large as hens'-eggs, the latter as hazel-nuts,—that, externally, one could discern hardly anything of the substance of the liver.

"The animal itself was almost perfectly healthy. In its total size, this monstrous liver was about equal in breadth to the two hands; and its length was about half an ell: the weight however was four pounds. I was obliged to divide it into two portions in order to be able to get it into a large jar (3 inches, glass) with spirit. When I pricked one of the vesicles with a needle, the water spirted out, as out of a fountain. I observed, however, that the distended vesicles con-

* A full account of Siebold's investigations has, in fact, appeared in Siebold and Kölliker's 'Zeitschrift' for 1853, under the title, "Ueber die Verwandlung der Echinococcus-brut in Tænien."—T. H., April 1854.

tained nothing beyond a mere lymph and possessed no special internal vesicle. In separating the one portion of the liver I could not avoid damaging some of the vesicles contained in its interior. Out of these tolerably hard leathery external vesicles, fell bluish, callous (kallöse), internal vesicles, which were still closed. In their substance indeed they were somewhat softer than the outer vesicle; but still far more cartilaginous than the vesicles of the globular, many-headed bladder-worms. On opening these there was found internally in different places a greyish granular matter like the smallest fish roe, which was united to a very delicate mucous membrane, [which] in water however immediately disappeared, so that the granules swam about by themselves. In a vesicle as large as a dove's egg there were thousands, so small that they could hardly be distinguished by the naked eye. Under No. 4. Tub. A of my microscope I could already perceive the organization of these corpuscles. Their form varied greatly; sometimes heart-shaped with an indent above and a dark line; sometimes pitcher-shaped, with two round knobs above, at each side one; sometimes like a horse-shoe with a short dark middle line; sometimes like a rounded handle, with an indent above and with two knobs laterally, and anteriorly rounded off with a dark circlet. When I used No. 1. Tub. A, I saw clearly that they were true tape-worms. The body flat with dark dots; anteriorly four suckers, and on the obtusely rounded proboscis, the double circlet of excessively small hooks; behind, however, in each there was a small excavated indentation like an anus. The others were contracted in quite peculiar forms, and the dark median streak was the hook circlet. Under the compressor, the four suckers, the circlet of hooks and the points become much clearer. In these worms I have observed a circumstance which I have perceived in no other kind of bladder-worm; namely that on pressure the delicate hooks are detached and float about freely.

"This kind of bladder-worm is distinguished then from that inhabiting the brain of staggering sheep by the following circumstances:—

"1. That the vesicles with the granular matter or with many thousand infinitely small worms, are covered by a strong leathery external vesicle in which they lie free.

"2. That their roe-like material swims about in the inner vesicle in a clear lymph, and the single worms are only united together by a delicate mucous membrane, but are not as in those, essentially adherent to the bladder, and not even to their [own] membrane.

"3. That each of these granules or worms is several hundred times smaller than one of the white corpuscles or worms in the central bladder of the staggering sheep.

"This is then the same, but now explained phænomenon, which the acute Pallas has already observed; but has left without elucidation.

"In the 'Stralsund Magazine,' 1. St. p. 81, he has already directed the attention of observers to these points:

"'Whoso will consider the above description of the true bladder-worm, will not perhaps with M. de Haen deny to worms all participation in the origin of watery tumours and of Hydatids, at least it seems to me very probable that the unattached (unangewachsene) watery bladders seen by many observers in the human body—most frequently in abnormal cavities in the liver—are caused by a worm similar to, if not identical with, our bladder-worm, I say from a worm *probably resembling our* bladder-worm; for we find in the liver and lungs of Oxen and Sheep another wonderful kind of watery bladder, which seems to arise from nothing but some kind of animal germ; but however is widely different from our bladder-worm, and cannot have arisen from it.'"

Pallas, after describing some of the Hydatids, goes on to say:

"The water-bladder itself consists of a white, hardish, quite homogeneous membrane, which becomes thinner towards the caudal extremity; wherever it is lacerated it folds back, and may be best compared with a section (as thin as paper) of a boiled cartilage of a young animal. Within, this external strong membrane is lined by a delicate structure or membrane, which is very easily separated from it, and is beset with a great number of small, white, commonly round, or oval, corpuscles. The corpuscles consist, as the microscope shows, of longish globules united together, whose substance appears to be dotted."

Subsequently (p. 261) Goeze quotes from the 'Nordische Beyträge,' 1. St. p. 83, thus:

"It is probable that the unattached hydatids which are at times observed in the human body (are), either of the same kind as the proper bladder-tape worm, or are the same as those singular watery bladders, which I have observed and described in the liver and lungs of diseased Calves and Sheep, and which are most certainly also to be ascribed to a living creature, and are not indistinctly organized (at least if we consider the inner membrane strewed over with granular globules).

"On reading through Leake's treatise upon the 'Staggers in the Sheep,' p. 85, it seems very probable to me that the bladders in the brain are more similar to those which I have described in the lung and liver in Sheep and Calves, than to the bladder-worm which Tyson and Hartman have described before me (our globular one); nay perhaps, that they even constitute one genus with the former. The small worm provided with a circlet of hooks and four suckers, in these vesicles, might be a development of the globules observed by me.

"I have at present no opportunity of examining these vesicles in the fresh state. Perhaps on applying a stronger magnifying power the granules might exhibit more organization.

"Consequently, Pallas did not at that time know what to make out of the granules of these vesicles. The peculiar organization of these he did not himself see, as I have now discovered, described and figured it. To whom then belongs the first and true discovery of the nature of the granules in the internal membranes of the singular Hydatids of the livers and lungs of Calves and Sheep?

"But I wish that I could throw more light upon and explain the mode of origin of these vesicles, and upon the œconomy of the many thousand single worms socially united in a single bladder. Do they grow? do they disperse themselves? does each build its own dwelling? or where do they remain? shall our successors learn nothing on these matters?"

Goeze's figures are very good.

The commonly received view of the relation between the cysts and their *Echinococci* appears to have been first advanced by Delle Chiaje in his *Elmintografia Umana*, p. 30*.

"The said worms, oval, narrowed at the two extremities and enlarged in the middle, are scattered irregularly over the interior of the vesicle. The extremity of the head is garnished with a crown of hooks deprived of suckers. In proportion as they enlarge, these little microscopical bodies take on, little by little, a spherical form, the hooks become detached, and new *Echinococci* are produced in such little bodies, which have transformed themselves into Hydatids. The new worms are the children (figliuolini) of the primitive Hydatid, which was a similar microscopic body. They have a proper vitality, different from that of the vesicle which contains them."

Müller, 'Jahresbericht,' 1836, describes the *Echinococcus*-cysts and their contents found in the urine of a young man labouring under renal disease.

The cysts had a laminated outer coat; some contained *Echinococci* and some none, but in other respects they were completely alike. The *Echinococci* exactly resembled the ordinary figures.

"In a few of the free ones, a trace of a membranous cord, looking as if it had been torn off, appeared at the posterior end of the body; as if the worms had at an earlier period been fixed."

Müller could not make out whether the *Echinococci* were fixed to the interior of the secondary vesicle or not.

Tschudi, 'Die Blasenwürmer, 1837,' observed the retrograding yellow *Echinococci*, which he assumes to be returning to the vesicular form. He considers that the "corpuscles" are ova, and that by their development in the interior of one of these retrograded *Echinococci*, the secondary cysts are formed.

Gluge, 'Annales des Sciences Naturelles, 1837,' describes the corpuscles of the *Echinococci* very carefully and minutely. He was the first to notice the peculiar structure of the endocyst. He says, "I have constantly seen in it a kind of arborization very similar to the formation in fibrinous exudations during the first stage of inflammation. We see these transparent bodies with slightly irregular contours resembling empty blood-vessels and ramifying like them. I do not know whether these are true vessels, I merely draw attention to the fact."

In the same year (1837) the second edition of Burdach's 'Physiologie' appeared. It contains an admirable chapter by Von Siebold, upon the development of the Entozoa. Burdach's work is so little known, and so inaccessible in this country, that I think it worth while to subjoin the whole of what Von Siebold says upon this subject:—

"In the development of the *Echinococci* also, much has remained obscure. We must in them always distinguish two things; the parent vesicle, and the proper *Echinococci* enclosed within this. The maternal vesicle is covered internally by an excessively delicate epithelium, in which are contained corpuscles similar, though here

* *Compendio di Elmintografia Umana.* Napoli 1825. Compilato da Stephano Delle Chiaje.

generally elongated, to those which we have found in the neck of *Cœnurus*. In the fluid which the maternal vesicle encloses, we meet with a few *Echinococci*, which when they have everted their coronet of hooks and their suckers, allow nothing to be perceived in their interior but a few scattered glassy corpuscles. These *Echinococci* evidently arise from the inner surface of the parent vesicle. My own observations hereupon have been made upon *E. hominis*, *E. veterinorum*, and a new species which, since the number of its suckers varies very much, I will call *E. variabilis*. On examining the inner surface of the parent vesicle we see little vesicles attached here and there, which contain a finely granular substance; out of this mass the *Echinococci* proceed (hervorkeimen), sometimes only one, sometimes two, six, seven or more. A portion of the granular mass becomes, in fact, sharply marked off, forms a small roundish body, which, however, by one of its ends, still clearly passes into the rest of the substance; the rounded body gradually takes on a pea shape, the constricted portion elongates, and the body, which has now assumed a more oval form, is connected only by a delicate viscid thread with the mass from which it sprang; we soon now observe in the interior of the body the circlet of hooks and the glassy corpuscles. The *Echinococcus*-head thus far developed now begins to move—everting and retracting its suckers and hooks; the whole body being at the same time sometimes elongated, sometimes contracted. The development of the *Echinococci* having proceeded to this stage, the delicate membrane in which they are enclosed bursts. The young *Echinococci* do not immediately fall out, for they are all connected to the inner surface of the membrane, which until now has enclosed them, by means of a delicate cord or process of the latter, which penetrates at the posterior extremity of the *Echinococcus*, through a pit, into the interior of the body of the *Echinococcus*. The pit looks almost like a sphincter, holding just that cord of the membrane; only after an interval do the cords and the bodies of the *Echinococci* become separated. The mode of connection of these cords with the bodies of the *Echinococci*, and their separation from them, reminds one completely of the relation which the bodies and tails of the *Cercariæ* have to one another. The membranous covering of the young *Echinococci* wrinkles up immediately when it is torn. The *Echinococci* become everted, and so form a rounded heap, in the middle of which the collapsed investment lies hidden, the *Echinococci* being attached to it like the polypes upon a polypidom.

"Such masses of *Echinococci* either remain for a long time hanging to the inner surface of the parent vesicle, or they become detached from it before the single *Echinococci* have separated from the wrinkled membrane. The granular mass contained in the vesicles is probably comparable with nothing else than with a yelk mass, which supplies the heads with the substance necessary for their development through those fine cords. For the rest, I will not undertake to decide whether all those larger and smaller vesicles, which contain *Echinococcus*-heads and float about free among fully-developed *Echinococcus*-heads in the cavity of the parent vesicle, are detached from the wall of the latter, or whether some few of them do not arise from the free *Echinococcus*-heads themselves, which have developed *Echinococcus*-germs in their interior, and afterwards become distended into vesicles by them; I was often surprised, in fact, to find upon free vesicles containing *Echinococcus*-heads, hooks attached, perhaps remnants of the destroyed circlet of hooks. In such vesicles of *E. variabilis*, in fact, I believe I could trace remains of the suckers. With greater difficulty can we understand the mode of origin and propagation of the maternal vesicle of the *Echinococci*. Since in *Echinococcus hominis* we often find smaller hydatids enclosed within larger ones, we must believe that the external hydatid is the parent in which the others have been subsequently produced. In what manner, however, this enclosure has taken place, I must leave as much unsolved as the origin of the parent vesicle itself."

The next step was made by Dr. Lebert, in his excellent paper (unfortunately without figures), "Einige Bemerkungen über Blasenwürmer," in Müller's Archiv for 1843. From this I make the following extracts:—

"In the most, even freshly examined hydatids, the animals no longer move. Yet not unfrequently, if many vesicles be examined, living groups may be met with. The movement of the animal, while still in the maternal vesicle, consists partly in turning upon its axis, partly in a wavy contraction, comparable to a peristaltic movement. In the interior of these yet living and moving animals I have perceived ciliary motion very clearly. It appeared in the whole interior of the animal, and I could observe it for hours together. At first I could with difficulty distinguish the single vibrating cilia; yet, partly after partial evaporation of the fluid in which the animals were contained, partly by modifying the light with a very fine perpendicular diaphragm, I could succeed in seeing the cilia themselves, which are slightly curved and somewhat hook-like, and hardly more than $\frac{1}{800}$ mm. in breadth. I have seen the single cilia with especial distinctness towards the margin of the animal; commonly, however, they are indistinct, on account of the contemporaneous vibration of a certain number of cilia, which resemble in their motion a field of corn agitated by the wind. The observation of this ciliary motion was perhaps rendered more easy by the circumstance, that I observed the animals still adherent to the finely granular membrane which forms the parent vesicle, and which, in all probability, favourably modified the light."

"As to what concerns the development of the vesicles themselves, it seems to go on in the following manner:—upon the inner wall of a cyst which contains *Echinococcus*-cysts, secondary cysts are formed, which, after they have attained a certain grade of development, become detached from the inner wall of the larger cyst, and fall freely into their cavities, but still show the remains of their attachment in a slightly pointed place: on the inner surface of these secondary vesicles tertiary ones are now formed in the same manner, and so on. The hydatid sacs then arise by a kind of endogenous formation similar to that which Prof. Müller has already so beautifully described in the development of a peculiar kind of hydatid tumours.

In his Article "Parasiten" (Wagner's Handwörterbuch d. Physiologie, bd. 2, 1844), Von Siebold, after recapitulating his view of the development of the *Echinococci* contained in Burdach's Physiologie, makes the following highly suggestive remarks:—

"Clearly as we can trace the development of the young of the *Echinococcus,* we understand very little of the mode in which the pill-box (eingeschächtelt) aggregations are produced. The multiplication of the vesicles certainly does not take place by division, nor by the formation of buds upon the outer surface of the parent cyst, as some have supposed. The hypothesis remains, that the young *Echinococci* cast off their circlet of hooks, become distended, lose their suckers, and so change into little *Echinococcus*-vesicles, in which a new brood then becomes developed. I must indeed confess that I have not directly observed this process. In any case, the young *Echinococcus* must be in a fit state to wander; and if it should be made out that new *Echinococcus*-vesicles proceed from them in the interior of the parent vesicles, we might also justly assume that the young *Echinococci,* wandering into other organs, or even into other persons, may thus lay the foundation for new colonies. Whether, again, there exists a special cestoid worm provided with sexual organs, with which the *Echinococcus*-vesicles stand in the same relation as the *Cercaria*-sacs do with certain *Trematoda,* time will show. If it be so, the young *Echinococci* must change, having become separated from their pedicle, not into *Echinococcus*-vesicles, but by the elongation of the body into *Tæniæ.*"

Finally, in the 'Verhandlungen der Physikalisch-Medicinischen Gesellschaft zu Würzburg' for 1850, (to which my attention was drawn by my friend Mr. Busk,) I find the following notice:—"Herr Virchow described the ciliary movement which he had observed in the stem by which the young *Echinococci hominis* of Man are attached to the maternal vesicle,—a new observation for this genus."

I have here endeavoured to notice all those Memoirs which, at the time of their publication, made a definite addition to what was already known upon the structure of *Echinococcus*. The literature of the subject is somewhat voluminous, and hence the necessity of this limitation, and the consequent absence of any account of the valuable memoirs of Goodsir, Curling, Busk, and Erasmus Wilson, all of whom had been anticipated by the continental observers.

EXPLANATION OF PLATE XI.

Diagrams:—Hypothetical representations of—A. a young *Tænia*; B. a *Cœnurus*; C. a *Cysticercus*; D. the same, encysted; E. a *Cysticercus*, encysted, enlarged, and developing many heads (like *Cœnurus*) from the upper portion of its outer (now inner) surface; F. a similar form, which developes heads from the lower portion of its outer (now wholly outer) surface, and so becomes an *Echinococcus*-cyst.

MISCELLANEOUS.

On the natural and artificial Fecundation of Ægilops *by* Triticum. By M. Godron.

The author referred to the researches of M. Fabre upon *Ægilops triticoides*, from which it appears that this grass is produced from seeds of *Ægilops ovata*, and that by cultivation it gradually approaches cultivated wheat. He does not, however, by any means admit the conclusion deduced from this fact by M. Duval, namely that wheat has originated from the *Æ. ovata*, and is nothing but a metamorphosis of the latter plant.

M. Godron, by examining the circumstances under which the *Æ. triticoides* is met with, has arrived at the conclusion that this plant is only an accidental product; it is never seen except on the edges of wheat-fields or in their neighbourhood; its habit resembles that of the varieties of wheat near which it has grown; it possesses beards when growing in the neighbourhood of bearded wheat, but these are rudimentary in places where beardless wheat is cultivated, and it is less fertile than legitimate species. He considers that *Æ. triticoides* exhibits all the characters of a hybrid plant, and that it is the product of the fecundation of *Æ. ovata* by cultivated wheat.

He has, moreover, confirmed this view by direct experiment; the artificial fecundation of *Æ. ovata* by *Triticum vulgare* has given him the two varieties of *Æ. triticoides* which are met with in the South of France. He has also obtained two new hybrid plants,—one by the fecundation of *Æ. ovata* by *Triticum spelta*, the other by the action of the pollen of *Triticum durum* upon *Ægilops triaristata*.—*Comptes Rendus*, July 17, 1854, p. 145.

THE OUNCES.

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

1. *Uncia Irbis*. Felis Uncia, *Schreber*; F. Pardus, *Pallas*. Tibet.
2. *Uncia macroscelis*, Horsf. Sumatra.
3. *Uncia macrosceloides*, Hodgson. India.
4. *Uncia marmoratus*. Felis marmorata, *Martin*; F. Diardii, *Jardine*. Penang.
5. *Uncia Charltoni*. F. Charltoni, *Gray*; F. Duvaucellii, *Hodgson MSS. fide Dr. Cantor*. India; Himalaya.—J. E. Gray.

THE AFRICAN SEAL, HELIOPHOCA ATLANTICA.

I have just received a well-preserved skin and the skeleton of this Seal from Algeria, under the name of *Phoca leporina*. It certainly cannot be the *Phoca leporina* of Lepechin, in Act. Acad. Petrop. 1777, 264. t. 8, 9 = the *Phoca Lepechinii*, Lesson, from the White Sea and the rivers flowing into it, which M. Nilsson considers to be the same as *P. barbata*; but I think this is doubtful, as Lepechin described the fur as dirty-white, sometimes with a yellow tinge without any spots, and the hair as erect, with abundance of under wool. The African Seal has very short, broad, closely adpressed hair, while Lepechin expressly states that the hair of *P. leporina* is not appressed, but erect, and is at once known from *Phoca barbata* by the large size of the grinders, which are very close together, and the last one very peculiarly placed across the line of the other teeth.—J. E. Gray.

Notes on the Development of the Actiniæ. By M. Haime.

I have verified the separation of the sexes in the *Actiniæ*. Each capsule of the ovary contains only a single ovule, but each testicle contains several hundred thousand spermatozoa. In the species examined by me (*A. equina*, L., *effœta*, L., *sulcata*, Penn., *pedunculata*, Penn., and *coriacea*, Cuv.), these always had a bilobed head and a very long filament.

Actinia pedunculata usually has the sexes completely separated as in the other species, but, in some cases, a few spermatic capsules occur in the midst of an ovigerous gland and *vice versâ*.

The ovules are sometimes uniform in size, sometimes of different sizes, which appears to indicate that several successive layings must take place, and in fact it is not uncommon to find young animals already furnished with twenty-four or even forty-eight tentacles in the visceral cavities of females containing at the same time ovules of very small size (*A. equina* and *pedunculata*). The only difference, except size, between the smaller and larger ovules consists in the smaller proportionate size of the Purkinjian vesicle in the latter. Two or three germinal spots are often to be seen. I have observed no ova in process of segmentation.

The ciliated larva is at first spherical, and no depression or projection is to be observed on its surface; it soon elongates a little and presents a conical extremity. The other extremity becomes hollowed in the centre, forming the rudiment of the mouth. The cavity formed at this point enlarges by degrees by the removal of the internal substance, and the visceral chamber is rapidly formed. The integuments already form a distinct layer at the surface of the body, which contains thread-capsules, globules and vibratile cells almost exactly similar to those which occur in the adult. In the general cavity of some species (*A. pedunculata* for instance) there are also some large coloured globules, which vibrate and gyrate.

Before any tentacular mammillæ make their appearance, narrow bundles of muscular fibres are formed in the direction of the length of the body. These are the rudiments of the muscular system, and correspond with the vertical plates which are to divide the visceral cavity. Their initial number is normally six in *A. equina*, and probably also in all the species of the group; but I found it impossible to ascertain whether it is the same in *A. pedunculata*, or whether it is only four; it is certain, however, that it soon rises to eight in this polype, and that it afterwards becomes a multiple of six.

After the formation of these first muscular cords, the form of the young larvæ, which was hitherto oval, becomes slightly modified; the body becomes more contractile, and soon elongates and shortens itself to a great extent by expanding or contracting in the middle. From the flattened buccal extremity, and on points corresponding with the spaces between the first muscular bands, rounded tubercles, representing the first tentacles, are soon seen to spring.

The initial number of the tentacles is of course in relation with that of the first vertical muscular bands, or rather of the mesenteroid plates which are inserted upon these. But these plates are not all developed at the same time; two of them, opposite to each other, first make their appearance; these grow from above downwards and present at their margin a little knotted band (*cordon pelotonné*), before the others begin to appear. If we consider that these two mesenteroid plates correspond with the two commissures of the mouth, and that the latter is produced transversely from the commencement, before the formation of any lamellar or appendicular organ, we shall arrive at this consequence, that the polype actually presents the character of bilaterality before acquiring the radiate arrangement, and that the former of these types, whilst combining with the other, still continues very apparent for a long time. The examination of the adult Corals shows that it never completely disappears.

In proportion as the tentacles increase in size and number, transverse muscular fibres begin to surround the body, and these rings, which at first are very distant, become more and more numerous, especially towards the extremity opposite to the mouth. This extremity soon flattens and acquires an adhesive faculty. The young polype then presents the most essential characters of its parent. Hitherto it has been swimming freely in the water, turning pretty quickly upon its axis, and having its pedal extremity in front. It preserves the cilia with which the surface of its body is covered, even after it is able to attach itself, and when it possesses three circles of tentacles. At this period the young of *A. equina* present no trace of the marginal vesicles which are to correspond with these three circles on the circumference of the disc of the adult animal.

I have stated that the initial number of tentacles in *Actinia* is six, like that of the first longitudinal muscular bands. It may happen, in consequence of accidental abortions, that this number is only five, or perhaps four, or the fortuitous inequality of the first tentacles may deceive the observer as to the number of elements in this first circle; but the type is normally hexameral. The exception which I have noticed in *A. pedunculata*, apparently only affects the second circle. I have, in fact, remarked that momentary checks in the development of the different parts of the second circle were not rare, especially in *A. equina*, but it is generally completed, as well as the third, in conformity with the laws established by M. Hollard. The fourth circle, on the contrary, almost always exhibits with much distinctness the mode of evolution ascertained by M. Milne-Edwards and myself for the partitions of Corals; that is to say, the twenty-four elements of which it is to be composed, do not make their appearance all together, but the twelve which originate between the tentacles of the first and third rows are all developed before those which are to come between those of the second and third circles.—*Comptes Rendus*, Aug. 28, 1854, p. 437.

RARE IRISH MOLLUSCA.

Cork, 9th Mo. 22nd, 1854.

To the Editors of the Annals of Natural History.

GENTLEMEN,—I have the pleasure of informing you that a few weeks since I found at Ballycotton, in the east of this county, alive and in good condition, and imbedded in turf, which reached to low-water mark, *Pholas crispata*, *dactylus* and *candida* (the last very abundantly), and to my great pleasure, several specimens of *P. papyracea*, now for the first time obtained in this county, and except one specimen found near Dungarvan by Dr. Farren, new to Ireland.

Yours truly,
SAMUEL WRIGHT.

TYPICAL COLLECTIONS OF MOLLUSCA.

The British Museum has lately received the following collections of typical specimens:—

1. The Land Shells of Jamaica, described by the late Professor Adams and the Hon. Edward Chitty. Presented by the Hon. Edward Chitty.

2. The Shells and Mollusca described, figured, or mentioned by the late M. Souleyet in his account of the 'Voyage of the Bonite,' and in the Monograph of Pteropods, by MM. Rang and Souleyet.

3. The Shells described and mostly figured in M. d'Orbigny's 'Voyage to South America.'

4. The Mollusca described and figured by M. d'Orbigny in M. Ramon de Sagra's 'Natural History of Cuba and the West Indies.'

5. The terrestrial and marine Shells described by M. d'Orbigny in Webb and Berthelot's 'Natural History of the Canaries.'

On a new species of Suthora *from China*. By G. R. GRAY, F.L.S., F.Z.S., &c.

SUTHORA WEBBIANA.

Crown of the head and back of the neck sandy red, passing into the olive tint of the back and upper surface generally; tail of the same colour, but of a shade darker than the back; primaries strongly edged with bright rufous; throat and breast light buff, washed with a rosy tint; abdomen inclined to olive; bill light brown, washed with rosy pink; legs either yellow or fleshy white.

Hab. China (Shang Hai).

A single specimen, collected by Mr. Webb, was presented by that gentleman to the British Museum. It is much larger than *S. nipalensis* and *fulvifrons*.—*Zool. Proc.* March 9, 1852.

On some Fishes allied to Gymnotus. By Alfred R. Wallace.

My object is to call the attention of the Society to some curious fishes allied to the Electrical Eel, which are abundant in the fresh waters of South America. They present many modifications of form, and will probably constitute a distinct family or subfamily. They may be characterized as fishes of an elongate form, very slender posteriorly, without dorsal or ventral fins, but with a very long anal fin. The intestines are situated immediately behind the head, and occupy a very small portion of the entire length of the fish. The teeth are very small, or altogether wanting. The air-bladder is in some species very long, in others almost obsolete; and the scales are very minute, ovate, concentrically striate, and often so imbedded in mucus as to be invisible till scraped off. The gill-opening is generally very small, and the eyes and nostrils minute.

There seems to be sufficient variety of form and structure to justify the establishment of *five genera*.

1. The true *Gymnotus* (of which the *Gymnotus electricus* appears to be the only well-known species), characterized by the anal fin reaching the extremity of the tail, which is flattened; by the air-bladder extending almost the entire length, in a cavity beneath the vertebræ; and by having a single row of short acute teeth in each jaw.

2. The genus *Carapus*, to which five of my species belong. These have the tail cylindrical and pointed, extending beyond the anal fin; a band of minute teeth in each jaw; and a double air-bladder, generally of very small size. One of my species appears to be identical with *Carapus brachyurus* of Bloch.

3. A form, of which I have but one representative, which has a deep body, a rather large mouth, but *no teeth*, and a small round single air-bladder.

4. Two long-jawed species, which have a very small mouth, *no teeth*, and *no air-bladder*. The larger of these is probably the *Gymnotus rostratus* of Schneider.

5. The genus *Apteronotus*, which differs from all the preceding in having a small, but perfectly-formed and rayed caudal fin, a rather large mouth, with the lower jaw shutting within the upper, and the teeth rather acute and prominent in a row on the *sides* of the jaws only. My representative of this genus appears to be quite distinct from *Apteronotus albifrons* of Lacépède.

These fishes were all found near the sources of the Rio Negro and Orinoco, one of the most central positions in South America. They are most abundant in the smaller streams, and feed on minute aquatic insects. None of them, except the common *Gymnotus*, have any electrical properties. They are all eaten, though, owing to the number of forked or branched bones in every part of their bodies, they are not much esteemed.

The situation of the vent in these fishes is very peculiar, the intestine passing forwards from the stomach, instead of backwards, as is usually the case, so that they have the anus situated under the throat; in one of the long-snouted species it is actually considerably in front of the eyes, a peculiarity which I believe does not occur in any other vertebrated animal.

This fish, too, is remarkable for the very singular manner in which it is said to feed. It is asserted that it lives principally on ants and white ants, which it obtains by laying its tail out upon land. The ants, attracted by its mucous covering, crawl thickly upon it, when the fish dives down and leaves the ants struggling upon the surface of the water, where it is enabled to eat them at its leisure. The Indians assert that, when fishing at night, they often see this take place.

To give some idea of the distribution of fishes in the rivers of South America, I may mention, that of 205 species which I found in the Rio Negro,—

43 were spinous-finned fishes, principally *Percidæ* and *Labridæ*;
54 were *Siluridæ*;
80 were *Salmonidæ*;
24 were other soft-finned fishes, of the families *Esocidæ, Anguillidæ* and *Cyprinidæ*; and
4 were Ray fish (cartilaginous fishes).—*Zool. Proc.* July 12, 1853.

METEOROLOGICAL OBSERVATIONS FOR SEPT. 1854.

Chiswick.—September 1. Very fine. 2. Slight fog: very fine. 3. Foggy: very fine. 4. Foggy: slight haze: excessively dry air. 5. Very fine: hazy: fine. 6—10. Very fine. 11. Dense fog: clear: quite cloudless: very fine. 12. Dense fog: very fine. 13. Cloudy: rain. 14. Cloudy: slight rain: overcast. 15. Very fine. 16. Overcast. 17. Very fine. 18. Fine: cloudy: rain. 19. Overcast and windy: slight rain. 20. Cloudy: rain. 21. Clear: quite cloudless: fine: lightning in the evening. 22. Very clear: fine. 23. Densely overcast. 24, 25. Very fine. 26—29. Foggy, with very heavy dews in the mornings: very fine throughout the days: clear and cold at nights. 30. Dense fog throughout.

Mean temperature of the month	56°·93
Mean temperature of Sept. 1853	55 ·45
Mean temperature of Sept. for the last twenty-eight years	56 ·98
Average amount of rain in Sept.	2·57 inches.

Boston.—Sept. 1—4. Fine. 5. Cloudy. 6. Fine. 7—9. Cloudy. 10—12. Fine. 13. Cloudy. 14. Rain A.M. 15—17. Cloudy. 18. Fine. 19. Cloudy: rain A.M. 20. Rain A.M. 21, 22. Fine. 23. Cloudy: rain A.M. 24. Cloudy: stormy A.M. and P.M. 25—29. Fine. 30. Foggy.

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

Mean temperature of Sept. for twenty-seven previous years	52°·32
Mean temperature of this month	55 ·07
Mean temperature of Sept. 1853	53 ·28
Average quantity of rain in Sept. for fourteen previous years	2·81 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1854. Sept.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	30·314	30·274	29·87	30·19	30·16	72	39	57	57	52	e.	calm	sse.	....	....	....
2.	30·353	30·339	29·87	30·13	30·13	74	37	59	58½	58	e.	s.	wsw.	....	....	....
3.	30·333	30·282	29·89	30·16	30·20	78	37	63	62½	56½	e.	s.	ssw.	....	....	....
4.	30·351	30·302	29·86	30·20	30·41	80	35	57	52	51½	e.	ssw.	wnw.	....	....	·06
5.	30·421	30·410	29·95	30·42	30·34	68	36	64	54½	52½	e.	e.	w.	....	....	....
○ 6.	30·378	30·236	29·90	30·13	30·22	73	38	55	56	58	ne.	calm	ne.	....	....	....
7.	30·237	30·206	29·77	30·31	30·34	76	46	64	52	51	e.	calm	ese.	....	....	·29
8.	30·221	30·176	29·77	30·30	30·23	67	43	58	55	52	ne.	nne.	ese.	....	....	....
9.	30·174	30·139	29·75	30·18	30·10	68	32	58	58	51½	ne.	n.	sse.	....	....	....
10.	30·191	30·101	29·74	30·02	29·93	68	33	61	57	57	ne.	calm.	s.	....	....	....
11.	30·174	30·082	29·74	29·81	28·84	73	31	52	61	58	se.	w.	sw.	....	....	·28
12.	30·016	29·901	29·58	29·75	29·52	81	58	60	62½	56½	se.	s.	s.	·03	....	·56
13.	29·912	29·779	29·38	29·55	29·42	72	58	67	55	55	se.	w.	s.	·08	....	....
☾ 14.	29·814	29·682	29·23	29·34	29·33	69	50	64	57	54	sw.	ssw.	w.	·28	·05	·49
15.	29·951	29·903	29·45	29·41	29·56	71	58	61	55	54	s.	sw.	sw.	·02	·03	·14
16.	29·876	29·822	29·30	29·35	29·41	71	62	69	57	58	sw.	sw.	sw.	·02	....	·18
17.	29·899	29·769	29·26	29·33	29·32	74	49	65	59	56	sw.	wsw.	sw.	....	....	....
18.	30·092	30·015	29·56	29·50	29·32	69	59	57·5	58	54	sw.	w.	sw.	·05	....	·22
19.	29·990	29·936	29·47	29·58	29·70	72	58	60·5	59	56	sw.	sw.	w.	·02	·08	·25
20.	30·006	29·890	29·37	29·53	29·51	71	41	58	58	55	n.	nw.	w.	·04	·06	·06
21.	30·193	30·144	29·57	29·91	30·10	72	34	54	54	49	w.	w.	w.	....	·04	·26
● 22.	30·314	30·255	29·88	30·11	30·05	63	44	47	57	56	nw.	nw.	se.	·03	....	....
23.	30·218	30·197	29·74	29·77	29·65	63	55	57	55	54	w.	nw.	nw.	....	....	·36
24.	30·093	30·058	29·50	29·55	29·68	70	36	62	46½	48½	w.	wsw.	wnw.	....	·02	·78
25.	30·300	30·247	29·80	29·99	30·04	64	34	51·5	49½	53½	n.	nw.	w.	....	·02	·15
26.	30·342	30·304	29·90	29·97	30·00	69	34	50	57	55½	nw.	sw.	w.	....	....	·10
27.	30·332	30·219	29·90	30·04	30·09	70	33	51	59	55	se.	s.	sw.	....	....	....
28.	30·138	30·080	29·73	30·11	29·99	71	33	54	52	53½	e.	se.	sw.	....	....	....
☽ 29.	30·106	30·070	29·68	29·91	29·84	76	37	48	55½	54	ne.	nw.	sw.	....	....	....
30.	30·159	30·134	29·74	29·84	30·10	75	36	51	54½	52	n.	calm	sw.	·01	....	....
Mean.	30·163	30·098	29·67	29·879	29·881	71·33	42·53	57·8	55·93	54·21				0·58	0·30	4·18

THE ANNALS

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XXXVI.—*Remarks on Associations of Colour and the Relations of Colour and Form in Plants.* By G. Dickie, M.D., Professor of Natural History, Queen's College, Belfast*.

Relations in the form, structure, number and position of organs are familiar to every botanist. *A priori* it might have been inferred that order prevails in the distribution of colours; that there is no mere fortuitous relation, but that all must be subject to law. This is not only the fact, but there are, besides, obvious indications of a relation between the colour and form of organs.

In April and May 1853, the facts to be here recorded were first observed and demonstrated to scientific friends in Belfast. Professor M'Cosh, in a lecture before the Natural History Society in May 1853, intimated that he had for some time entertained a belief in the existence of complementary colours in the vegetable kingdom. The results of my own observations were embodied in a paper read at the October Meeting of the same Society in that year. It would seem, however, that certain associations of colour have been long known to artists who have cultivated the special department of flower-painting. Any relation, however, between form and colour appears to have escaped notice, and even erroneous ideas have been promulgated respecting this point. Thus Ruskin, in his 'Lamps of Architecture,' states that "the natural colour of objects never follows form, but is arranged on a different system;" and again, "colour is simplified where form is rich, and *vice versâ*." "In nature," he further says, "the boundaries of forms are elegant and precise; those of colours, though subject to symmetry of rude kind, are yet irre-

* Read to the Botanical Society of Edinburgh, Nov. 9, 1854.

gular—in blotches." All these statements are far from representing the truth.

Without alluding to differences of opinion which have been recently published regarding the law of harmonious colours, it may be sufficient to allude briefly to the views usually entertained by physicists and most generally adopted. White or compound light consists of three simple colours called primaries, viz. yellow, red, and blue; combinations of these yield secondaries;—yellow and red give orange, yellow and blue give green, red and blue give purple. Combinations of secondaries yield tertiary colours,—green and orange give citrine, purple and green give olive, orange and purple yield russet.

A primary and secondary, together containing all the primaries, are complements to each other; for example, yellow and purple; red and green; blue and orange. The presence of all the colours either separate or combined (which form white or compound light) is a physical want of the organ of vision.

The artist recognizes a melody of colours, that is, gradations of hues and shades, and speaks of harmony when complementary colours are present. A white line (or black) between two colours not complementary subdues discord. There is a correspondence between the depth of any hue and that of its complement; for example, red-purple and yellow-green are associated. Every association of colour in the organic world may be regarded as an actual embodiment of results, which cannot be otherwise than in strict harmony with those great principles which have guided the plans of the Great Author of nature.

It is worthy of notice, that colour is the foundation of one of the more recent classifications of Algæ, that of Professor Harvey. They are divided by him into red, green, and olive; among the red series are comprehended many which present various tints, of purple for example, and in the olive series not a few are yellow-green. All this is in strict accordance with the views just adverted to.

Among the family of the Mosses the red or red-purple teeth of the peristome are associated with the green or yellow-green capsule; the same is true of the different parts of their stems and leaves.

In flowering plants the cases are so numerous, that only one example or two need be recorded.

Primula vulgaris.

Young leaves { stalk, red-purple.
leaf, yellow-green.

Caladium pictum.

Leaf { centre, red or red-purple.
border, green or yellow-green.

Coleus Blumei.

Leaf { centre, red or red-purple.
border, green or yellow-green.

Victoria Regia.

Leaf { lower surface, red-purple.
upper surface, yellow-green.

Taxodium sempervirens.

Young shoots, yellow-green.
A year old, red-purple.
Older still, citrine.

In this last instance, as well as in many others, advanced growth seems to be accompanied with greater composition of colour. In the curious pitcher-like organs of *Sarracenia, Nepenthes* and *Dischidia,* we find that red-purple and yellow-green are associated.

In the flower, similar associations are the rule.

Ranunculus repens.

Corolla, yellow.
Calyx, purple spots.

The same may be observed in many other species of the same genus.

Hieracium pilosella.

Flower, yellow.
Those of the circumference variegated with purple.

Anthyllis vulneraria.

Corolla, yellow.
Tip of calyx, purple.

Saxifraga ligulata.

Corolla, white with purple spots.
Anthers, yellow.

Kalmia (species).

Ten spots of *purple* on the corolla at points in contact with the yellow anthers.

Juncus compressus.

Anthers and pollen, yellow.
Ovary and stigma, purple.
Perianth { edge, russet.
centre, dark green.

Strelitzia Reginæ.

——— *juncea, &c.*

Sepals, orange.
Petals, blue.

In most Orchideæ we find constant associations of yellow and purple.

We need not expect to find in a corolla or any other organ pure red and pure yellow, or blue and red, *in contact with each other.*

Of the primaries, blue is the least common, and in fact, generally speaking, may be called *very rare*; many so-called blues being blue-purples: transmitted light shows this. Pure blue being so uncommon in any organism, Professor M'Cosh suggested to me that this is compensated for in the atmosphere, and I may add, in the ocean too. Yellow is probably the most general of the primaries, in the flower at least; the most common association is therefore yellow and purple. We can now understand why yellow is the usual colour of the pollen, and some exceptional cases seem to confirm this; in the Turn-cap Lily for instance, the decidedly red pollen is associated with the green filaments of the anthers.

The statistics of colour in different natural orders have not been fully examined; it may be remarked, however, that purple and citrine prevail in the flowers of the Grasses, and russet and dark green in the Junci. In the Fir-tribe and its allies, secondaries and tertiaries are common, such as the purple and citrine scales of young and old cones, the russet and dark green in the stems and leaves respectively; at the same time the copious yellow pollen must not be lost sight of.

In examining this subject, we must keep in view that the colour of the flower may have its complement in that of other organs, as stem, leaf, &c. It sometimes happens that one of the associated colours is not visible to the eye at all times. The inside of a nearly ripe fig is red-purple, the outside yellow-green; the same is true of the pericarp in some species of Pæony. In some Cactaceæ the yellow corolla is succeeded by a purple fruit.

The newly ripened cone of the *Pinus Pinaster* is citrine; when the scales open, the complementary purple is revealed at the base of each. In the fruit, fixed relations of colour are probably too familiar to require illustration. In certain varieties of the Apple, red and red-purple, green and yellow-green of various hues and shades are associated. In some varieties of Pear, yellow-green, red-purple and citrine occur together.

Direct exposure to light, although usually, and in general correctly admitted to have a direct relation to intensity of colour in organisms, appears not to be necessary in every instance; the plant, however, must receive the light at some part or other in order to produce that depth of colour observed in the coats of seeds, the interior of fruits, and in the tissues of subterranean organs.

In conclusion—

1. *The primaries, red, yellow, and blue, are generally present in some part or other of the plant.*

2. *When a primary occurs in any part of a plant, its complement will usually be found in some other part* (*or at some period or other of the development of the plant,* as was suggested to me by Professor M'Cosh).

Observations on the same subject in the animal kingdom have occupied my attention during the past twelve months; Birds, Mollusca, and Radiata present associations of colour not less remarkable than those here recorded.

The relation between colour and form may now be examined, and the remarks, for the present, have reference to the parts of the flower.

When the calyx and corolla are equal in size and similar in form, the flower is regular; differences in size and form are found in irregular flowers. For example, the Violet has an irregular flower, that of the Wallflower is regular; a Primrose has a regular flower, a Snapdragon presents an example of irregularity. Such expressions are equally applicable to monocotyledonous and to dicotyledonous plants, to polypetalous and gamopetalous corollæ.

LAW 1. *In regular polypetalous and gamopetalous corollæ the colour is uniformly distributed, whatever be the number of colours present.*

That is to say, the pieces of the corolla being all alike in size and form, have each an equal proportion of colour. The common Primrose is an example where one colour only is present. In the Chinese Primrose the same holds where two colours (one the complement of the other) are present; the eye or centre is yellow, the margin purple. These two colours in this regular flower are uniformly diffused, that is, each piece has an equal proportion of yellow and of purple respectively. In *Myosotis, Anagallis, Erica, Pyrola, Gentiana,* &c., we have instances. All corollifloral Exogens with regular flowers are examples; the same is true of certain Thalamifloræ, as Papaveraceæ, Cruciferæ, &c. In *Iberis coccinea,* belonging to Cruciferæ, we find unequal size of petals, but equal distribution of colour, because regularity of flower is the law in that family.

Calycifloral Exogens with regular flowers are also examples, as Rosaceæ, Cactaceæ, &c.

LAW 2. *Irregularity of corolla is associated with irregular distribution of colour, whether one or more colours are present.*

The odd lobe of the corolla is most varied in form, size, and in colour.

When only one colour is present, it is usually more intense in the odd lobe.

When there are two colours, one of them is very generally confined to the odd lobe. Sometimes when only one colour is present and of uniform intensity in all the pieces, the odd lobe has spots or streaks of white. This piece of the corolla therefore in irregular flowers is distinguished from the others not merely by size, form and position, but also by its colour.

Papilionaceæ present examples of this law; a few instances may suffice.

Cytisus Laburnum.
4 petals yellow.
5th yellow with purple veins.

Lathyrus pratensis.
Much the same as *Laburnum.*

Trifolium pratense.
Odd lobe distinguished from the others by its darker purple veins.

Kennedia monophylla.
4 petals purple.
5th yellow eye and purple margin.

Swainsonia purpurea.
4 petals purple.
5th white eye on purple ground.

Even when the odd lobe of a papilionaceous plant is smallest,—not a common case,—it may be distinguished by its colour; for instance, in *Brachysema acuminatum* the odd lobe is comparatively small, but has yellow eye and purple margin.

Irregular gamopetalous corollæ also present examples of this law.

Ajuga reptans.
Corolla { 4 divisions purple.
5th has yellow spot on inner surface.

Thymus Serpyllum.
Corolla, generally red-purple.
Two pale spots on odd lobe.

Galeopsis Tetrahit.
Odd lobe has generally two colours, yellow and purple.

Numerous other examples from Labiatæ might be quoted.

Among Scrophulariaceæ we may instance the following:—

Euphrasia officinalis.
Corolla purple, generally.
Odd lobe has yellow spot.

Digitalis purpurea.
Has white on odd lobe.

In some species of *Schizanthus* and *Collinsia* we find purple the prevailing colour; the primary, yellow, appears in the odd lobe.

In some genera with irregularity of flower often less marked than in the examples alluded to, it is worthy of notice that the two divisions on each side of the odd lobe frequently partake of its characters as regards colour, half of each resembling the odd piece; *Viola, Gloxinia, Achimenes, Rhododendron,* &c. are examples. In some Thalamiflorous Exogens with irregular flower, as *Pelargonium* and *Tropæolum,* we find that the two upper pieces are usually largest, and present also the greatest variety in depth of colour. In the Horse-chestnut there is a very decided relation between the size of the petals and the intensity of the colour. On each petal there is usually a crimson spot at the junction of the limb and claw; the size of this spot and its intensity are in direct relation to the size of each petal; the two upper being largest, the two lateral smaller, and the odd piece least of all.

It may therefore be stated, that *in some Thalamiflorous Exogens with irregular corolla, owing chiefly to difference in size of the petals, the largest are most highly coloured.*

Law 3. *Different forms of corolla in the same inflorescence often present differences of colour, but all of the same form agree also in colour.*

The Compositæ are illustrations of this: when there are two colours, the flowers of the centre have generally one colour of uniform intensity; those of the circumference agree together also.

The common Daisy has all the tubular flowers of the centre yellow, and all the ligulate flowers of the ray are white, variegated with purple. A yellow centre with purple ray is a common association in compound flowers, for instance, in species of *Aster, Rudbeckia,* &c.

The same general laws prevail in Monocotyledons as in Dicotyledons. In the former the calyx and corolla generally resemble each other in structure and shape, and in colour also; hence an dea entertained by some that the perianth is single, relative osition having been overlooked. In Dicotyledons we generally find a greater contrast between calyx and corolla as regards colour.

The law of the contrasts is therefore simpler in Monocotyledons than in Dicotyledons.

The former may be symbolized by the triangle, 3 and 6 being the typical numbers in the flower; the latter by the square or pentagon, 4 and 8, 5 and 10 being the prevalent numbers.

The simplicity of figure corresponds with simpler contrast of colour in the one, while greater complexity of colour and of structure are in direct relation in the other.

In families of Monocotyledons having regular flowers there is regular distribution of the colours, for instance, in Amaryllidaceæ, Liliaceæ, &c.

Orchidaceæ are notable examples of the other law, that irregularity of form and of colour are associated. In a large proportion of this family the colours are yellow or yellow-green, and purple or red-purple; the latter being confined to the part of the corolla usually called *lip*.

Proceeding on the principle, that since plants of all epochs of the earth's history were constructed on the same general plan, so the same associations of colour, and of colour and form, must have prevailed also, we shall glance finally at a few conclusions which may be derived from this source.

During the earlier periods when Acrogenous Cryptogamia were abundant, the secondary and tertiary colours, as russet, purple, citrine, green, must have prevailed.

During the reign of Gymnosperms, when Cycadeæ and Coniferæ were numerous, the secondary and tertiary colours must still have given a sombre aspect to the vegetable world.

From the commencement of the Chalk formation there appears to have been a very marked and progressive increase of Angiospermous Dicotyledons, which form at least three-fourths of existing vegetation. Among them we find the floral organs with greater prominence in size, form and colour; and such prominence of the "nuptial dress" of the plant, to use the quaint expression of Linnæus, is peculiarly a feature of species belonging to natural families which have attained their maximum in man's epoch, and are characteristic of it.

XXXVII.—*On* Linaria sepium *of Allman.* By Charles C. Babington, M.A., F.R.S., &c.*

At a meeting of the Royal Irish Academy, held June 6th, 1843, the occurrences at which are reported in the 'Proceedings' of that body, Dr. G. J. Allman described what he supposed to

* Read before the Edinburgh Botanical Society, Nov. 9th, 1854.

be a new species of *Linaria*, and upon which he conferred the name of *L. sepium*.

In the second edition of my 'Manual of British Botany' (p. 232), the opinion was stated that the plant is "scarcely more than a variety of *L. italica*," and in the third edition of the same book I ventured to consider it and the *L. italica* of the Manual as hybrids between *L. vulgaris* and *L. repens*.

In consequence probably of the latter remark, I was favoured by Dr. Allman, in June 1852, with a large packet of living specimens and roots of the disputed plant. A careful examination of these, and a comparison of them with living specimens of *L. repens*, led me greatly to doubt the correctness of the supposition that it was a variety of *L. repens*; and Dr. Allman justly states in a letter to me that the "total absence of *L. vulgaris* from the neighbourhood where the plant in question abounds must render hybridization impossible." In another letter he remarks, "I only know of one spot in the neighbourhood of Bandon where *L. vulgaris* grows apparently wild, and there very sparingly. It may possibly have escaped from a neighbouring garden. This spot is more than a mile in a direct line from the nearest patch with which I am acquainted of *L. sepium*, and three or four miles from other localities where the *L. sepium* is abundant." Also, "in the same hedge with the apparently wild plants of *L. vulgaris* just mentioned, and removed perhaps from these about 100 yards, grows *L. repens*, and yet not a trace of *L. sepium* have I found to grow within a mile of them." These remarks show the great improbability, if indeed I might not say impossibility, of the *L. sepium* being a hybrid. Two of the roots received from Ireland have grown well and flowered profusely in the Cambridge Botanical Garden, and have thus afforded an excellent opportunity for studying the plant.

As I now believe the plant to be a distinct species, I have drawn up the following character and description of it, and in doing so have followed the type of the descriptions of the allied species to be found in the valuable 'Monographie des Antirrhinées' of Chavannes.

Linaria sepium (Allm.); radice repente, caulibus erectis glabris, foliis lineari-lanceolatis acutis sparsis, floribus racemosis, sepalis ovatis acutis glabris calcare brevioribus, *seminibus tuberculato-scabris trialatis*.

L. sepium, *Allman in Proceed. R. Irish Acad.* (1843) p. 404.

Caules e rhizomate repente incrassato sæpeque tuberculis instructo prodentes, plurimi, simplices vel ramulosi, læves, basi lignescentes (cortice fuscescente), bipedales; ramuli alternes, erectiusculi. Folia pollicaria vel sesquipollicaria, lineari-lanceolata, utrinque attenuata, acuta, subtrinervia (nervis lateralibus tenuibus), erectiuscula, glaucescentes, inferiora sæpe subterna ceteraque sparsa. Bracteæ lineari-lanceolatæ, acutissimæ, erectæ, inferiores pedicello longiores, superiores pedicello breviores. Racemus strictus, laxiusculus. Calyx parvus; segmentis e basi lato attenuatis, acutissimis, glaberrimis, trinerviis, post anthesin apice paululum reflexis. Corolla minor quam in *L. vulgari*; calcar conicum, paululum incurvum, corollam æquans; tubus, calcar et labium superius grisei striis pallide purpureis signati; labium inferius dilute luteum striis pallide purpureis et parum distinctis notatum; palatum villis luteis vestitum, villis pallide purpureis quemque marginem investientibus, valde prominens, bilobum, lobis aurantiacis; lobis labii superioris ellipticis, dorso invicem applicatis sed apicibus incurvis; lobis labi inferioris lateralibus reflexis conniventibus, oblique rotundatis intermedio patenti latioribus et paululum longioribus. Stigma capitatum. Capsula subovata, dehiscens superne sex valvulis lanceolatis, calycem subæquans. Semina subtrialata; testa nigra, muricata.

Found plentifully near the river at Bandon, in the county of Cork, flowering from June to September.

L. sepium forms dense masses of strong stems, and presents a very different appearance from *L. repens* or *L. vulgaris*. Its flowers and seeds are unlike those of either of them; and in size the flowers are almost exactly intermediate between those of its allies. The same part of the rhizome does not appear to flower a second time, but numerous stems spring up at a short distance from it, which flower in the succeeding year.

In *L. vulgaris* the middle lobe of the lower lip of the corolla is relatively much smaller and is *strongly reflexed*, whilst the lateral lobes are patent-deflexed.

In *L. repens* the lobes of the upper lip of the corolla are erect with incurved points, and all those of the *lower lip patent*.

It will be seen above that in *L. sepium* the lobes of the upper lip are pressed closely back to back; and that the lateral ones of the lower lip are reflexed, but the intermediate one is patent. The colours also are different.

After a careful examination of all the descriptions of *Linariæ* with which I am acquainted, I have not found any recorded species to which this plant can be referred. I am therefore reluctantly compelled to consider it as a new species. It agrees in many respects with *L. linifolia* (Chav.), differing chiefly in the presence of a few three-leaved whorls towards the base of the stem, the shorter upper bracts, the striped flowers, and the three-winged seeds.

The seeds of *L. sepium* are different from those of any species that I have examined. They are discoidal, and surrounded by a wing; but have in addition another wing on one of the sides which is variable in its size and direction, being sometimes nearly at right angles with the disk, and at others laid so closely upon it as to be with difficulty detected. Rarely the additional wing is reduced to a reduplication of the wing of the disk through more or less a distance. The disk is covered on each of its sides with elevated ridges radiating more or less regularly from the centre. The whole seed is black.

XXXVIII.—*Characters of four Indian species of* Cyclophorus, Montfort, *followed by Notes on the Geographical Distribution of the Genera of the* Cyclostomacea *in Hindostan.* By W. H. Benson, Esq.

1. *Cyclophorus altivagus*, nobis.

Testa angustissime umbilicata, fere perforata, globoso-conica, solida, striata, superne rufa, castaneo picta, subtus versus periomphalum albida; spira elevata, turbinata, acutiuscula; anfractibus $5\frac{1}{2}$ convexis, superne costis spiralibus sex munitis, ultimo rotundato, ad periphæriam vix carinato, basi lævigata, umbilico pervio; apertura vix obliqua, subovali-circulari, superne angulata, intus lutescente; peristomate duplici, interno continuo, valde porrecto, acuto, externo expansiusculo, costam fingente, superne anguste angulatim adscendente, ad anfractum penultimum late emarginato, margine columellari minime sinuato, supra umbilicum angustum dilatato-reflexo. Operc.?

Diam. major 31, minor 26, alt. $24\frac{1}{2}$ mill. Apert. intus 17 mill. longa, 15 lata.

Hab. in summis montibus Mahabuleshwar Indiæ Meridionalis. Detexit A. E. Benson.

A single decorticate specimen was found by my son, Lieut. Arthur E. Benson, Tenth Royal Hussars, after the close of the rains of 1853, on the summit of the range of Ghauts overlooking the low tract in which *Cyclophorus Indicus* occurs. It differs from this species in its more elevated form, indistinct keel, rounded last whorl, more elongate aperture, porrect inner lip, the absence of any sinuosity in the plane of the aperture on the columellar lip, less expanded outer peristome, and by the greater expansion of the external columellar lip over the umbilicus, which is also much narrower; and permits no view of the internal whorls. The outer lip, at its junction with the last whorl, rises more suddenly to a point than in *C. Indicus*. It is probable that when in good condition the internal border of the aperture is of an orange colour. In the specimen before me I can find no trace of the close-set raised lines between the liræ which are present in all my specimens of *C. Indicus* from Elephanta and the Concan, however weathered. In one antiquated specimen of the latter, with a porrect superstructed inner peristome, this part still preserves the expanded edge, so different from the sharp lip present in the mountain species.

2. *Cyclophorus pyrotrema*, nobis.

Testa umbilicata, turbinato-conica, solida, superne costis spiralibus, obtusiusculis, confertis, striisque obliquis confertissimis sculpta, castaneo albidoque fulguratim strigata et marmorata; spira conica, elevatiuscula, apice acuto. Anfractibus 5 convexis, ultimo fascia albida mediana, infra periphæriam obsolete angulatam fascia lata, subtus nonnullis aliis castaneis ornata; basi valde convexa circa umbilicum submediocrem pervium albida; apertura vix obliqua, irregulariter subcirculari, superne angulata, intus lactea vel cærulescente; peristomate duplici, breviter ad anfractum penultimum adnato, interno continuo, expansiusculo igneo, externo reflexiusculo albido, margine columellari sensim arcuato, fere verticali, subrevoluto, subsinuato. Operculo normali, tenui, pallide fusco, margine anfractuum elevatiusculo, scabro.

Diam. major 36, minor 30, alt. 26 mill.
——— 34, —— 28, — 24 mill.
——— 26, —— 21, — 18 mill.

Hab. ad Sikrigali et Patharghata, Bahar, et ad Rajmahal Bengaliæ. In rupibus umbrosis et sub arboribus, inter folia emortua, annis 1831 et 1835, ipse detexi.

A variety occurs in which the shell is of a pale buff colour, darker towards the apex, the bands and markings being obsolete, and the colour of the peristome being equally vivid with that of the typical shells. Another thinner variety occurs, in which the interior coloured lip is not present.

Sowerby, in 1834, marked this species as *C. Involvulus*; however, the typical form of that species proves to be more depressed, the umbilicus more open, the aperture more rounded, with an orange interior, while in this species it is cærulean white or milky.

A description of the animal will be found in the last vol. of the 'Zoological Journal' under the name of *C. Involvulus*.

With a general resemblance in form to *C. Indicus*, Desh., it will be at once distinguished by the absence of a keel or acute spiral ribs, by the wider umbilicus, less developed peristome, and more elevated form. The very gradual arcuation of the columellar lip is also an essential character, detracting from the uniformity of the circular aperture. The sinus observable at this part, impinging on the plane of the aperture, is also conspicuous in *C. Indicus*.

3. *Cyclophorus Exul*, nobis.

Testa angustissime umbilicata, fere perforata, globoso-turbinata, tenui, undique lineis spiralibus vix elevatis, superne 8–9 valde obtusis, striisque obliquis teneribus decussata; sub epidermide fusca, tenui, albida; superne castaneo flexuoso-strigata, fascia nulla mediana cincta; spira turbinata, apice obtusulo, rufescente, suturis distinctis. Anfractibus 5 convexis, ultimo rotundato. Apertura vix obliqua, subcirculari, superne angulata; peristomate simplici, tenui, expanso, reflexiusculo, vix continuo, margine columellari umbilicum non pervium subtegente.

Diam. major 25½, min. 20, alt. 17 mill. Apert. intus 13 mill. longa.

Hab. ad Bhamoury, ad pedem montium Rohillano-Himalayanorum. Detexit W. J. M. Boys.

This is the most northerly *Cyclophorus* known. It was discovered by the late Captain W. J. M. Boys, an indefatigable collector in several branches of zoology, and the discoverer of the genus *Boysia*, Pfr., by whose recent decease, as well as by that of Dr. J. F. Bacon, another Indian collector of great experience, science has sustained a severe loss.

This shell differs from the pale-lipped *C. pyrotrema*, in which the aperture is not fully developed, by its more globose form, ventricose last whorl, small impervious umbilicus, more regular sculpture above, stronger sculpture below, thinness, pale colour, and the absence of any medial fascia. From the pale-lipped variety of *C. Stenomphalum* with undeveloped peristome, it differs by the greater breadth of the aperture in proportion to its length, its non-pervious umbilicus, the absence of any carina at the periphery, the more closely sulcate and regular sculpture above, the extension of the sculpture on the under side into the umbilicus, its pale suite of colours, and by the absence of any colouring below the periphery. From *C. Indicus* it may be known by the absence of keel, suite of colours, sculpture, and aperture.

4. *Cyclophorus Tryblium*, nobis.

Testa subaperte umbilicata, depresso-turbinata, solida, superne costis 7–8 planulatis munita, albida, castaneo marmorata, subtus lævigata, versus periomphalum albida, fascia nigricante ad periphæriam ornata; spira turbinata, superne rubella, apice acutiuscula. Anfractibus 5 convexis, ultimo subdepresso, obsolete angulato, subtus valde convexo; umbilico profundo, infundibuliformi. Apertura vix obliqua, subcirculari, intus lutescente; peristomate subsimplice, continuo, breviter adnato, pallide aurantio, subincrassato, superne angulatim adscendente, margine dextro subrevoluto, columellari subexpanso, planato. Operc.?

Diam. major 47, minor 38, alt. 29 mill. Apert. intus 20 mill. longa.

Hab. ad Darjiling. Detexit H. Chapman.

I find a single specimen, not in fine condition, among shells kindly collected at my request by Dr. Chapman, to whom I was also indebted for the first known specimen of *Meg. funiculatum.*

It does not appear to have been detected by any subsequent collector in the environs of Darjiling. Nearly equal in size to *C. Himalayanus,* Pfr., from the same locality, it is distinguished from it by its form, depressed last whorl, wide umbilicus, sculpture, verticality of the angle at the upper part of the mediocre aperture, and by the colour of the peristome. There are indications of a broad light chestnut zone below the dark band at the periphery. The compressed character of the last whorl presents a strong contrast to the subglobose form of *C. Himalayanus* in that part.

Geographical Distribution of the Genera of the Cyclostomacea *in Hindostan.*

In the 8th vol. of the New Series of the 'Annals,' I attempted a view of the geographical distribution of the Indian species of *Cyclostoma* as then known to me. I am now able to add some species to the list, and it will prove interesting to exhibit the manner in which the different genera, as recognized by Pfeiffer, are distributed, from the Himalaya to Cape Comorin.

Cyclophorus, Montf.

Beginning with the largest and most extensively spread form, *Cyclophorus,* we find it at Darjiling in the Sikkim territory, occurring at an elevation of 7000 feet, under the gigantic types *C. Himalayanus,* Pfr., *C. Tryblium,* nobis, *C. Stenomphalus,* Pfr., the variety which I designated as *C. Aurora,* and the small widely umbilicated *C. Phænotopicus,* nobis. This region carries a subtropical vegetation to a great elevation. At some hundred miles to the west and north, at the foot of the Rohilkhund Himalaya, where a similar vegetation begins to give way to more European types, we find the outpost of the genus, in this direction, in *C. Exul,* nobis; and, as might be expected, the shell is dwarfed in size, light in structure, and modestly coloured. It may be remarked, in illustration, that *C. turgidus,* Pfr., is found near the Chinese coast, as high as Loochoo, in a parallel, however, less northerly than Bhamoury. The influence of a marine climate tells on that species in its superior solidity and colouring.

Crossing, to the eastward, the valley of Assam, and arriving at the group of mountains south and east of the Berhampooter river, we meet some fine forms in *C. eximius,* Mouss., *Pearsoni,* and *zebrinus,* nobis, *Stenomphalus,* and *Bensoni**, Pfeiffer; *C.*

* The habitat of this shell was unknown to Pfeiffer. I have the ordinary variety from the northern base of the Khasya hills, near Gowahatty, in the Assam valley. The specimens were kindly sent to me by Captain

milium, nobis, a dwarf species from the warm southern valleys, perhaps belongs to this type. Again traversing westerly the Gangetic plain of Bengal, *C. pyrotrema*, nobis, appears among the first rocks met with in the outlying portions of the Rajmahal range, where the stream of the Ganges makes a bend to the south; and the genus proceeds along the ranges, with a southerly tendency, towards the western side of the peninsula, skirting the north bank of the Nerbudda, and is represented by a fine new species, *C. Pirrieanus*, Pfr., in the Khoondah hills; by *C. stenomphalum* at Chyabasa in Singhboom; and at Mandoo, west of Indore, by a species not well ascertained, but which has been attributed, erroneously, to *C. Volvulus*, Müll., although widely differing from the Pulo Condore form. Traversing the river-valleys of the Nerbudda and Tapty, we find *C. Indicus*, Desh., inhabiting the warm region of the Concan (enclosed between the sea and the high Western Ghauts) and the adjacent islets.

A small species, from the description evidently new, and probably attributable to this type, was found near the ridge of these hills by Lieut. A. E. Benson, at the Caves of Karli, but unfortunately was broken and the fragments thrown away. This hint may assist in securing its detection when a conchologist may have an opportunity of visiting the spot. Still farther south, on the summits of the range at Mahabuleshwar, *C. altivagus*, nobis, adds another form to the genus; and at the expanded southern termination of the ridge, the Nilgherries present a rich series in *C. Nilagiricus, Jerdoni, cœloconus, cuspidatus**, and *ravidus*, nobis, and *Stenostoma*, Sow., the two last belonging, equally with the Darjiling *C. Phænotopicus*, to the planorbular type. It is to be remarked that *Cyclophorus*, after obliquely crossing Central India, is confined to the high ridge on the western side of the peninsula, and that no species has yet been discovered on the eastern coast, nor in the intermediate hills and plains, its place being partially supplied by other genera of the *Cyclostomacea*.

Alycæus, Gray.

This is the most northerly and westerly genus of the *Cyclostomacea* in Hindostan. Its head-quarters appear to be in the Sikkim Himalaya, where *Al. constrictus* and *Al. Urnula*, nobis, inhabit Darjiling. To the north-west the genus is represented by *Al. strangulatus*, Hutton, in the sub-Himalayan ridges of

Rowlatt. An elegant variety has been sent from Chittagaon, in the north-east angle of the Bay of Bengal, in which the peristome is of a beautiful translucent yellowish-orange colour.

* A specimen of *C. cuspidatus* with the operculum shows that it belongs to *Cyclophorus*. Pfeiffer had placed it among the species *incertæ sedis*.

Kemaon, Sirmore, and as far as the banks of the Sutlej. The only other species known occurs in Cochin-China.

Megalomastoma, Guilding.

This form is confined to the Eastern Himalaya, and presents only two species, *M. funiculatum*, nobis, from Darjiling, and *M. pauperculum*, Sow., brought by Griffith from Bootan, to the north of the Assam valley. The nearest known point at which it again appears is Tavoy, where *M. sectilabre*, Gould, is met with. In Ceylon it is represented by eight different species of the allied form, *Cataulus*.

Pterocyclos, Benson.

Appears in the south-east angle of the Berhampooter river in *Pt. hispidus* and *parvus*, Pearson; again, across the plain of Bengal, in the Rajmahal range, we find the typical species, *Pt. rupestris*, nobis. Near the eastern coast of the peninsula, in the Northern Circars, the same species is repeated; and near Salem, and at the eastern foot of the Nilgherries, *Pt. bilabiatus*, Sowerby, and *nanus*, nobis, form a link with the Cingalese representatives of the genus.

Cyclotus, Guilding.

Occupies a subcentral zone. It was detected at Neemuch, to the north of the Nerbudda, in Southern Rajpootana, by Captain Hutton, in *C. semistriatus*, Sow., and the Dekkan habitat of the species cited by Sowerby has been lately verified by my son, who has taken it at Kirkee, a few miles from Poonah. A second species, *C. semidiscoideus*, Sow., (*aratus*, nobis), occurs in the Northern Circars, near the east coast of the peninsula*. It may be observed that the Cochin-Chinese species described and figured by Souleyet, in the 'Voyage of the Bonite,' as *Cyclostoma Tourannense*, and placed by Pfeiffer in the list of species only known to him by figures, is clearly to be referred to *Cyclotus* from the description of the operculum; although that accessory piece has apparently been exchanged, by the engraver of the plate, with the operculum of the Penang *Leptopoma* (*Cyclostoma*) *Garreli*, Soul.

Leptopoma, Pfeiffer.

I have no certain information of the occurrence of this genus in the tract under consideration. I have described two species

* The discovery of an operculum in a specimen of *Cyclostoma filocinctum*, nobis, from the Nilgherries, enables me to range it as a third species of *Cyclotus*, belonging to the same division as *C. substriatus*, Sow. The characters of the shell confirm the propriety of this location.

from Ceylon, and it probably extends to the peninsula. *Cyclostoma spurcum,* Grateloup, alleged to have been found near Bombay, is referred by Pfeiffer, with a mark of doubt, to *Leptopoma**; and the same author, on the authority of Mr. Cuming's collection, assigns a small variety of the widely-spread *L. vitreum,* Sow., to the Nilgherries; but the name of the finder is not recorded, and it has not been met with by Dr. Jerdon. Dr. Cantor took it on an islet near Penang; its occurrence on the mainland lying west of the Bay of Bengal requires confirmation.

Cyclostomus, Montf.

Dr. Pfeiffer assigns my species *C. tersum,* from the Khasya hills south-east of the Berhampooter, and my Nilgherry *C. filocinctum*† and *Trochlea* (the two first with marks of doubt), to this division. In the absence of opercula it is difficult to decide; but I am inclined to dissent from his judgment in regard to the two latter. It seems to me probable that *C. filocinctum* must eventually be referred to *Cyclophorus*; and *C. Trochlea* does not well agree with the species with which it has been associated. May it not be an *Omphalotropis*?

Another stray species from the southern base of the Khasya hills remains, viz. *Cyclostoma sarritum,* nobis, which, in the absence of the operculum, cannot well be determined; it is placed by Pfeiffer among the species *incertæ sedis.* Its form is suggestive of *Cyclostomus.*

It will be seen, from the above enumeration, how rich in *Cyclostomacea* the tract under consideration is already proved to be. Thirty-six well-ascertained species inhabit it, and three others are indicated. When the valleys of Nipal (from the Ghagra to Sikkim), Bootan, the extensive jungle tract of Central India, and the extreme southern point of the peninsula, shall have been properly explored, we may expect interesting additions to the family. Most of the species enumerated have been made known only very recently, and every year adds several species to the catalogue.

Diplommatina, Bens.

If this genus should, on further examination (not of cabinet specimens, but of the animal in the shell), be proved, contrary to the experience of those who have observed the species in their native hills, to belong to the *Cyclostomacea,* three more species

* I find, on reference to the Monograph, that Pfeiffer includes it under *Opotoma.* A consideration of the characters leads me to the conclusion that its place will be found eventually in *Cyclotus.*

† *Vide* note on this species under the heading "*Cyclotus.*"

will require to be added to the list. All these inhabit the north-western portion of the Himalaya. Two of them may be found in company with *Alycæus strangulatus*, wherever that little shell occurs. *D. Huttoni*, Pfr., is the most local, having only been taken at Simla, and at Jerripani below Mussoorie. *D. folliculus*, Pfr., and *costulata*, Hutt., are abundant in the whole region.

In conclusion, I must again advert to the total absence of the *Cyclostomacea* in the vast plains which extend from the mouth of the Indus round by the north of Delhi, and along the river system of the Ganges, to the head of the Bay of Bengal, cutting off from the Himalaya the central and southern mountain groups of the Indian peninsula; a deficiency attributable, in all probability, to the want of rocky shelter, inasmuch as every variety of aspect, from the most arid desert to a moist soil supporting the richest tropical vegetation, is present in the circuit. It must however be remarked, that in the sandstone tract, extending from the west of the Sone river to Delhi, which is generally of an arid character, and even where primary and igneous rocks are upheaved beneath them, as in Bundelkhund, no Cyclostomatous shell has rewarded the researches of myself and others.

Spa, Belgium, 13th November, 1854.

XXXIX.—*Description of a new genus of Bivalve Mollusca.* By H. and A. Adams.

Tyleria, H. and A. Adams.

Shell oblong, equivalve; valves thin, nearly membranaceous, covered with a thin epidermis, rounded anteriorly, gaping and slightly produced posteriorly. Hinge composed of a cartilage-pit in each valve, cartilage internal, ligament partly external; a calcareous lamina extending from the cartilage-pit anteriorly, as far as the front muscular scar, supported in its length by calcareous septa and free anteriorly; pallial impression with slight posterior sinus.

The curious little shell on which this genus is founded, and which we have named *Tyleria fragilis*, was discovered, buried in sand, in the interior of other shells from Mazatlan, by R. W. Tyler, Esq., to whom we have dedicated the genus,—a gentleman well known as an enthusiastic conchologist and an indefatigable collector. The calcareous lamella is connected with the interior of the valves (for it is present in both) by means of vertical plates, which, being produced on each side, cause the lamella to assume a dentate appearance.

Royal Naval Hospital, Haslar.

XL.—*On Artificial Sea Water.*
By Robert Warington, Esq.

To the Editors of the Annals of Natural History.

Gentlemen,

In the 'Annals and Magazine of Natural History' for July last, you published a short communication from Mr. Gosse, on the artificial formation of sea water, and having lately had my attention especially directed to this paper by a friend who wished to put the formula given into practice, I was surprised at the difference in the proportions of the ingredients as compared with what I had myself employed in the course of 1853, more particularly from the circumstance, that when Mr. Gosse called upon me in January last, and consulted me on the feasibility of the plan, I told him that there could be no difficulty in the matter, as I had made and had then in use several small quantities artificially produced, and that all that was required was that a good analysis should be taken as the basis for deducing the proportions, and at the same time referred him to the source from which I myself had worked, namely Dr. E. Schweitzer's analysis of the water of the English Channel taken off Brighton.

Now, as numerous parties have been inquiring respecting this subject, and the erroneous formula has been copied into other journals, it may prevent much annoyance as well as disappointment if this matter is set right. The error appears to be twofold, the one arising from miscalculation, the other from assuming that the sulphate of magnesia as given in the analysis, represented the ordinary crystallized salt, and not the anhydrous sulphate, which is always the case in giving analytical results, and which is, indeed, so specified by Dr. Schweitzer in his paper, when he states that the dry residue obtained by the evaporation of 1000 grains of water amounts to 35·25628 grs., consisting of the following ingredients :—

Chloride of sodium	27·05948	grains.
,, of magnesium . .	3·66658	,,
,, of potassium . .	0·76552	,,
Bromide of magnesium . . .	0·02929	,,
Sulphate of magnesia . .	2·29578	,,
Carbonate of lime	0·03301	,,
Sulphate of lime	1·40662	,,

Now, as these results all stand in the same denomination, grains, it is competent for us to treat them as pounds, ounces, or any other weight that may best suit our purpose, and as the decimal notation is so readily capable of facilitating these deductions, there is no difficulty in at once arriving at the correct relations. Thus, the gallon of water being equal to 10 pounds, if we wish to estimate the proportions of materials for that quantity, or for 100 pounds, 10 gallons, it only requires that the decimal point should be removed, in the first case, two figures, or, in the latter, one figure to the left, and we have the whole operation completed and the result exhibited in decimal fractions of the pound; thus for 100 lbs. or 10 gallons:—

Chloride of sodium	2·706	
,, of magnesium	0·367	
,, of potassium	0·076	
Bromide of magnesium	0·003	
Sulphate of magnesia	0·230	anhydrous = 0·472 crystals.
,, of lime	0·140	anhydrous = 0·178 crystallized sulphate.
Carbonate of lime	0·003	

It will be observed, that in order to simplify the notation I have decreased the extended places of decimals and employed the nearest amount to such fraction, by this means throwing off three places of figures. Then by reducing these decimal fractions to the nearest value in terms of avoirdupoise pounds and ounces, the proportions will stand thus for the 100 pounds of water produced:—

		Gosse.
Chloride of sodium	$43\frac{1}{4}$ ounces.	35 ounces.
,, of magnesium	6 ,,	$4\frac{1}{2}$,,
,, of potassium	$1\frac{1}{4}$,,	$0\frac{9}{10}$,,
Bromide of magnesium	21 grains.	——
Sulphate of magnesia anhydrous $3\frac{3}{4}$ oz. = crystals	$7\frac{1}{2}$ ounces.	$2\frac{1}{2}$,,
Sulphate of lime anhydrous $2\frac{1}{4}$ oz. = crystallized	$2\frac{3}{4}$,,	——
Carbonate of lime	21 grains.	——

In order to exhibit the extent of the error I have alluded to, I have placed in the adjoining column the proportions deduced by Mr. Gosse from the same analysis and for the same quantity of water, one of the ingredients having been omitted, besides the two that exist in so small a quantity. Now, as Dr. Schweitzer's analysis is on a given weight of which the saline ingredients constitute a part, it becomes necessary to deduct their weight from the 10 gallons of water employed; this, it will be seen, amounts to $60\frac{3}{4}$ ounces, or in round numbers to 60 ounces, which is equal to three imperial pints, so that 9 gallons and 5 pints will be the true proportion of water to be used.

The next point that presents itself is as to the best mode of obtaining these saline ingredients for the manufacture of the artificial sea water, as many of them, not being usually kept for sale, would have to be made for the purpose. There cannot be a question that by far the simplest plan would consist in the evaporation of the sea water itself in large quantities at the source, preserving the resulting salt in closely stopped vessels to prevent the absorption of moisture, and vending it in this form to the consumer; the proportion of this dry saline matter being $56\frac{1}{2}$ oz. to the 10 gallons of water, less the 3 pints. This plan was suggested by Dr. E. Schweitzer himself for the extemporaneous formation of sea water for medicinal baths, and, on inquiry since writing the above, I find that such a preparation is manufactured by Messrs. Brew and Schweitzer of No. 71 East Street, Brighton, under the title of "Marine Salts for the instantaneous production of sea water." Mr. H. Schweitzer writes me, that he has for many years made this compound in accordance with his cousin's analysis. The proportion ordered to be used is 6 oz. to the gallon of water and stirred well until dissolved.

Apothecaries' Hall, Nov. 1, 1854.

XLI.—*On the Genus* Mermis*. By Dr. G. Meissner. Analysis by Dr. W. I. Burnett†.

A memoir of great value has recently appeared upon these singular parasites, which has the double importance of quite clearing up the history of these animals in all their stages, and of furnishing a contribution to the histology of the lower animals of a most valuable character. This memoir has been prepared by G. Meissner of Munich, under the directions of Siebold, who furnished him with specimens and other opportunities for its successful prosecution. Seldom have we met with a paper of more careful and extended detail, and which leaves so little behind for investigators in the same direction. Added to this textual detail, every anatomical point is illustrated by admirably executed figures. With our limited space we can at best notice only a few of the more prominent points of this paper.

In the first place it should be remarked that the natural history of the *Gordiacei* was for a long time quite obscure and little understood, and many detached observations not of a parallel character did not improve the subject. To the sagacity

* Beiträge zur Anatomie und Physiologie von *Mermis albicans.* Von Dr. Georg Meissner. In Siebold und Kölliker's Zeitschrift für wissenschaftliche Zoologie, v. 1853, p. 207–285.

† From Silliman's American Journal of Science and Arts for July 1854.

of Siebold we are indebted for the successful solution of the whole enigma, and the results he has obtained are as singular as new*. It appears that these animals live part of their life as regular entozoons, and the rest as independent beings. And what is most remarkable, they enter the animals in which they are for a time parasites, not in the form of eggs, as do other Helminths, but as more or less developed forms. The animals in which they live as parasites are almost exclusively Insects of different orders, in both the larva and imago states. In the abdominal cavity of the larva of *Yponomeuta albicans*, Siebold found numerous undeveloped forms of *Mermis albicans*. Watching these he found that after further growth, they perforated the skin of these larvæ and made their escape. These freshly-escaped individuals were all sexless, but each contained a considerable *corpus adiposum*, at the expense of which their sexual parts were subsequently developed. These animals crawled about, and soon entered some damp earth, where they remained several months, during which time they were further developed, changed their skin, copulated and laid their eggs. The embryos hatched from these eggs had the filamentoid form of the adults, and as Siebold conjectured that they intended to come to the surface for the sake of entering in their turn young insects, he procured quite young larvæ of this same insect and put them in a glass vesael together with the young *Mermithes*. In a few hours they had entered the body of these larvæ, two or three in each. Siebold took the precaution to make this point certain by carefully examining the larvæ previously and determining that their bodies were free of these parasites. After this, the same round of life is again passed. It would appear, then, that these animals pass their earlier (but not their embryonic) conditions of life, during which they attain their development—in fact a proper larval state—in the bodies of insects, and that their life as distinct sexual individuals is free and non-parasitic. Siebold found this species in very many genera of Lepidoptera, also in different species of Orthoptera, Coleoptera, and Diptera. We may mention that the common Cricket, as also some other Orthoptera, are frequent recipients of *Mermis*, and we have seen many specimens of this kind. Until Siebold's recent contributions we had supposed, in common with other naturalists, that these Helminths merely hibernated in these insects, but this is now quite improbable.

So much for a brief reference to the mode of life of these

* Siebold. See the Entomol. Zeitung zu Stettin, 1848, p. 292, 1850, p. 329; also Beiträge zur Naturgeschichte der Mermithen, in Siebold und Kölliker's Zeitsch. für wissensch. Zool. v. 1853, p. 211.

animals; we will now turn and glance at some of the important histological points, as wrought out by Meissner.

Cutaneous System.—Omitting the very full details given of the structure of the skin in these animals, its composition of three distinct layers, &c., we will allude only to the fact that *chitine* enters into its formation. This fact is important as corroborative of other observations. Chitine was formerly supposed to belong exclusively to the teguments of the Arthropoda, being particularly prominent in the skin of insects; but recent chemical analyses of the teguments of lower animals show that it occurs in nearly every class of the Invertebrata*. It can therefore no longer be regarded as having diagnostic characteristics for certain classes, but sustains relations to the external dermic skeleton of the Invertebrata generally, analogous to those of bone in the four classes of Vertebrata.

Muscular System.—This was found quite developed, and it is a singular fact that all the muscles have a longitudinal direction. Transverse muscles do not exist. But Meissner has indicated a histological feature of the muscular tissue in these animals, which deserves notice. It is well known that striated muscular fibre is rather limited in its distribution among the Invertebrata. We have not observed it below the Articulata, and have regarded it as actually absent in the remaining classes—the Cephalopoda, Cephalophora, Acephala, Annelides, Turbellaria, Helminthes, Echinodermata, Acalephæ, and Polypi. Now, we have hitherto supposed from observations that the fibre being the true embryological element of muscle, a further division into fibrillæ occurred only in the higher form of this fibre, the so-called *striated* muscle; in other words, that a fibrillated structure of muscular fibre was found only in the striated form. But Meissner describes the fibre of *Mermis* as readily capable of being split up into longitudinal fibrillæ of the most regular and delicate character, and yet neither these fibres nor fibrillæ are properly transversely striated. He remarks however, that an appearance like striation is sometimes observed during a wave-like contraction of the fibre†. Results of this character which the more careful research of the present day is developing, in the study of the lower animals especially, fully indicate that the subject of muscular tissue is not well understood as to its manifold variations of

* Besides the present case we would refer to the following: Grube, Müller's Arch. 1848, p. 461, and Wiegmann's Arch. 1850, p. 253; Schultze, Beitr. zur Naturgesch. d. Turbellarien, p. 33; and Leuckart in Siebold und Kölliker's Zeitsch. 1851, p. 192, and Wiegmann's Arch. 1852, p. 22.

† We suspect it is this same wave-like aspect that has been often mistaken for striation in the muscles of some of the lowest animals, thereby leading to no little discrepancy among observers in their statements.

form; at least, after we have left the typical forms of the higher animals. Thus, I may mention that Leydig* found the muscles of the alimentary canal of *Artemia* among the Crustacea, composed of spindle-shaped instead of disk-like elements, so arranged, with the points and bases alternating, as to form a symmetrical fibrilla. In conclusion, we may remark upon this system, that Meissner found no sarcolemma, and no perimysium of the muscular layer.

Nervous System.—The researches of Dr. Meissner in this direction have particular interest, because the existence of this system in the *Gordiacei* has been generally denied, and, if seen by previous observers, their statements were most unsatisfactory†. But the histology of this system is quite as interesting.

Meissner found it so developed that he divides it into three portions: a central, a peripheric, and a splanchnic portion.

The *central portion* is divided into two parts, one at the cephalic, the other at the caudal extremity of the body. In the first are two anterior and two posterior cephalic ganglia, and an œsophageal ring composed of a superior and an inferior ganglion united by lateral commissures. In the second part, situated in the tail, there are three fusiform ganglia of like character, but smaller than those of the head.

The *peripheric portion* consists of six filaments given off from the upper part of the anterior cephalic ganglia, which go to as many papillæ on the head, which are probably organs of sense,—of two lateral cords arising from the superior œsophageal ganglion, which traverse the sides of the body, giving off filaments to the muscles, the skin, &c., and of some smaller twigs from the cephalic centres for the muscles of that region.

The *splanchnic portion* consists of two lateral trunks arising from the œsophageal ganglion, which soon meet and unite on the median line of the body, forming one cord which extends to the tail. From this cord are given off filaments to the organs of vegetative and reproductive life.

The three cords thus formed, having traversed the body, end each in one of the three ganglia above described. We can here allude to only one more point in the disposition of the nervous system; this is the final termination of the nerve-filament in muscle. According to our author, a twig enters the muscular fibre at right angles to the course of the latter, and upon its entrance divides into two twiglets, one of which runs with the

* Ueber *Artemia salina* und *Branchipus stagnalis*, in Siebold und Kölliker's Zeitsch. iii. p. 280, Taf. 8. fig. 6.

† Berthold and Blanchard both supposed they saw cords which might be nerves, but their observations were wholly unsatisfactory;—for references see Siebold and Stannius' Comp. Anat., Amer. ed., vol. i. § 104. note 5.

fibre one way and the other the opposite, becoming lost in the muscular tissue*.

The histology of this system in animals so minute as these, worked out by an observer so expert and faithful as Meissner, presents many note-worthy points.

The ganglia in question are composed exclusively of ganglion-cells or globules which appear to be the infundibuliform expansions of as many nerve-fibres that compose the nervous cord connecting these ganglia with the general system. There are none of the so-called nerve-cells usually found in nervous centres—in fact these central masses rather resemble true ganglionic formations, excepting that they are terminal instead of on the course of a nervous cord. Meissner's description and figures, especially the latter, are so good, as to leave no doubt that there is here a direct continuity of the nerve-fibre with the ganglionic vesicle.

In a former notice we alluded to some discrepancy on this point, and as this continuity had been observed by some, and yet not seen by others who had searched carefully for it, we suggested that this direct connection, when present, might be an exceptional condition. But numerous researches since published, and especially the very complete memoir of Axmann†, represent this as a very common disposition of the elements of nervous centres in Man and the Mammalia. The subject is indeed somewhat obscure in a functional point of view, for what is the interpretation of this direct continuity of the vesicular with the tubular portion of this system? Certainly it is not the essential condition of function between the two, or all nerve-fibres would terminate in this manner, and there would be no ganglionic vesicles but those having this connection. But this, as is well known, is far from being the case. We leave the subject until another time. As to the structure of the peripheric nerves, our author describes them as having at first a distinct fibrillated structure as usual, but that this gradually disappears and the nerve appears as a homogeneous cord. But from our own investigations upon the terminal nerves of some insects, we suspect that this disappearance of the true fibrillæ may have been apparent and not real; for we have, in the cases referred to, thought that such was the case, but by using higher powers with some reagents, the fibrillæ were seen. We think therefore that whatever may be the mode

* As Meissner observes, a similar disposition is mentioned by Doyère (Ann. d. Sci. Nat. 1840, xiv. p. 346) in the muscles of the Tardigrada, and by Quatrefages (*ibid.* 1843, xix. p. 300) in the Eolidina, some Annelides and Rotatoria.

† Beitr. z. mikroskop. Anat. u. Phys. d. Ganglien-Nerven-systems des Menschen u. d. Wirbelthiere. Berlin, 1853.

of termination of the nerve-fibre, the fibrillar structure is never lost.

Digestive Apparatus.—This structure, according to Meissner, presents so many peculiarities and is so widely different from anything observed in other animals, that we almost relinquish any attempt to give even a brief description of it, without the aid of figures. In the first place, the alimentary canal has no anal or excretory passages, and therefore the food and assimilation must be such as to leave little or no so-called fæcal matter.

From the circular buccal orifice a semi-canal proceeds a short distance, when it passes into another structure. This semi-canal is the œsophagus. The structure into which it passes is a tube quite small at first, but which soon expands; it is filled with a finely granular sponge-like substance, and is alternately dilated on each side into sacs. Through this laterally varicose tube the semi-canal of an œsophagus extends to its very end. Suppose then a tube with alternate lateral dilatations, filled with a spongy substance, and through which runs a semi-canal or half-tube like an œsophageal groove. Each of these dilatations has an inversion—a folding in of its internal membrane, producing an infundibuliform body in the dilatation itself. This body opens through a prolongation of the external membrane of the dilatation, which is continuous into a tube connecting with some adipose receptacles.

The food passes along the semi-canal or groove, is gradually absorbed by the spongy substance filling the dilatation, thence passes into the invested body by endosmotic absorption, and is then conveyed as assimilated material into the fat-receptacles which lie in the cavity of the body. These receptacles are storehouses of nutriment and are particularly enlarged and developed during the larval condition,—their contents being used for the formation of the sexual parts afterwards. Now as there is no vascular system in these animals, the dispersion of the nutrient material for the growth and substance of the various tissues must take place by permeation and endosmosis from the fat-bodies which extend over and between all the organs. This assimilation without any particular excretion is a remarkable fact; but it appears more conceivable when we bear in mind the œconomy of the animal. Its larval or parasitic state is like that of insects—merely preparatory for the ulterior changes of its full development. During this time its food is probably mostly pure fat, which has only to be taken up and stowed away as material for the development of the reproductive organs. This last ensues during a quiescent state, and after the full discharge of the sexual functions, the animal probably dies.

Genitalia.—Males.—The disparity in numbers of males and females was remarkably wide—our author having found only three males among several hundred specimens examined. He divides the internal organs into *testis, vas deferens, vesicula seminalis,* and *ductus ejaculatorius;* but these are all continuous, forming a cæcal tube stretching from the anterior portion of the body to the caudal extremity. The testis consists of the infundibuliform cæcal extremity of this tube and is lined with nucleated, epithelial (?) cells.

The external organs consist of two penises situated one on each side of the *ductus ejaculatorius* in a sheath. They are composed of two somewhat curved half-canals disconnected when unprotruded with the internal organs; but when protracted, they form a more or less closed tube projecting beyond the external orifice of the duct.

Females.—Meissner divides the internal female organs, which are double, into five portions: *ovary, vitellus-organ, albumen-sac, tuba,* and *uterus.* Their names indicate their respective functions, and we can here enter into no description of their intimate structure.

In connection with this should be noticed one point not a little remarkable, that is, a kind of hermaphroditism occurring in these animals.

Meissner found individuals which had perfectly well-formed internal female genital organs, but whose caudal extremity was wholly male. Thus, there were the penises, with their protractor and retractor muscles, their sheaths—in fact, all the external organs of the male, yet in these individuals no trace of internal male or of external female organs could be found. Moreover these organs present precisely the same characteristics as though in proper males and females, and had also a functional activity,—eggs being found in the ovaries, &c. But this anomaly was never found in the inverse sense, that is, female external and male internal organs. Here then is presented the striking peculiarity of an animal having double systematically-developed internal organs of one sex, and at the same time perfectly-formed external organs of the other sex. This hermaphroditism, it will be seen, is like that of other animals only in name; for in these last the double sex is at the expense of the symmetry, one side being female and the other male, or it is due to modifications of analogous facts by different grades of development, thereby destroying generally the functional perfection and completeness of each or one of the forms of the sexual organs. But here we have a perfectly symmetrical female internally, with an equally symmetrical male externally, with no fusion of parts.

In regard to the development of the spermatic particles, our author's researches have been minute and quite complete. His results confirm the doctrines of Kölliker, Wagner, and ourselves; that is, there are parent sperm-cells in which are formed daughter-cells; in each of these last there is formed a spermatic particle. But Meissner is undecided whether this formation occurs through a metamorphosis of the nucleus of the daughter-cell. Our own observations have led us fully to think that this nucleus is thus metamorphosed.

The development of the egg is very remarkable, as it shows, what we have never clearly understood before, viz. how botryoidal ovular masses are formed, and moreover carries out the beautiful analogy existing. even to minute details, between the functions of the parent sperm-cell and the ovular cell. An ovular or egg-cell from the ovary is seen; it increases in size and its nucleus segmentates, several nuclei being formed. These nuclei approach the surface of what we will now call the parent egg-cell; diverticula are given off from the cell-wall by protrusions containing each a nucleus. These protrusions become constricted and at last appear as little daughter-cells, on the surface of the parent-cell. They now increase at the expense of this last, become pedunculated, and finally appear as larger pedunculated cells attached around a common, insignificant centre. These are the ova, and form groups of variable number—Meissner having observed as many as twenty, though there are generally less. Thus formed, their peduncles break off, and they pass from the ovary proper into the other sections of the genital tube.

There is one other point taken up in connection with this subject by Meissner, to which we shall briefly allude. We refer to the wonderful *micropyle* of Keber, by which it is alleged that the spermatic particles penetrate the interior of the egg and impregnate it. Meissner has seen nothing to justify the view that such a structure exists in the eggs of *Mermis* excepting the remains of the peduncle above mentioned, and he is not sure of this being hollow. Moreover even if it were hollow, it appears to us wholly different from the special structure insisted upon by Keber.

As to the embryonic development of *Mermis*, our author found nothing essentially different from what had been described by previous observers upon this order (Grube, Leidy, &c.). No proper metamorphosis appears to occur, and therefore the newly-hatched embryos more or less closely resemble in form, &c., the adults.

In conclusion, we repeat what we said in the beginning, that this memoir is one of the most excellent of its kind we have ever seen, and the care, patience and fidelity displayed therein will ensure attention towards its author as one from whom much may be expected.

XLII.—*On the Fecundation of the* Coniferæ. By Dr. W. Hofmeister*.

Robert Brown's prophecy, that the Coniferæ would furnish the fittest material for the detection of the act of reproduction in Phanerogamic plants, on account of the length of time occupied in the development of their seeds, has not been fulfilled. Long as the period is in the Coniferæ, especially in the Firs, between flowering and maturity, the development does not progress gradually, but in intermittent leaps; in the most decisive epochs it advances with great rapidity, and no external sign is given of this. Difficulties are placed in the way of observation, over and above those depending upon the structural conditions, which explain sufficiently not only the differences of opinion of the many investigators who have busied themselves with this question, but also the fact that a by no means inessential feature of the process of development has hitherto escaped observation.

Schacht has lately published some remarks upon this subject†. The conclusions he draws from his latest observations, which deviate from the account given by me three years ago, are essentially as follows:—

"Active filaments (spermatozoids) *are not formed at any time* in the pollen-tube of the Coniferæ I have examined. The act of impregnation in the Coniferæ *is in no way* comparable with the formation of the germ of the higher Cryptogamia in the interior of the 'germ-organ' [*Keim-organ*; this is the name applied by Schacht to the archegonium].

"*No free cells* originate in the *corpuscula* of the Coniferæ. What Hofmeister regarded as cells, are globular spaces filled with clear fluid, bounded by a denser substance containing fine granules; they are what are called pseudo-cells (vacuoles) not uncommonly occurring elsewhere, and making their appearance in the same way even in the pollen-tube of the Coniferæ themselves * * *. From this it is clear that Hofmeister's view, that a cell existing in the *corpusculum* is impregnated by the pollen-tube, *rests upon a misconception*, since *no* free cell exists in the *corpusculum* before the entrance of the pollen-tube (p. 288).

"When the pollen-tube has penetrated into the *corpusculum* in the Scotch Fir (*Pinus sylvestris*), it soon swells up slightly; it displays itself as a small vesicle in the apex of the *corpusculum*. By the formation of a horizontal septum a cell originates in this vesicle; this cell divides cross-ways into four daughter-cells. To

* From the 'Flora,' Sept. 14th, 1854. Translated by Arthur Henfrey, F.R.S. &c.

† Beiträge zur Anatomie und Physiologie der Gewächse, Berlin, 1854, pp. 287 and 324.

the short sac-like part of the pollen-tube hangs, at this time, in the summit of the *corpusculum*, the body composed of four cells, which is soon afterwards to be found at the bottom of the *corpusculum*, that is to say, at the part opposite to the point where the pollen-tube entered. This cellular body, out of which are formed not only the so-called 'lower rosette,' but the suspensors and the first cell of the embryo, makes its way very gradually to the bottom of the *corpusculum*, detaching itself from the sac-like portion of the pollen-tube. For the contents of the *corpusculum* become very gradually more limpid from above downwards; the lower, denser portion, still filled with vacuoles, consequently supports the cellular body, till at length it reaches its goal and then undergoes further development. Not unfrequently, however, a division of the four cells in a horizontal direction takes place earlier, on which account the cellular body situated at the base of the *corpusculum* ordinarily consists no longer of four *simple* cells arranged side by side in a rosette, but of four double cells. I traced this cellular body both in its formation from the end of the penetrating pollen-tube, and also in its course downwards, so that I have seen it perfectly developed, composed of four cells, still connected with the sac-like portion of the pollen-tube, in the apex of the corpusculum, then in the middle of the latter, and finally in the place of its destination, the base of the corpusculum (p. 326).

"In the Yew (*Taxus baccata*) it is well known that the pollen-tube applies itself as a large vesicle over the summit of the embryo-sac; it descends into the excavations under which the *corpuscula* lie, and forms even there, before it has broken through the softened wall of a *corpusculum*, in its interior (and apparently by division, not by free cell-formation) a body composed of four cells arranged like a rosette, which probably originates, like the body composed of four similar cells on the pollen-tube of *Pinus*, by the division of *one* mother-cell (whether by a single or two successive divisions is a question). I was fortunate enough *several times* to detach uninjured the pollen-tube overlying a *corpusculum*, so that I was enabled to examine the cellular body lying in a pouch-like protrusion of the pollen-tube, most closely, *several times* and *on all sides*. The apex, or rather the pouch of the vesicularly expanded pollen-tube, in which the said cellular body lies, in the next place sinks into the *corpusculum*, and gradually fills it up by expanding until its size corresponds to the cavity of the *corpusculum*. The cellular body situated in the pouch of the pollen-tube, now inside the *corpusculum*, enlarges meanwhile by repeated, but not always perfectly regular cell-division * * *. I succeeded in dissecting out the portion of the pollen-tube which had penetrated into the *corpusculum*, *perfect*, in various states of development. Ordinarily however the pollen-tube is torn off at the point where it fits the opening of the *corpusculum*."

It will be perceived that Schacht's present description removes two of the most important points of difference existing between him and me. The untenable assertion, that in the Abietineæ the pollen-tube gradually fills up the *corpusculum*, and then produces the first cell of the embryo in its interior, is wholly retracted. The young pro-embryo of *Taxus* is represented, in accordance with nature, as composed of parallel longitudinal rows of cells, not drawn as formerly*, as a longish-ovate mass of twelve-sided cells. The microscopical figures, the interpretation of which is now in question, do not differ importantly from what I have seen.

In recent years, my researches have been almost exclusively directed to the fecundation of the Coniferæ, in those few weeks during which the most decisive stages of development are passed through. I have especially endeavoured to make out the course of development of those free cells which make their appearance in the expanding pollen-tube, to which I directed attention on a former occasion†. I have not yet arrived at a decision on this point; but on the other hand, I have complete observations which make me regard the new views of Schacht as unfounded. I publish the existing results of my later researches, in the hope of stimulating some other observers to form an opinion on this subject from their own observations, in the course of the next few years. First of all, however, I will call attention to the two facts, sufficiently established before, which stand in direct opposition to Schacht's present account, viz. the presence of numerous free cells in the *corpusculum* before the arrival of the pollen-tube, and the circumstance that the first cell of the pro-embryo may be observed, in all the three great divisions of the Coniferæ, as a *simple* cell (not originally as a rosette of cells) pressed into the lower concavity of the *corpusculum*‡.

It is quite inexplicable how Schacht can question the first of these conditions. The majority of observers, Mirbel and Spach, Gottsche and Pineau, mention these cells; Pineau has figured them in *Pinus sylvestris*. The vacuoles, which appear earlier than in the fluid contents of the *corpuscula*, and which Schacht describes quite correctly, have nothing in common with these cells.

In the Abietineæ, as in the Cupressineæ, each *corpusculum*

* Schacht, Entw. des Pflanzen-Embryon, t. 9. figs. 11, 13.

† Vergleichende Untersuchungen, &c., p. 132 (1851).

‡ *Ibid.* pp. 133, 136, 137. This stage of development, and still more the preceding, of which I shall speak subsequently, are passed through so rapidly, that their being overlooked is readily excusable.

originally contains only one very large central vacuole; the protoplasm of the contents of the *corpusculum* forms a layer over the wall, on which the primary nucleus of the cell is imbedded*. This condition is at an end early in the Abietineæ, in *Pinus sylvestris* at the beginning of June. The watery fluid which filled the vacuoles becomes distributed into the continually multiplying smaller globular cavities of the protoplasm, the dimensions of which become progressively smaller in proportion to the total internal cavity of the still constantly enlarging *corpusculum*. The free globular cells now make their appearance outside these vacuoles, which from this time disappear one after another. This condition is particularly evident in *Pinus canadensis*, where one or two of these vacuoles still exist shortly before the impregnation, among the collection of floating cells which fill up the whole *corpusculum*. That the said structures are cells is proved, not only by their aspect and the presence of a nucleus, but more particularly by their often-observed multiplication†.

In the Cupressineæ the one central vacuole, and also the primary nucleus of each *corpusculum*, are retained until a short time before the impregnation. A few days only (the space of time cannot be stated accurately on account of the seeds of the Cupressineæ not being developed simultaneously; I have every reason to believe it is at most forty-eight hours) before the pollen-tubes reach the upper ends of the *corpuscula*, by pushing aside the rosettes of cells covering them, the single vacuole becomes broken up into several, between and especially above which the formation of free spherical cells takes place. Meanwhile the primary nucleus of the *corpusculum* slowly disappears; its nucleoli remain visible longer than its membrane.

In general, among the numerous daughter-cells of the *corpuscula*, those situated in the upper end, next the micropyle, are farther developed than the rest. While the latter appear destitute of a membrane, as 'primordial cells' (naked primordial utricles), the former are usually enclosed in a demonstrable cellulose coat; in the Firs (*Pinus sylvestris, austriaca, maritima*) often appressed against the wall of the *corpusculum* or impressed into its upper convexity, like the germinal vesicles of the Monocotyledons and Dicotyledons; in the Pines (*Pinus Picea*, L., and *canadensis*) mostly swimming free, not globular however here, but ovate. In *Taxus*, where the number of comparatively large cells appearing free in the *corpusculum* is but small, a single one ordinarily swims free in the centre of the *corpusculum*, while the remainder adhere to various points on the wall. Here, there is not the

* *Ibid.* t. 28. figs. 4, 5.

† Vide Pineau, Ann. des Sc. Nat. 3 sér. xi. pl. 6; and my Vergleich. Untersuch. pl. 29. figs. 1, 3–5.

least difficulty in observing these cells; in the Abietineæ and the Cupressineæ, on the contrary, their outlines are often difficult to detect, on account of the fluid contents of the *corpusculum* and its daughter-cells refracting light in exactly the same degree. But by keeping the preparation for a longer time in water, still better by treating it with a very dilute acid, all the conditions come out clearly even in these.

The internal walls of the upper part of the *corpuscula* of the Cupressineæ become thickened, often very strongly, in the manner of scalariform vessels. In *Biotia orientalis*, in particular, these walls when viewed in face present a very elegant appearance, through the transverse streaking, depending on the small breadth and close apposition of the slit-like thinner parts of the membrane.

The formation of the free cells in the interior of the pollen-tube does not commence until its arrival at the albumen-mass, in the Cupressineæ (*Juniperus communis, Sabina* and *virginiana; Biotia orientalis*), after the rupture and passage through the membrane of the embryo-sac (dissolved at the point of contact), and after the hollow above the apex of the *corpusculum* has been filled up. The earliest conditions (recognized as early by the *corpuscula*, with untouched rosette lids, still containing a large central vacuole, the formation of free cells in their interior not having yet taken place) display, swimming in the centre of the expanded portion of the pollen-tube, *one* large, free, globular cell with a very soft membrane, through the fluid contents of which, rendered opake by numerous granules, a central globular nucleus shines as a lighter space. Preparations in which the pollen-tube had commenced the displacement of the rosette of cells covering the *corpuscula*, frequently exhibited *two* such cells, or the cell had a longish ellipsoidal form and contained two nuclei, one in each focus. In a few cases I saw three, in two cases four such globular cells in the end of the pollen-tube. When there are more than one, they are always smaller than a solitary one. Other pollen-tubes, taken from ovules where the *corpuscula* were filled with daughter-cells, contained in place of one or more of these large cells, one or two groups of four to eight smaller cells, with similar contents to the larger, adherent to the wall. Sometimes a number of such smaller cells occur with one large one in the same pollen-tube. In many cases the smaller separate from one another when the preparation is pulled about in extracting the pollen-tube. When these smaller cells are burst by pressure, three things may be distinguished in the contents: very small granules, globular or angular, in which the three dimensions are about equal; longish corpuscles, spindle-shaped or stick-shaped, coloured brown by iodine, like the smaller granules; lastly, minute vesicles with very finely granular, almost transparent contents, of diameter about equalling the length of the spindle-shaped bodies.

It appears indispensable to the accomplishment of the impregnation, that the pollen-tube should, in the Cupressineæ also, completely displace or push aside the covering rosette of the *corpusculam*, so as to come into direct contact with the upper convexity of the *corpusculum*. My former statement*, contrary to this, seems to depend upon an erroneous interpretation of an observation: either the large cells, apparently situated in the lower concavity of two *corpuscula*, observed then (only in one case) with a perfect preservation of the rosette of cells closing up the corpuscula, may have been abnormally enlarged sister-cells of these *corpuscula*, beside, not in the *corpuscula*;—or, the pollen-tube may have reached the impregnated *corpusculum* laterally, by a protruded process removed in making the section. In an uncommonly large number of examinations, I have never met with anything similar in *Juniperus*. Cases corresponding to the first hypothesis, I have observed repeatedly, as before †, in *Cupressus*, in which the development of pollen-tubes and of embryos was wholly arrested every year, while the albumen and the *corpuscula* attained to their full size—as ordinarily happens in our climate, probably resulting from the low temperature at the period of the discharge of the pollen. Phænomena analogous to the second conjecture occur in the Abietineæ, where it happens at times, in the most varied species, that the pollen-tube makes its way to the *corpusculum* by penetrating laterally through the tissue of the albumen, and not by the appointed way, through the covering-cells of the *corpuscula*. In *Biotia orientalis* also I have observed a pollen-tube penetrate into the endosperm far to one side of the group of *corpuscula*; it contained one of the often-mentioned large cells.

Ordinarily the pollen-tube sends out a short process into the *corpuscula* to be impregnated, pushing inwards the softened, apparently thicker membrane of their upper convexity. At the same time it pushes the remains of the compressed covering-cells before it, and penetrates into the interior of the *corpusculum*, through that gelatinous layer, if this has not been, as often happens, already dissolved and destroyed. More rarely the pollen-tube merely rests upon the summit of the *corpusculum*; it is equally rare for it to penetrate into it more than about $\frac{1}{10}$th of its length. Once I found it (in *Juniperus communis*) advanced as far as $\frac{1}{8}$th of the longest diameter of a *cor-*

* Vergleich. Unters. p. 131. pl. 33. fig. 12.
† *Ibid.* pl. 33. fig. 26.

pusculum. It had only just touched the *corpusculum* immediately adjoining this one, but impregnation had taken place in both. The rarest cases are those in which the pollen-tube sends out a slender, very short pouch between the covering-cells of the *corpusculum,* these at the same time retaining pretty much their original position and form.

I always found the projecting pouches of the pollen-tubes closed, even in the cases where it was evident impregnation had but just taken place: when the first cell of the pro-embryo, free and of spherical shape, had not yet descended to the bottom of the corpusculum. In *Biotia orientalis* it is not difficult to prepare the pollen-tube free from the albumen, and to extract its perfectly closed projection out of the impregnated *corpusculum.* In the Junipers this manipulation is rendered difficult, by the rapid expansion of the contents of the corpuscula both in pure water and in solutions of salts or sugar. But the phænomena usually occurring here in the expansion and final bursting of the *corpuscula* are so much the more convincing; the pouch of the pollen-tube which had penetrated into the *corpusculum* is turned inside out, and a rapid whirling current is set up into it. Finally, the vesicular expansion bursts, and the contents of the *corpusculum* make their way into the interior of the pollen-tube.

After the arrival of the pollen-tube at the *corpusculum,* one of the cells which had been produced in its interior increases in circumference and in its finely-granular contents. In none of the Cupressineæ did I see this cell in contact with the pouch of the pollen-tube which had penetrated the *corpusculum.* On the contrary, in many cases the position of its unaltered sister-cells rendered such a process in a high degree improbable, inasmuch as these so filled up the space between that cell and the end of the pollen-tube, that the enlarged cell could not have made its way through them. In the earliest conditions of which I could get a view, the enlarged impregnated cell was in the upper third of the *corpusculum;* in other cases in its centre or lower end, where it is at first only loosely imbedded. In many instances a globular nucleus without nucleoli may be detected in its centre, in other cases this cannot be made visible. The region of the *corpusculum* below the descending impregnated germinal vesicle, is remarkably poor in cells.

After the impregnated germinal vesicle has become firmly adherent to the lower end of the *corpusculum,* it divides, in all cases, by a horizontal septum. Then first, often only in the lower cell of the two, occurs the formation of longitudinal septa, converting the pro-embryo into a body composed of parallel longitudinal rows of cells.

During this process, those small cells with opake contents adherent to the wall, are ordinarily to be found in the interior of the pollen-tube, but now separate from one another. Some have burst; the solid bodies contained within them are diffused in the cavity of the pollen-tube. Many of the still intact cells are also frequently shrivelled up. Sometimes the pollen-tube contains no cellular structures of any kind during the impregnation; but I never missed then the spindle-shaped and stick-shaped bodies which were especially accumulated in the pouches which penetrated into the *corpuscula*, being often joined in numbers into bundles. Pollen-tubes of this character could be more readily dissected out free than those of the first kind, both in *Biotia* and in *Juniperus*. Lastly, it happens that those large cells are preserved, mostly the majority, in the pollen-tube, during and after the impregnation; but very much changed; flattened into a lenticular or meniscus form, firmly appressed to the wall of the pollen-tube, sometimes at the side, sometimes at the bottom. The central nucleus has now vanished; in its place are perceived in the cloudy (by transmitted light, yellowish) contents of the cell, a definite number (8—16) of sharply circumscribed, circular, bright places (nuclei), between which run delicate reticulated lines (the faces of contact of daughter-cells) only to be detected with the best defining magnifiers. This is the appearance in face; in profile it is perceived that it is a simple layer of prismatic cellules, into which the large cell has been divided. In a single instance a fresh, freely swimming, globular, large cell with a central nucleus was observed in the pollen-tube of an ovule of *Biotia orientalis*, in two of the *corpuscula* of which the pro-embryos had already made their appearance. In all these cases those stick-shaped bodies were to be found, even though sparingly, in the pollen-tubes, outside the large cells. In pollen-tubes in this condition (which effect impregnation as freely as the others) I never met with the protruded pouches sent into the *corpuscula*. There is not the slightest difficulty here in separating the pollen-tube, uninjured, from the albumen and the fertilized *corpuscula*.

The appearance of free globular cells in the widely expanded end of the pollen-tube of *Taxus baccata*, formerly described and figured by me*, is also in this plant followed by alterations of these cells similar to those occurring in the *Cupressineæ*. In farther developed ovules, such cells appear firmly applied against the wall of the pollen-tube, much flattened down, and divided by walls standing crosswise and perpendicular to the membrane of the pollen-tube. This condition of the said cells, the size of which mostly exceeds that of the young pro-embryo,

* Vergleichende Unters. p. 132, t. 31. fig. 18.

strikingly resembles in the profile view young conditions of the pro-embryos, of the *Abietineæ* more particularly, in a lesser degree those of *Taxus* itself.

I found the behaviour of the pollen-tubes to the impregnated *corpusculum* twofold, in *Taxus* as in *Juniperus*: either the pollen-tube sends a short process into the narrow mouth of the *corpusculum*, or it applies itself broadly over the summit of the *corpusculum*, with a shallow convexity of its membrane projecting a little way into it. In both cases the five or six cells of the covering-rosette of the *corpusculum* were mostly only pushed asunder and squeezed flat, not completely absorbed. The pollen-tube was very firmly adherent to them. As they are very intimately connected with their neighbouring cells, the pollen-tube is usually torn at this place in the attempt to dissect it out from the impregnated *corpusculum*. In rare cases the adhering cover-cells of the *corpusculum* are separated from their connection and lifted up with the pollen-tube. Then even the outline of the pouch of the pollen-tube is frequently rendered indistinct by adherent and contained granular mucilage, so that it is not often to be clearly made out whether this pouch is closed or has a minute opening. But so much the more certainly can we be convinced of the closure of the *flat* protusions of the pollen-tube squeezed in between the cells of the covering-rosette; the form in which, as it appears to me, the impregnation most frequently takes place.

According to Schacht's idea, one of these cell-rosettes, similar to young pro-embryos, must be formed in the pollen-tube over each *corpusculum* to be impregnated, into which, then, after the destruction of the cover of the *corpusculum*, the large portion of the pollen-tube lying above it has to bulge out and insert itself, carrying the four- or many-celled pro-embryo to the bottom of the *corpusculum*. Against this view speak not only the above-stated, but the following reasons:—

1. In all cases, I find the cell-rosette, which makes its appearance in the pollen-tube, somewhat larger than the earliest rudiment of the pro-embryo, and much too large to pass through the ordinarily narrow mouth of the *corpusculum*. In particular, the part of the pollen-tube which is torn off in the attempt to extract it from the just-impregnated *corpusculum*, is very small, quite out of proportion to the size of the cell-rosettes in the pollen-tube and of the young pro-embryo.

I give a few of the measurements:—

a. Transverse diameter of the young, four-celled pro-embryo, 0·753 millim.

Transverse diameter of the mouth of the *corpusculum* into which a short protrusion of the pollen-tube had penetrated, 0·111 millim.

b. Smallest diameter of a cell-rosette adherent to the lateral wall of the pollen-tube, 0·500 millim.

Greatest diameter of the same, 1·225 millim.

Transverse diameter of the mouth of a *corpusculum* impregnated by the same pollen-tube, 0·124 millim.

Transverse diameter of the unicellular rudiment of a pro-embryo situated at the bottom of the same *corpusculum*, 0·832 millim.

c. Transverse diameter of the orifice of a pollen-tube torn off at the point of entrance into the *corpusculum*, 0·013 millim.

Upper end of the eight-celled pro-embryo situated at the bottom of this *corpusculum*, 0·861 millim.

2. In a pollen-tube dissected free from an impregnated *corpusculum*, I detected the shrivelled remains of the cell-rosette contained in it, situated above the point where the latter had been torn off.

3. The upper part of the *corpusculum*, not filled up by the pro-embryo, contained free cells exactly similar to those existing there before impregnation.

4. There is no reason to doubt that the *simple* cells, frequently observed, filling up the lower concavity of the *corpuscula* of *Taxus baccata* and *canadensis*, are the primary cells of the pro-embryos. But, in that case, they could not derive their origin from the cell-rosettes contained in the pollen-tube.

I owe to the kindness of my friend Schacht, a sight of his preparations of *Taxus baccata*. They have not been sufficient to convince me of the correctness of his interpretation. Schacht has several times observed that in *Taxus* also (as frequently happens in *Juniperus* and the *Abietineæ*) the pollen-tube penetrates pretty deeply into the *corpusculum* and there expands to a certain extent;—perhaps an individual peculiarity of the specimens which furnished Schacht with the materials for his investigations; throughout very numerous examinations I have never met with anything of the kind. These vesicularly-expanded pouches of the pollen-tube, separated from the *corpuscles*, were of very various magnitudes. I estimated the diameter of one at 0·1 millim.; of another at 0·4 millim. The largest would therefore have about half filled a *corpusculum*; a condition which is sometimes at least approximatively attained even in the gigantic *corpuscula* of the *Abietineæ*. The but indistinctly perceptible cellular structures existing in these protruded sacs of the pollen-tubes bore no resemblance whatever either to young pro-embryos of *Taxus,* or the cell-rosettes originating together with them in the pollen-tubes, of which latter Schacht possessed very elegant preparations.

There cannot be the slightest doubt that the pro-embryo of the *Abietineæ* may be observed as a *simple* cell impressed into the lower concavity of the *corpusculum*; the first division of this cell taking place, as in *Juniperus,* by a transverse wall. Very often, the crosswise arranged longitudinal walls, which lay the foundation of the construction of the pro-embryo out of four longitudinal rows of cells, make their appearance only in the lower of the two cells; or the upper and larger of the two is divided only once by a longitudinal wall. These cases, frequent in *Pinus Strobus* and *canadensis,* contradict Schacht's view most decidedly. Among the preparations which Schacht was good enough to show me, I found one which exhibited a free cell-rosette of four tough-walled cells in the upper concavity of a *corpusculum* which had been halved by the section. In another *corpusculum* of the same albumen, opened by the same cut, it could be made out that the pro-embryo which had originated there had already sent out embryonal tubes $\frac{1}{4}$ of a line long.

Whoever has made investigations on the fertilization of the Abietineæ, knows how surprisingly simultaneous, in all ovules of the same species, is the passage through the exceedingly rapid course of the first stages of development of the pro-embryo. I may mention by way of example, that at Leipsic, in the present year (1854), not a pollen-tube had penetrated to a *corpusculum* on the 22nd of June, while only three days later, on the 25th of June, among several hundreds of impregnated *corpuscula* that were examined, not one could be found which did not contain at least one 4-celled pro-embryo. I regard it as quite impossible that one *corpusculum* can outstrip its neighbour by some twelve days, in one and the same albumen, in the development of the embryo. I look upon that preparation of Schacht's as an artificial product; I believe that cell-rosette—perhaps the end-cells of the embryonal tubes of the neighbouring *corpusculum*—must have been carried, in slicing, into the impregnated *corpusculum.* Such occurrences readily happen in making sections of objects held between the thumb and finger. I possess a preparation of *Pinus canadensis,* in the opened, apparently otherwise undisturbed *corpusculum* of which, lies an epithelial cell from the skin of the finger-tip. Other preparations of Schacht's exhibited, beside the introduced end of the pollen-tube, two cells, flattened by mutual pressure, appressed against the upper concavity of the corpusculum—germinal vesicles, such as I have already figured in a similar condition in *Pinus austriaca.* Schacht has no observations to speak directly in favour of his assertion that the said cell-rosette is formed from the pollen-tube by "tying-off" (*abschnürung*).

My later researches, made principally upon *Pinus canadensis*, have led me to the conclusion that the appearance of the first cell of the pro-embryo in the bottom of the *corpusculum* is a secondary condition. Many times, in *corpuscula* into or upon which pollen-tubes had penetrated, I detected in the middle of the *corpusculum* free, ovate cells, distinguished above their neighbours—unimpregnated germinal vesicles—by size, and above all by the extremely abundant granular mucilage they contained, in the same way as is the case in the impregnated germinal vesicles of *Biotia* and *Juniperus*. That these cells gradually make their way to the bottom of the *corpuscula* is rendered still more probable, since the undoubtedly unicellular forms of the pro-embryo of *Pinus canadensis* are made to draw back far away from the lower concavity of the *corpusculum*, by the application of reagents contracting the primordial utricle; a certain proof that they at first lie loose here. Hitherto I have not observed these cells—in my opinion the impregnated germinal vesicles—in immediate contact with the pollen-tube. In the cases where they were nearest to it, they were always at a distance at least equalling the longitudinal diameter of the cell. But it is nevertheless probable, that there is always direct contact in the impregnation. This would explain the coincident observations of Scheljesnow * and Cienkowski †, according to which, in *Larix europæa* (which I have not yet examined), a large cell hangs for a long time to the pollen-tube which has penetrated the *corpusculum*. The fecundation seems to be effected more slowly here than in the other Abietineæ.

I have little to add to my former statements regarding the cell-formation in the interior of the pollen-tube of the Abietineæ. During the impregnation I saw in its interior, with free starch, spherical cells with granular mucilaginous contents, sometimes combined in groups, and then eight in number. Not the least sign can be observed of an opening of the pollen-tube. The two modifications of its mode of penetration already mentioned as occurring in the Cupressineæ and Taxineæ, are met with also in the Abietineæ. While it frequently advances only as far as the upper concavity of the *corpusculum*, it still more frequently projects a hemispherical end a little way in, and sometimes penetrates tolerably deeply. I possess a preparation of *Pinus canadensis* in which it fills up a full third of the *corpusculum*.

* Bulletin de Moscou, 1849, p. 466.

† *Ibid.* 1853, p. 337. t. 7. fig. 13.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 15, 1854.—The Earl of Rosse, President, in the Chair.

"On the Structure of certain Microscopic Test-objects, and their Action on the Transmitted Rays of Light." By Charles Brooke, M.A., F.R.S.

In order to arrive at any satisfactory conclusions regarding the action of any transparent medium on light, it is necessary to form some definite conceptions regarding the external form and internal structure of the medium. This observation appears to apply in full force to microscopic test-objects; and for the purposes of the present inquiry it will suffice to limit our observations to the structure of two well-known test-objects, the scales of *Podura plumbea*, and the siliceous loricæ or valves of the genus *Pleurosigma*, freed from organic matter: the former of these is commonly adopted as the test of the *defining* power of an achromatic object-glass, and the several species of the latter as the tests of the *penetrating* or *separating* power as it has been termed. The defining power depends only on the due correction of chromatic and spherical aberrations, so that the image of any point of an object formed on the retina may not overlap and confuse the images of adjacent points; this correction is never theoretically perfect, since there will always be residual terms in the general expression for the aberration, whatever practicable number of surfaces we may introduce as arbitrary constants; but it is practically perfect, when the residual error is a quantity less than that which the eye can appreciate. The separation of the markings of the Pleurosigmata and other analogous objects, is found to depend on good defining power associated with large angle of aperture.

The Podura scale appears to be a compound structure, consisting of a very delicate transparent lamina or membrane, covered with an imbricated arrangement of epithelial plates, the length of which is six or eight times their breadth, somewhat resembling the tiles on a roof, or the long pile of some kinds of plush. This structure may be readily shown by putting a live Podura into a small test-tube, and inverting it on a glass slide; the insect should then be allowed for some time to leap and run about in the confined space. By this means the scales will be freely deposited on the glass, and being subsequently trodden on by the insect, several will be found, from which the epithelial plates have been partially rubbed off, and at the margin of the undisturbed portion, the form and position of the plates may be readily recognized. This structure appears to be rendered most evident by mounting the scales thus obtained in Canada balsam, and illuminating them by means of Wenham's parabolic reflector. The structure may also be very clearly recognized when the scale is seen as an opake object under a Ross's $\frac{1}{12}$th (specially adjusted for uncovered objects), illuminated by a combination of the parabola and a flat Lieberkuhn, as the writer has elsewhere described*. The underside of the scale thus appears as a smooth glistening surface with very slight markings, corresponding probably to the points of insertion of the plates on the contrary side. The minuteness and close proximity of the epithelial plates will readily account for their being a good test of *definition,* while their prominence renders them independent of the *separating* power due to large angle of aperture.

The structure of the second class of test-objects above mentioned differs entirely from that above described; it will suffice for the present purpose to notice the valves of three species only of the genus *Pleurosigma,* which, as arranged in the order of easy visibility, are, *P. formosum, P. hippocampus, P. angulatum.*

These appear to consist of a lamina of homogeneous transparent silex, studded with rounded knobs or protuberances, which, in *P. formosum* and *P. angulatum,* are arranged like a tier of round shot in a triangular pile, and in *hippocampus,* like a similar tier in a quadrangular pile, as has frequently been described; and the visibility of these projections is probably proportional to their convexity. The "dots" have by some been supposed to be depressions; this however is clearly not the case, as fracture is invariably observed to take place *between* the rows of dots, and not *through* them, as would naturally occur if the dots were depressions, and consequently the substance thinner there than elsewhere.

This in fact is always observed to take place in the siliceous loricæ of some of the border tribes that occupy a sort of neutral, and not yet undisputed, ground between the confines of the animal and vegetable kingdoms; as for example the *Isthmia,* which possesses a reticulated structure, with depressions between the meshes, somewhat analogous to that which would result from pasting together bobbinnet and tissue paper.

The valves of *P. angulatum* and other similar objects have been by some writers† supposed to be made up of two substances possessing different degrees of refractive power; but this hypothesis is purely gratuitous, since the observed phænomena will naturally result from a series of rounded or lenticular protuberances of one homogeneous substance. Moreover, if the centres of the markings were centres of greatest density, if in fact the structure were at all analogous to that of the crystalline lens, it is difficult to conceive why the oblique rays only should be visibly affected. When *P. hippocampus* or *P. formosum* is illuminated by a Gillett's condenser, with a central stop placed under the lenses, and viewed by a quarter-inch object-glass of 70° aperture, both being accurately adjusted, we may observe in succession, as the object-glass approaches the object, first a series of well-defined bright dots; secondly, a series of dark dots replacing these; and thirdly, the latter are again replaced by bright dots, not however as well defined as the first series. A similar suc-

* See British Association Reports for 1850.

† Vide Quarterly Journal of Microscopical Science, No. V. pp. 9, 10.

cession of bright, dark, and bright points may be observed in the centre of the markings of some species of *Coscinodiscus* from Bermuda.

These appearances would result if a thin plate of glass were studded with minute, equal and equidistant plano-convex lenses, the foci of which would necessarily lie in the same plane. If the focal surface or plane of vision of the object-glass be made to coincide with this plane, a series of bright points would result from the accumulation of the light falling on each lens. If the plane of vision be next made to coincide with the surfaces of the lenses, these points would appear dark, in consequence of the rays being refracted towards points *now* out of focus. Lastly, if the plane of vision be made to coincide with the plane *beneath* the lenses that contains their several foci, so that each lens may be, as it were, combined with the object-glass, then a second series of bright points will result from the accumulation of the rays transmitted at those points. Moreover, as all rays capable of entering the object-glass are concerned in the formation of the second series of bright focal points, whereas the first series are formed by the rays of a conical shell of light only, it is evident that the circle of least confusion must be much less, and therefore the bright points better defined, in the first than in the last series.

If the supposed lenses were of small convexity, it is evident that the course of the more oblique rays only would be sensibly influenced; hence probably the structure of *P. angulatum* is recognized only by object-glasses of large angular apertures, which are capable of admitting very oblique rays.

The writer has recently, in an address to the members of the Royal Institution, proposed to explain the extreme darkness of the dots, under certain conditions of focus and illumination, by the hypothesis that some of the oblique rays are thrown out of the field by internal reflexion, being incident at the upper surface at an angle too large for emergence; but this does not appear to invalidate the present hypothesis respecting the course of the transmitted rays.

It does not appear to be desirable that objects should be illuminated by an entire, or, as it may be termed, a *solid* cone of light of much larger angle than that of the object-glass. The extinction of an object by excess of illumination may be well illustrated by viewing with a one-inch object-glass the *Isthmia* illuminated by Gillett's condenser. When this is in focus, and its full aperture open, the markings above described are wholly invisible; but as the aperture is successively diminished by the revolving diaphragm, the object becomes more and more distinct, and is perfectly defined when the aperture of the illuminating pencil is reduced to about 20°. The same point may be attained, although with much sacrifice of definition, by gradually depressing the condenser, so that the rays may diverge before they reach the object; and it may be remarked generally that the definition of objects is always most perfect, when an illuminating pencil of suitable form is accurately adjusted to focus, that is, so that the source of light and the plane of vision may be conjugate foci of the illuminator. If an object-glass of 120° aperture or upwards be used as an illuminator, the markings of Diatomaceæ will be scarcely distinguishable, with any object-glass; the glare of the central rays overpowering the effects of structure on those that are more oblique.

"On the Structure and Functions of the Rostellum in *Listera ovata*." By J. D. Hooker, M.D., F.R.S.

The author first gives an account of the form and structure of the rostellum of *Listera ovata*, and its relation and position to the anther and stigma. He finds that the rostellum is divided by parallel septa (at right angles to the plane of that organ) into a series of longitudinally elongated loculi, which gradually taper from the base upwards, and terminate at two opake cellular spots, one on each side of the apex of the rostellum, towards which latter the loculi also converge. When the flower is fully expanded, these loculi are distended with a viscid grumous fluid, full of chlorophyll granules. Their external walls, and the septa dividing them, are formed of a delicate, transparent tissue, which is cellular at the base and apex of the rostellum only.

Their grumous contents, when examined at the earliest period of development, present the appearance of opake club-shaped compressed bodies, with areolated surfaces; a form and appearance that may be restored at a later period by coagulating with alcohol.

At the period of impregnation the slightest irritation of the rostellum causes the sudden and forcible discharge of the contents of these loculi (through the rupture of the cellular tissue at the apex of the rostellum) and its protrusion in the form of two viscid glands, which coalesce into one, after which the rostellum rapidly collapses and contracts.

The pollen-masses, when freed from the anther-case, fall naturally upon the rostellum; they are retained there by their viscid gland-like contents, and, breaking up, the pollen-grains become (by the contraction of the rostellum) applied to the subjacent stigmatic surface.

The author adds remarks on the structure of the rostellum in allied genera of Orchideæ, and indicates some of the more important morphological changes to which that organ is subjected, in connection with the development of various appendages to the column and pollen in the same natural family.

ZOOLOGICAL SOCIETY.

November 23, 1852.—Dr. Gray, F.R.S., Vice-President, in the Chair.

1. Note on the Gouwa (Bos frontalis) of Western India, called "the Bison" by English residents. By Capt. J. Wycliffe Thompson.

Eliot Vale, Blackheath, Kent,
20th Nov. 1852.

The size of the beast I cannot state with any exactness, having had no means of judging beyond forming an estimate by the eye of the carcase as it lay on the ground before me. The common report amongst Indian sportsmen is, that the old bull stands 19 hands (6 feet 4 inches) at the shoulder. Upon what grounds this estimate rests I cannot say, but it is in some degree confirmed by my own impression, that an old bull was pretty nearly equal in height and bulk to one of the very largest of the London dray-horses. The colour is chocolate-brown, deepening in shade on the belly; the lower part of the leg is of a dirty yellow-brownish white from the foot upwards to a little above the knee in the fore and the hock in the hind leg, the line of demarcation between the white and the chocolate being abrupt, as in a 'white-stockinged' horse. The profile of the face is decidedly curved, the part of the forehead between the horns is excessively raised in a kind of ridge, of which traces are to be seen in the skulls, though in these it is much less strongly marked than in the live animal. The shoulder is raised, not in a hump like that of the Brahminee bull or common Indian ox, but in a kind of ridge, giving the idea that the spine, beginning at the shoulder, had been unnaturally raised, and carried at that elevation some way to the rear, and then allowed suddenly to drop into the ordinary level of the back. The forehead, including the high ridge between the horns, inclines to ash-colour; the tail is small and short.

The only part of the country in which I have met with these animals is on the "Suhyadri" mountains or "Western Ghauts," a narrow belt of wild, broken, and thickly-wooded country dividing the high lands of the Deccan or Maratha country from the low land of the Concan or country bordering the margin of the sea. This Ghaut country is of most peculiar appearance: anything that can be called a *plain* does not exist in it; it is a succession of the most rugged hills and of the most wild, deep ravines; the whole, with the exception of here and there a bare ridge of hill, covered with a dense mass of bushes, brushwood, tall ferns and flowering plants, so thick that it is frequently necessary to clear a road with bill-hooks; imbedded in this mass of vegetation lie broken crags of brown rock; above all this rise clumps of forest trees, and above these again rises some rugged hill-side crowned by a bare perpendicular scarp of black rock. This line of country, which in every part that I have visited forms a line of demarcation between the Concan and the Deccan, and consequently stretches in point of length over a wide extent, is in point of breadth inconsiderable, occupying no larger space than must necessarily be covered by a mountain range with broken and irregular spurs. As you will perceive from my description, it is a country which one would scarcely think adapted to huge cattle like the Bison, but they *do* inhabit it, and hold to it most rigorously, as I never saw or heard of one either in the Concan or the Deccan. Occasionally they make their appearance on the borders of this country, and do great damage to the small fields of corn which the natives cultivate on the very verge of the forest; choosing, as I gather from the natives, the night for their operations; but their usual abode is in the depths of the Ghaut country, as not only are they invariably, when sought for by sportsmen, found in the very depth of the thick forest, but constant traces of them may there be met with; as for instance, crossing a little open glade in the forest, covered, as is sometimes the case, with nothing but a long thin dry grass, it is not unusual to see half a dozen patches where the squashed and flattened grass shows where the Bison has been sleeping; and the natives frequently point out a bed of a greener and more delicate kind of grass, and show where it has been cropped by the grazing Bison.

The usual method of hunting these beasts is to take up a post commanding some narrow pass, and throwing from fifty to a hundred beaters into the forest, to form them into a *cordon*, which driving the Bison before it, contracts as it approaches the pass and forces them through it under the fire of the hunters. The Bison, when stirred but not as yet much alarmed by the distant line of beaters, are usually seen plodding along with a slow heavy gait, and with their heads carried low. When under these circumstances I have been able to obtain a clear view of them, they have struck me by a resemblance in general figure to the North American Bison, of which I have seen specimens in England: they have a heavy, compact, short-necked, thick-headed look, which distinguishes them most strongly from the long-faced dolorous-visaged tame buffalo of India. When disturbed by the closer approach of the beaters, they break into a heavy lumbering trot, which under circumstances of violent alarm, they exchange for a furious rush, in which they go straight through the jungle as a horse might burst through standing corn, making the forest ring again with the sound of crashing boughs; and, as they cleave their way through the dense masses of bush, making their progress visible by a long track of waving branches tossing above them, like the wake of a ship at sea. I have been posted on the ridge of a hill so far away from the Bison that they looked, when I caught occasional glimpses of them, no bigger than terrier dogs, and yet have heard the incessant crashing of the jungle quite loud as the game moved to and fro.

They have a great reputation for ferocity amongst both the English sportsmen and the native hunters; and this reputation is in some degree borne out by the fact, that within no very great number of years, and within a limited extent of country, two English officers have been killed by them. Nevertheless, although I do not at all doubt that they can be on occasion savage and dangerous, I can say from experience that their ferocity is much exaggerated. I have seen a good many Bison, but never yet saw one that did not show a strong desire to avoid me if it possibly could. That when wounded or finding their line of retreat blocked up, they will charge, there is no kind of doubt; but excepting these extreme cases, they will usually, on catching sight of a man, give a start with a little back-jump, much as an antelope does when catching sight of a startling object, and then plunging into the thickest forest, hold their course in the direction which will carry them the farthest and soonest out of the neighbourhood of human beings.

They usually go in small herds of four or five, though I have I think seen as many as seven or eight together. Though, from its great size, the Bison is not a difficult animal to hit, it is by no means an easy animal to bring down. One shot, accurately placed behind the shoulder, will bring him down never to rise again; but you might as well fire into a hay-stack as hit him anywhere else. And even when brought down and brought to the last gasp by a well-directed shot, the tenacity with which he holds on to the small remains of life is wonderful. I have fired at a fallen Bison with the muzzle of the gun within a foot of his head, and yet he kicked, and before dying rolled himself quite over; I remember once putting my gun so close to the back of the head, just behind the horns, that the hair smoked from the flash of the powder, and still the animal breathed for some time.

The natives, though they hold the ferocity of the Bison in consideralbe respect, yet do not seem to consider him an animal of very acute perception. I remember a "shikarry" or native huntsman pointing out to me a patch of long thin grass lying close by the side of a small path across a hill top, and affording nothing that I should have considered very good concealment, and telling me that I might safely on emergency lie down in it and let the Bison pass along the path. I forget whether it was at this very spot, or at one precisely like it, that one of my beaters put this stratagem into practice and allowed the animal to pass close beside him.

The flesh is I think the finest beef I ever tasted. The natives of "Caste," holding the Bison in reverence as a species of Cow, refuse to eat him, and even in some cases refuse to show him to the hunter, though their reluctance to this last may generally be overcome by money. The out-caste tribes, those whom people in England call "Pariahs," have no such scruples, and the instant that a Bison is killed light a fire by the carcase and sit down and gorge themselves.

When I was in India I tried to get one or more Bison Calves for the Zoological Society, and offered the natives what to them were large sums of money if they would bring me one. They never succeeded; partly from the real difficulty of the undertaking, still more I fancy from the unwillingness of the Hindoo to do anything unusual or contrary to "custom;" they reflected, I do not doubt, that their fathers had never been requested to catch a Bison calf, and could not comprehend why *they* should. I myself twice surrounded a calf with a circle of beaters, but in both instances it broke the line and escaped. Calves sometimes fall into the hands of the natives by accident, and I have seen a young one so caught, which unfortunately died in the possession of an English officer, who had bought it from its captors.

All the natives with whom I have spoken on the subject are firmly persuaded that there are two distinct species of Bison. To these two species they give the name of "Gouwa" in common, but distinguish them as the "Myse Gouwa" and the "Gaee Gouwa." "Myse" signifies the common domestic buffalo; "Gaee" the domestic cow. I never succeeded in getting any man to give me a clear explanation of what he imagined to be the difference, but I have found the belief so universally spread amongst those natives who have the best opportunities of knowing, that I do not think it altogether to be discredited.

December 14, 1852.—Dr. Gray, F.R.S., Vice-President, in the Chair.

Notes on the Anatomy of the Tree-Kangaroo (Dendrolagus inustus, Gould). By Professor Owen, F.R.S., V.P.Z.S., etc.

The specimen of the above rare species, the first that had been exhibited alive in Europe, was a full-grown and somewhat aged female, having lived in the Society's Menagerie since the 8th of October, 1848. It had suffered from a disease in the tail, for which more than half of that organ had been amputated, and the stump was well-healed. I am not aware what symptoms preceded the animal's death, which took place on the 13th of October, 1852; the dissection did not bring to light any well-marked morbid appearances.

The external characters of the animal have been so well described and illustrated by the learned Dutch naturalists, MM. Müller and Schlegel, that further remarks on them may be here dispensed with: the chief modifications of the Kangaroo-form which adapt the herbivorous marsupials of the present subgenus to their singular sphere of existence, are a reduction of the length of the hind-limbs to a more near equality with the fore-limbs, which are proportionally longer and stronger than in the land Kangaroos: the claws of the principal toes in both limbs are longer, stronger, and more curved than in other *Macropodidæ*; they are, in fact, the chief instruments enabling the Tree-Kangaroos to maintain a firm hold on the branches of the trees in which they habitually reside.

As the bones of the animal dissected are still in maceration, any remarks that the osteology of the *Dendrolagus* may require, will be communicated at a future meeting.

Before commencing the dissection the weight of the animal was taken, which was 16 lbs. avoirdupois.

The length of the animal, from the muzzle to the end of the tail, was 2 feet 1 inch; the length of the head was 4 inches 9 lines; the length of the fore-limb, from the head of the humerus, was 12 inches; that of the hind-limb, from the head of the femur, 1 foot 6 inches.

The dental formula was :—$i\,\frac{3-3}{1-1}$, $c\,\frac{1-1}{0-0}$, $p\,\frac{1-1}{1-1}$, $m\,\frac{4-4}{4-4}=30$. The canines, confined as above indicated, to the upper jaw, were much smaller than in the Potoroos, indicative of a closer affinity to the Kangaroo family, which affinity was further manifested by the form and structure of the stomach. The premolars presented the great antero-posterior extent characteristic of the subgenus *Dendrolagus*: they are trenchant, with many minute vertical grooves; they play upon each other like the blades of scissors, and must perform an important part in cutting off the leaves or fruit, or dividing after they are detached, the natural objects of food of the Tree-Kangaroos: the true molars are double-ridged transversely, as in the *Macropodidæ* generally.

The tongue is long, narrow, depressed, with a smooth and even dorsum, showing three fossulate papillæ at its base, arranged in a triangle with the base turned forwards: the *Macropus major* has a single fossulate papilla near the base of the tongue. The epiglottis is broad and large, slightly emarginate at its middle part.

The œsophagus is suspended to the bodies of the dorsal vertebræ by a broad fold of the pleural membranes: it is continued into the abdomen for about 3 inches before terminating in the stomach. The diameter of the tube in a state of contraction is only 3 lines, until within an inch of its termination, when it begins gradually to expand.

A series of well-marked fasciculi of muscular fibres come off from an oblique tract of the external surface of the termination of the œsophagus and diverge in oblique curves which partly surround that termination before the fasciculi spread upon the stomach itself. The œsophagus terminates 4 inches from the cardiac end of this bag, which is formed by one of the pouches of the sacculated part of the stomach, the sacculated structure being continued through five-sixths of the extent of the organ.

The length of the stomach, measured along the greater curvature when fully distended, is 3 feet 8 inches; the circumference at the middle of the sacculated part is 11 inches. The sacculi are formed chiefly by two longitudinal bands, one along the front, the other along the back part of the stomach, and by a third of narrower extent along the greater curvature, from which the epiploon is continued. The principal sacculi are about fifteen in number; the terminal part of the organ, which has the form of a simple digestive stomach, measures about 6 inches along the greater curvature. The circumference of the pylorus is 2 inches 9 lines. The duodenum expands at its commencement. The epithelium is continued from the œsophagus for a breadth of 2 inches down the posterior surface of the stomach, and of $1\frac{1}{2}$ inch down the anterior surface, and thence is continued slightly diminishing in breadth 3 inches towards the pyloric end of the stomach, and $2\frac{1}{2}$ inches towards the cardiac end. The rest of the cavity is lined with the usual gastric vascular membrane, the surface of which is diversified by patches of follicular apertures along the upper curvature of the stomach, which patches increase in breadth as they approach the true digestive portion. At the cardiac orifice two parallel longitudinal ridges extend along the lesser curvature to the pyloric end of the stomach, $2\frac{1}{2}$ lines in breadth and 7 lines apart, forming a channel of that width leading from the cardiac towards the pyloric orifice; both the muscular and the mucous coats of the stomach increase in thickness towards the pylorus, which is defended by an oblique ridge.

In the great Kangaroo the cardiac end of the sacculated stomach is bifid, and the epithelium lines one of the culs-de-sac: in the rock Kangaroo (*Macr. penicillatus*) the cardiac end terminates, as in the Tree-Kangaroo, in a single cul-de-sac. In the *Hypsiprymni* the whole of the sacculated structure of the stomach is on the left side of the termination of the œsophagus, whereas in the *Dendrolagus*, as in the true Kangaroos, the major part of that structure is to the right of the cardiac orifice.

The intestines were 9 feet in length, the small intestines being 6 feet, the large 3 feet.

The circumference of the cæcum is 5 inches, the length the same. It is simple, and terminates obtusely without diminishing in diameter. The ileo-cæcal aperture is in the form of a narrow transverse slit, 4 lines in extent, with a tumid margin opening upon a fold, which partially denotes the boundary between the cæcum and colon. There is a patch of agminated glands at the beginning of the colon, and smaller patches in other parts of that intestine.

The parotid gland is of large size, and extends far down upon the neck.

The liver is relatively small, and was situated in the right hypochondrium : it consists of a right and left lobe, the former subdivided and the latter giving off the Spigelian lobe. The large gall-bladder was loosely suspended in a deep cleft of the right lobe. The coats of the ductus choledochus are thickened before the termination of the duct, in common with that of the pancreas, in the duodenum. The spleen, as in the Great Kangaroo, is T-shaped.

The heart showed the usual marsupial structure in the presence of the two distinct superior venæ cavæ, and the absence of the 'fossa' and 'annulus ovalis.' Both right and left lungs were cleft at their anterior margin, and a large azygos lobe was developed from the former, and occupied the part of the posterior mediastinum between the pericardium and diaphragm.

The larynx agreed in structure with that of the Great Kangaroo: the glottis being widely open, and the chordæ vocales very short and rudimentary at the fore part of the 'rima.'

The kidneys presented the usual simple conglobate structure. The ureters passing through the vaginal loops terminate close together 14 lines from the communication of the urethra, or neck of the bladder, with the uro-genital canal.

The ovaria, about 8 lines by 4 lines in size, presented a wrinkled cerebriform surface. A cyst of near an inch in diameter was developed from the left ovary. The oviducts, about $1\frac{1}{2}$ inch in length, terminate each in a subcompressed elongated uterus 1 inch by 3 lines. Each uterus opens by a distinct os tincæ into the fundus of a vagina, with a median cul-de-sac, extending 1 inch 3 lines beyond the commencement of the lateral bent vaginal canals. These canals are about 3 inches in length : they presented a finely longitudinally plicated inner surface, with a semilunar valvular fold 5 lines before their termination in the uro-genital canal : the length of this canal is 2 inches : it then opens, with the rectum, into a short and wide common cloacal vestibule, closed by a strong sphincter muscle. The lateral bent vaginal canals are shorter in proportion than in the *Macropus major* : but the median vaginal cul-de-sac was closed, as in that species.

In a specimen of the *Macropus Bennettii* which I dissected in 1845, I detected a natural aperture of communication between the median cul-de-sac and the urogenital canal. I had the pleasure of showing the specimen to Dr. Poelman, during a recent visit of that eminent Comparative Anatomist to the Hunterian Museum, and of thus confirming the observation which he had, independently, made of a similar modification of the female generative organs in a specimen of the *Macropus Bennettii* dissected by him at the University of Gand *.

The brain of the *Dendrolagus inustus* weighed 6 drachms.

The cerebral lobes were smooth, and showed only a short linear indentation above the anterior part of each. There was no trace of supra-ventricular commissure (corpus callosum), and in all particulars save the more simple external surface the structure of the brain corresponded with that of the Great Kangaroo as described in the 'Philosophical Transactions' for 1837. The proportion of the weight of the brain to that of the body is as 1 to 230; in the *Macropus major* it is as 1 to 800, the comparison being made on the body of a large old male. The difference between the large and small species of Kangaroo depends on the brain not increasing in proportion to the increase in the bulk of the entire animal. The smaller species in any natural family of Mammalia, resemble the fœtus of the larger species in the greater proportional size of both the brain and the eyes.

On the Monkeys of the Amazon. By Alfred R. Wallace.

The great valley of the Amazon is rich in species of Monkeys, and during my residence there I had many opportunities of becoming acquainted with their habits and distribution. The few observations I have to make will apply principally to the latter particular. I have myself seen twenty-one species; seven with prehensile and fourteen with non-prehensile tails, as shown in the following list:—

3 Howlers, viz.—*Mycetes ursinus, M. caraya*? and *M. Beelzebub*;
1 Spider Monkey,—*Ateles paniscus*;
1 Big-bellied Monkey (*Barrigudo* of the Brazilians),—*Lagothrix Humboldtii*;
2 Sapajou,—*Cebus gracilis* (Spix) and *C. apella*?;
4 Short-tailed Monkeys,—*Brachyurus couxiu, B. ouakari* (Spix), *B. rubicundus* (? *Calvus*, B. M.), and a new species;
2 Sloth Monkeys,—*Pithecia irrorata* and an undescribed species;
3 Squirrel Monkeys,—*Callithrix sciureus, C. personatus* and *C. torquatus*;
2 Nocturnal Monkeys,—*Nyctipithecus trivirgatus* and *N. felinus*; and
3 Marmoset Monkeys,—*Jacchus bicolor, J. tamarin* and a new species.

The Howling Monkeys are generally abundant; the different species, however, are found in separate localities; *Mycetes Beelzebub* being apparently confined to the Lower Amazon, in the vicinity of Para; a black species, *M. caraya*?, to the Upper Amazon; and a red species, *M. ursinus*, to the Rio Negro and Upper Amazon. Much confusion seems to exist with regard to the species of Howlers, owing to the difference of colour in the sexes of some species. The red and

* Bulletin de l'Académie Royale de Belgique, tom. xviii. p. 599.

the black species of the Amazon, however, are of the same colour in both sexes. The species of this genus are seminocturnal in their habits, uttering their cries late in the evening and before sunrise, and also on the approach of rain. Humboldt observes, that the tremendous noise they make can only be accounted for by the great numbers of individuals that unite in its production. My own observations, and the unanimous testimony of the Indians, prove this not to be the case. One individual only makes the howling, which is certainly of a remarkable depth and volume and curiously modulated; but on closely remarking the suddenness with which it ceases and again commences, it is evident that it is produced by one animal, which is generally a full-grown male. On dissecting the throat, much of our wonder at the noise ceases; for besides the bony vessel formed by the expanded "os hyoides," there is a strong muscular apparatus which seems to act as a bellows in forcing a body of air through the reverberating bony cavity.

Of the genus *Ateles*, the four-fingered Spider Monkeys, one species is found only in the Guiana district, north of the Amazon and Rio Negro. Another, probably *Ateles ater*, inhabits the West Brazil district on the river Purus. These monkeys are slow in their motions, but make great use of their prehensile tail, by which they swing themselves from bough to bough; and I have been informed that two have been seen to join together by their hands and prehensile tails, to form a bridge for their young ones to pass over. The Indians also say, that this animal generally moves suspended beneath the boughs, not walking on them.

The next genus, *Lagothrix*, is a very interesting one, being quite unknown in Guiana and Eastern Brazil. The species I am acquainted with (*L. Humboldtii*) is found in the district south-west of the Rio Negro, towards the Andes, which I call the Ecuador district of the Amazon. They are remarkable for their thick woolly grey fur, their long prehensile tails, and very mild disposition. In the upper Amazon they are the species most frequently seen tame, and are great favourites, from their grave countenances, more resembling the human face than those of any other Monkeys, their quiet manners, and the great affection and docility they exhibit. I had three of them for several months before leaving Brazil, and they were on board with me at the time the ship was burnt, when, with their companions, they all perished.

The Sapajou Monkeys, forming the genus *Cebus*, appear to be more generally distributed, and the species have a wider range. They are also frequently domesticated, but offer a remarkable contrast to the species of the last genus, in their constant activity and restlessness, and they have the character of being the most mischievous monkeys in the country.

Each species of the genus *Brachyurus* appears to be confined to a particular district. The *B. couxiu* is a native of Guiana, and does not pass the Rio Negro on the west, or the Amazon on the south. The *B. ouakari* is found on the Upper Rio Negro; the *B. rubicundus* on the Upper Amazon, called the Solimoes; and another species, apparently undescribed, is found on the lower part of the same river.

The Sloth Monkeys, forming the genus *Pithecia*, have an extensive range as regards the genus, but the separate species seem each confined in a limited space. Of the two species inhabiting the Amazon district, one, the *P. irrorata*, is found on the south bank of the Upper Amazon; and another, apparently undescribed and rendered remarkable by a bright red beard round the face and under the chin, occurs only to the south-west of the Rio Negro.

Of the little Squirrel Monkeys, one, the *Callithrix sciureus*, a specimen of which is now in the Society's Gardens, has an extensive range, being found on both banks of the Amazon and Rio Negro. The *C. torquatus*, a white-collared species, is found only on the Upper Rio Negro, and the *C. personatus* on the Upper Amazon.

Of the curious Nocturnal Monkeys forming the genus *Nyctipithecus* there are two species in this district; one, which appears to be the *N. trivirgatus* of Humboldt, is found in the district of Ecuador, west of the Upper Rio Negro; the other, closely allied, probably the *N. felinus*, on the Upper Amazon. Their large eyes, cat-like faces, soft woolly hair and nocturnal habits render them a very interesting group. They are called "devil monkeys" by the Indians, and are said to sleep during the day and to roam about only at night. I have had specimens of them alive, but they are very delicate and soon die.

Of the Marmozet Monkeys there are three species, though none of them have the characteristic tufts of hair on the head. Each species seems to be confined to a very limited tract of country. The *Jacchus tamarin* is found only in the district of Para, where it is abundant. The *J. bicolor*, a pretty grey and white species, I have only seen on the Guiana side of the Rio Negro near the city of Barra. Another species entirely black, with the face of bare white skin, inhabits the district of the Upper Rio Negro. It appears to be quite new.

The last three genera appear to be to a great extent insectivorous, and I am inclined to think they also devour small birds and mammalia. At least those I have had alive would attempt to pull into their cages any of my small birds which passed near. The little black *Jacchus* last mentioned was particularly savage. He once seized a large parrot by the neck, pulled him into his cage, and bit out a large piece from his bill, and would probably have destroyed it, had I not opportunely come to the rescue. Two other small birds which approached too near his cage he seized and completely devoured.

I will now make a few remarks on the geographical distribution of these animals.

In the various works on natural history and in our museums, we have generally but the vaguest statements of locality. S. America, Brazil, Guiana, Peru, are among the most common; and if we have "River Amazon" or "Quito" attached to a specimen, we may think ourselves fortunate to get anything so definite: though both are on the boundary of two distinct zoological districts, and we have nothing to tell us whether the one came from the north or south of the Amazon, or the other from the east or the west of the Andes. Owing to this uncertainty of locality, and the additional confusion created by mistaking allied species from distant countries, there is scarcely an animal whose exact geographical limits we can mark out on the map.

On this accurate determination of an animal's range many interesting questions depend. Are very closely allied species ever separated by a wide interval of country? What physical features determine the boundaries of species and of genera? Do the isothermal lines ever accurately bound the range of species, or are they altogether independent of them? What are the circumstances which render certain rivers and certain mountain ranges the limits of numerous species, while others are not? None of these questions can be satisfactorily answered till we have the range of numerous species accurately determined.

During my residence in the Amazon district I took every opportunity of determining the limits of species, and I soon found that the Amazon, the Rio Negro and the Madeira formed the limits beyond which certain species never passed. The native hunters are perfectly acquainted with this fact, and always cross over the river when they want to procure particular animals, which are found even on the river's bank on one side, but never by any chance on the other. On approaching the sources of the rivers they cease to be a boundary, and most of the species are found on both sides of them. Thus several Guiana species come up to the Rio Negro and Amazon. but do not pass them; Brazilian species on the contrary reach but do not pass the Amazon to the north. Several Ecuador species from the east of the Andes reach down into the tongue of land between the Rio Negro and Upper Amazon, but pass neither of those rivers, and others from Peru are bounded on the north by the Upper Amazon, and on the east by the Madeira. Thus there are four districts, the Guiana, the Ecuador, the Peru and the Brazil districts, whose boundaries on one side are determined by the rivers I have mentioned.

In going up the Rio Negro the difference in the two sides of the river is very remarkable.

In the lower part of the river you will find on the north the *Jacchus bicolor* and the *Brachyurus Couxiu*, and on the south the red-whiskered *Pithecia*. Higher up you will find on the north the *Ateles paniscus*, and on the south the new black *Jacchus* and the *Lagothrix Humboldtii*.

Spix, in his work on the monkeys of Brazil, requently gives, "banks of the river Amazon" as a locality, not being aware apparently that the species found on one side very often do not occur on the other, though the fact is generally known to the natives. In these observations I have only referred to the monkeys, but the same phænomena occur both with birds and insects, as I have observed in many instances.

BOTANICAL SOCIETY OF EDINBURGH.

November 9th, 1854.—Professor Balfour, President, in the Chair.

The following papers were read, viz.:—

1. "On the Associations of Colour, and Relations of Colour and Form in Plants," by G. Dickie, M.D., Professor of Natural History, Queen's College, Belfast.

This paper will be found in the present Number of the Annals and in the Society's Transactions.

2. "Record of New Localities for Plants," by Dr. Balfour.

Sinapis nigra. Dysart, Mr. Clay.

Cuscuta Trifolii. Gleghorny, North Berwick, Dr. Balfour.

Anagallis arvensis. Near Luighi House, North Berwick, Miss J. Arnot.

Atriplex laciniata. Near Drem, Mr. D. P. Maclagan.

Orchis pyramidalis. Leven Sands, Mr. G. S. Lawson.

Eriophorum latifolium. Crichton Bog, near Edinburgh, Mr. D. P. Maclagan.

Carex incurva. Near Longniddry, Mr. Clay.

Brachypodium pinnatum. Pathhead, near Edinburgh, Mr. D. P. Maclagan.

Elymus arenarius. Leven and Largo Links, Mr. G. S. Lawson.

Triticum laxum. North Berwick, Dr. Balfour.

Chordaria divaricata. On *Zostera marina* in Belfast Lough, Dr. Dickie.

Woodsia ilvensis. Near Windermere, Westmoreland, Dr. Clowes.

Polystichum Lonchitis. Helvellyn, Dr. Clowes.

Asplenium germanicum. Near Windermere, Mr. Hawker.

Lycopodium annotinum. Near Windermere, Dr. Clowes.

Specimens of many of the above were exhibited.

3. "Remarks on the Formation of Ascidia," by Dr. Balfour. The author stated that he was induced to make some remarks on the formation of ascidia by seeing lately a statement to the effect that all pitchers were formed by a hollowing-out process. He was disposed to think that *true ascidia*, such as those of *Nepenthes*, *Sarracenia*, *Cephalotus*, and *Heliamphora*, were formed by folded leaves in the same way as carpels are supposed to be produced. The anomalous ascidiform production in the leaves of cabbage, lettuce, &c. might be traced to a similar process, and in some instances the pitcher-like body appeared to be a second leaf folded in an opposite manner from that from which it sprung. Occasionally two or more leaves combined to form ascidia. What has been called the "hollowing-out process" is applicable to such cases as *Eschscholtzia*, Myrtle, Rose, *Hovenia*, &c. This process causes a development of the circumference of the receptacle, peduncle, or other part, while the central portion is undeveloped, and thus there arises a cup-like body with a hollow centre. In such instances there seemed to be a union in the early state of the circumferential cellular papillæ, arising from the peduncle or receptacle or other part; these became elongated so as to form a gamophyllous

rim of greater or less depth, enclosing a hollow space in which certain organs are developed. The pitcher-like peduncle or receptacle was often intimately connected with the calyx, and was lined by cellular matter in the form of a disk.

4. "On *Linaria sepium* of Allman," by C. C. Babington, M.A.—See p. 408.

5. "On Diseases in Plants caused by Mites," by Mr. Hardy, of Penmanshiel. A specimen of Broom injured by insects, gathered in the West of Scotland, having been submitted to Mr. Hardy, he sent the following remarks upon it:—"I ascribe the disease in Broom to colonies of young mites inhabiting the interior of the buds. I observed them very distinctly with a triple lens, but the mites being dead, I have not succeeded in detaching one to place under the microscope, but with fresh specimens I have no doubt you would detect them. They are of a pink colour, or paler tinted. In the Berwickshire Club's Proceedings, vol. iii. No. 3. p. 111, I have recorded all the observations I have made on this subject. I have met with three galls on the Broom, caused by the larvæ of *Cecidomyiæ*, but not, as yet, this mite production. The rent in the bark of the branch appears to be owing to a caterpillar which I often observed in the shoots; a part of its web remains under one of the buds." On other plants injured by mites Mr. Hardy remarked—"I send you specimens of *Helianthemum vulgare*, altered in a singular manner by the larvæ of mites, and precisely similar to the buds of wild thyme and those of broom sent by you lately, except that the stem takes part in the alteration, owing perhaps to some of the mites harbouring in the axils. It is from a dry steep bank at Monynnt, among the Lammermuirs. The young mites have the same appearance as those observed in broom, and will probably reach you alive. The buds are often occupied by a gall-fly larva, and the effects are not unlike, but not to this degree. I also send dwarf plants of *Epilobium palustre*, which have the leaves twisted and sometimes rendered involute by larvæ of mites. The buds of *Lotus corniculatus*, and sometimes the leaves, have purple spots occupied by mite larvæ. I can trace no difference in any of them. Specimens are likewise sent of *Geranium molle* from a barren pasture in the Lammermuirs; it is completely occupied by mites."

6. "Botanical Notes," by Dr. J. D. Hooker, in a letter to Dr. Balfour. Dr. Hooker remarks (1.) that the natural order *Balanophoraceæ* is truly Dicotyledonous, and far removed from *Rafflesiaceæ*, the latter being (as Brown pointed out) closely allied to *Aristolochia*. The *Balanophoraceæ* are far more perfect in their ovules, and have albuminous seeds, with a Dicotyledonous embryo. They are closely allied to *Gunnera*.—(2.) He finds the germination of *Nymphæaceæ* to be genuinely Dicotyledonous. It is only the adventitious roots which are sheathed, as is the case with many other exogens. The rhizome of the Order is a very reduced form of the exogenous, but not at all constructed on the endogenous type. The species of *Nymphæaceæ* must apparently be reduced to a very few, for in India half-a-dozen varieties in colour, number of petals, stamens and stig-

matic rays, are found in one tank, and no two tanks have exactly the same forms.—(3.) Dr. Hooker considers that Brown's theory of carpellary sutural placentation is the correct one, and that axile and free placentation may be reduced to it. Dr. Hooker mentions a case of *Stachys* with a four-lobed, one-celled ovary formed by two carpels placed back and front, and bearing half-way up a pair of parietal sutural ovules; also a Primrose with parietal ovules. The Yew which Schleiden describes as having an ovule terminating the axis, has been shown to have often two ovules, and when one, it is always oblique and lateral.

7. "On *Stellaria umbrosa*, Opitz," by Mr. G. Lawson. *Stellaria umbrosa*, hitherto only known as a Sussex plant, had been observed by Mr. Lawson on the shore near Rossyth Castle, in Fifeshire. He had not, however, much faith in its claims to specific distinction, and regarded it in the light of a book species, made out of forms of *S. media*; the Scotch *S. umbrosa* appeared to form even a greater departure from the typical *S. media* than the Sussex one. No plant appeared to be more capable of adapting itself to all conditions of soil, climate, and situation, than *Stellaria media*, and to this circumstance was due the numerous forms of the plant known to botanists; the extremes of these forms were remarkably distinct from each other; but when studied in detail, all were found to be intimately linked together.

LINNÆAN SOCIETY.

January 7th, 1854.—Robert Brown, Esq., V.P., in the Chair.

Read Extracts from a Letter, addressed by Dr. Edward Vogel to Berthold Seemann, Esq., Ph.D., F.L.S.

Dr. Vogel, as is well known, is attached to the expedition dispatched by Her Majesty's government for the exploration of Central Africa. He quitted London on the 19th of February 1853, reached Tripoli in the beginning of March; and after a stay of several months, caused partly by the delays of his travelling companion, the brother of the Sheikh of Bornou, and partly by his own preparations, he started southwards towards the end of June, and after passing Benoulid and Soknu, reached Mourzouk on the 5th of August. On the 15th of October he was to leave that place for Lake Tsad; but previously he addressed, along with his official dispatches, various letters to his friends in Europe, treating of different branches of science; and among these one to Dr. Seemann, dated "Mourzouk, October 8th, 1853," giving some account of the botanical features of the region between Tripoli and Mourzouk, from which the following extracts are taken:—

"There will shortly arrive at the Foreign Office in London a box containing amongst other things a collection of dried plants addressed to Mr. Robert Brown. The following will serve as a commentary on that collection; and you will greatly oblige me by communicating it to that *savant*, and making known those parts which you consider fit for publication. The plants were chiefly collected in Fezzan, except a few on the coast of North Africa; for I did not like to fill the paper I am able to carry with well-known things; and, moreover, the numerous preparations for my journey left but little time for botanical pursuits during my stay at Tripoli. I was in hopes of making a rich harvest in the great valleys through which my route lay, about the 30th degree of north latitude; but, contrary to expectation, all vegetation was dried up with the exception of a *Ruta*, which was to be met with in situations less exposed to the scorching rays of the African sun; still, high bunches of withered Grasses, and fields covered with *Artemisias* and *Thymus*, gave evidence of what I might have collected if I had come three months earlier. The more I advanced towards the south, the more naked became the country, until at last, about Fezzan, nearly every vestige of wild plants had disappeared, save a shrubby *Tamarix* and a spinose *Papilionacea*, called *Agùl* by the Arabs, and used as fodder for the camels; and the eye perceived, for days in succession, nothing but date palms, under which the drifting sand of the desert, the bane of vegetation, had accumulated to a considerable height, as if attempting to bury even these trees under its deadly mantle. In the gardens of the neighbourhood of Mourzouk the inhabitants cultivate with great care several kinds of grain and culinary vegetables. The seeds are sown in decomposed manure, with which the hard salty soil has previously been covered about 2 inches high. To irrigate a garden of about 100 square yards, one man has to work twelve hours, a labour for which he gets a fourth of the produce of the piece of ground he attends. During winter, *barley* and *wheat* are grown; during the summer, *Gosub* and *Garfuli*; of the latter two I have transmitted specimens, because they furnish the chief portion of the food of the inhabitants of the Sahara, and because there are so many contradictory statements regarding their botanical name; indeed to such a degree do the accounts of travellers vary, that one calls them beans, another rice, while again a third party pronounces them to be millet. The "Garfuli mosri," so often mentioned by African travellers, is the Indian corn (*Zea Mays*), the spikes of which are gathered before they are quite ripe; and in that state they are toasted and eaten.

"To convey a notion of the poor return agriculture yields in this part of the world, I will state that the inhabitants surround *each* spike of the *Gosub* and *Garfuli abiad* with a neatly-made basket, in order to prevent the wild pigeons from picking the seeds.

"Among the few trees growing here, the finest is a *Cornus*, called *Kurno* by the Arabs; it attains a height of 80 feet, and a diameter of about 3 feet; the country about Sudan and Bornu is, I am informed, its true native land, and the 26th degree of north latitude appears to be its most northern range. A description, and additional information concerning this tree, will be found with the flowering specimens in my herbarium. The *Gum Acacia* will also be found in my collection; it enlivens and adorns the most stony sides of the valleys of the Wadi Scherzi and Cherbi. The specimen of the gum is very small; but there was some difficulty in procuring more, as all the trees growing near the road are generally well searched by the Arabs, who collect the gum as an article of food for themselves. I could never find the eating of gum-arabic much to my taste. Most of this article is brought by the Tuariks, and seems to grow between Dgerma and Ghat.

"According to Sir W. Hooker, in the Admiralty 'Manual of Scientific Inquiry' of 1851, the plant producing the senna of commerce is still unknown botanically. I collected it in Wadi Cherbi, near Dgerma, west of Mourzouk, where it grew wild under date palms; it is found in enormous masses in Ahir, to the south of this place; but it is now-a-days gathered in very small quantities, as senna-leaves, on account of their trifling value (half-a-crown the cwt.), are not sufficiently remunerative to bear the cost of the transport, and the 24 per cent. transit duty levied upon them here. I have also sent seeds of the Sudan cotton-plant, in case I should not go far enough west to collect them in their native country. In the materia medica of the Arabs, *Peganum Harmala*, vernacularly termed *Harmel*, occupies a prominent place. It is celebrated as a preventative against ophthalmia. For that purpose the immature seed-vessels are recommended; every Arab swallows in the spring of the year about a dozen of them, fancying that in doing so he will be exempt from all diseases of the eyes. I have not been able to ascertain whether the seed-vessels purify the blood or act as a purgative. *Peganum Harmala* ranges from the north coast of this continent to Fezzan, and is very common; as is also the *Cucurbitacea*, known by the name of Colocynth, the fruits of which are eaten by the ostriches. This *Cucurbitacea* covers the valleys of the Black Mountains; in the Wadi Cherbi and Wadi Scherzi, the most fertile districts of Fezzan, it is a most troublesome weed. The Tibus are very fond of the seeds; they roast them in the manner the Germans occasionally do those of the pumpkin, after they have previously been soaked twelve hours in water to deprive them of their bitter taste. The fruit itself is used against urinary complaints and diseases of the sexual organs, which are very common in these parts; it is placed in a basin of milk, and after remaining in it about twelve hours, the fluid is drank. *Ricinus communis* is common in the neighbourhood of Tripoli, and the oil of it might become an article of export, if they would only take the trouble of gathering the seeds. I met here, in Fezzan, an old acquaintance, in the shape of the sunflower (*Helianthus annuus*), which, growing to the height of about 9 feet, is the only ornament of the small cottage gardens; its seeds are eaten. I was also very glad to find *Tulipa sylvestris*, a great ornament of the Targona mountains. I have been unable to collect more than a single specimen; for although the plant occurs in the locality mentioned in enormous quantities, I arrived too early (end of March) to see it in flower. In my collection there are specimens of a plant resembling in foliage the thorn, and I have mentioned on the slip of paper accompanying it, that the bark of its root is used by the Arabs for tanning leather and dyeing red. (A small parcel of this drug is for Sir W. Hooker.) I have omitted to add, that the charcoal of this shrub is used in manufacturing gunpowder; for there are, it must be known, a great many secret powder-mills, especially in Benoulid, which manufacture an inferior sort of powder, sold for about two shillings the pound.

"After this digression I return to the theme I had in view in commencing this letter,—to give an account of the useful and cultivated plants of Fezzan. I will begin with the *date-palm*. All Fezzan and half of Tripolitania live upon it. Here every door, every post is made of date-palm wood; the ceilings of the rooms are of the stems of that tree, between which are laid the leaves of the palm, instead of the cane used by us. The poorer classes live in huts entirely made of date-palm leaves. Date-palms furnish the most common fuel (the poor people bringing a bundle of it on their backs to this place from a distance of from six to eight miles, for which they get one piastre, *i. e.* 2*d.*). Dates are the food of both man and beast; camels, horses, dogs, all eat dates. Even the kernels of this fruit are soaked in water, and after having become soft, are given to the cattle*.

"On the sheet enclosed I have given figures and descriptions of thirty-eight varieties of the date-palm, from which it will be seen that this tree varies quite as much as our cherries and plums; in the tree itself, independent of the fruit, I have never been able to find a difference. Of the enormous numbers in which this palm occurs you can hardly form a conception. When Abdel Gelil besieged Soknu (1829), he felled all the date-palms he could, to compel the town to surrender, and his people cut down, during seven days, 43,000 trees; and yet there are still 70,000 to be found. Their produce is comparatively small;—100 full-grown trees yield about 40 cwts. of dates, worth at this place 30 shillings. In Tripoli the same quantity would fetch about four times that sum. The dates, after having been gathered, are dried in the sun, and when quite hard, buried in the sand. They may thus be preserved about two years; but after the first eighteen months they are attacked by the worms, and in the beginning of the third year nothing is left of them but the kernels. As an every-day food dates are considered very heating; and this is the reason why they are not much used on a journey, travellers being obliged to drink too often. They are most wholesome, and taste best, when made into dough with barley. When the heart of the leaves has been cut out, a sweet thickish fluid collects in that

* There is no grass, nor any other herbage, except a little Sassfah (*Melilotus*), cultivated with almost as much care as the corn, and fetching on that account a good price; a bundle, about as much as one is able to hold in both hands, is sold for 2 piastres (4 pence). I was obliged to send my camels about 100 miles to the north, the nearest place where there is sufficient pasture for them. Here, about Mourzouk, there is nothing but sand and salt; the ninety gardens, outside of the town, cover together about a quarter of an English square mile. In the whole town of Mourzouk there are only two cows, one of which belongs to the pasha; there are no goats; sheep are brought from Wadi Scherzi, fifty miles distant. When we happen to have milk for our tea or coffee, we consider it a feast.

cavity, called *Lagbi*, which is very refreshing and slightly purgative. A few hours afterwards the fluid begins to ferment, becomes acid and very intoxicating. (The sap is not tapped, as Dr. Gumbrecht has stated in Wappäu's 'Handbuch der Geographie und Statistik,' Band ii. p. 57, 7th edition.) From the ripe fruit a syrup is prepared, used especially for making leather-pipes oil-tight, and also for distilling a brandy called *arogi*."

After giving many other details concerning the date-palm, Dr. Vogel proceeds thus :—"I have taken great care to note down the southern limits of the fruit-trees, and I will give you the result of my observations. In Tripoli there are oranges, lemons, pistachios, pomegranates, figs, St. John's bread, mulberries, peaches, apricots, almonds, olives, opuntias, and grapes in great abundance. Apples and pears are rather plentiful, but of poor flavour. The best varieties of pears degenerate in a very few years. Cherry-trees there are three; one of them stood in the garden in which my people were located, and I gathered from it six cherries. Melons and water-melons arrive at great perfection, and the latter I have seen weighing as much as 150 lbs. They are sown on the hard hills of the desert, and the young plants are protected from the sun by boughs; they require no artificial irrigation, the heavy dew being sufficient for their growth. Potatoes also succeed in Tripoli; the tubers are very large, and have a fine flavour. Chestnuts there are none. Of the above-mentioned fruits the following go as far south as Mourzouk (lat. 25° 55′), viz. pomegranates, figs, peaches, almonds and grapes. The vine succeeds extremely well on the shores of the natron lakes of Fezzan; the branches of this plant have very small leaves, and climb over pomegranates and fig-trees; the most common grapes are the black varieties; the white are scarce. A few apple-trees are found in Wadi Schati (about 26° 30′ N.L.), but their fruit is unfit for use. Oranges, lemons, pistachios, and St. John's bread do not go further than the Targona Mountains; they are confined to a district of about fifty miles from the coast. The olive-tree is not found beyond Benoulid, on the southern slope of the Targona Mountains (31° 44′ N.L.), and at the same place is found the last *Opuntia vulgaris*. The mulberry-tree goes as far south as Soknu (29° 4′), the apricot as far as Sebha (27° 3′). A group of about fifty olive-trees is found, it is true, near the village of Abiad, in Wadi Cherbi (27° N.L.), but they bear no fruit. Cotton is seen here and there in gardens, commencing at Bondjem, (both *Gossypium arboreum* and *herbaceum*,) but the state of the soil does not admit of its being extensively cultivated. The vine is said to grow wild in Tripolitania, but that statement must be incorrect; I have never seen it except cultivated."

February 7.—Thomas Bell, Esq., President, in the Chair.

Read a "Note on the Elaters of *Trichia*." By Arthur Henfrey, Esq., F.R.S., F.L.S. &c.

After referring to observations by Hedwig, Kaulfuss and Corda, asserting the existence of spiral fibres in the filamentous elaters mixed with the spores of *Trichia*, and to those of M. Schleiden and of M. Schacht, by whom these spiral fibres are called in question, Mr. Henfrey states, that having examined the elaters of a species of *Trichia* (*Tr. serotina,* Schrad.?), in some specimens sent to the Society from New Zealand by Mr. Ralph, he is prepared to assert positively the existence in them of spiral fibres exactly analogous to those in *Marchantia polymorpha.* The number of fibres in an elater of this species of *Trichia* is three; in some species Corda describes a much greater number, but this Mr. Henfrey regards as open to doubt. The fibres thin off towards the very gradually attenuated ends of the tubular elaters, and apparently become confluent there, in the same manner as he has himself described in those of *Marchantia polymorpha* (Linn. Trans. vol. xxi. p. 107); but the ends are so fine, that even with a power of 1000 diameters and a good light, he could not clearly define the terminations of the fibres. The tubular character of the elaters was proved by a transverse section of certain curved filaments, which gave a circular form; and the spiral structure was clearly distinguishable with a power of 250 diameters; but in order to count the fibres, it was necessary to take out a few of the elaters, and to mount them in the thinnest possible film of liquid under very thin glass, and apply a magnifying power of 1000, when the individual fibres could be made out with quite sufficient clearness to allow of their being drawn with the *camera lucida.* These elaters, Mr. Henfrey observes, may be regarded as very good test-objects for the defining power of the higher object-glasses; or, perhaps—considering the confusing effect of the crossing nerves of the number of parallel spiral fibres—as test-objects, by which to measure the value of observations on the more difficult tissues. Viewed in this light, he regards the conclusions on this subject drawn by M. Schleiden and by M. Schacht as indicating an inferiority in the microscopes used by those observers.

Read also, "Notes on the habits of *Medusæ* and of small Fishes." By Charles W. Peach, Esq. Communicated by Dr. Francis, F.L.S.

Mr. Peach's observations were made at Peterhead, N.B., in the beginning of August last, at which time *Cyanea aurita* and *Cyanea capillata* (or *C. inscripta* of Peron?) were so abundant in the harbour and bay as occasionally very much to inconvenience the fishermen, and render it difficult to lift the oars, especially of small boats, from amongst them. Round these *Medusæ* very small fishes were observed playing, sometimes sporting round *C. aurita,* and quitting it on a sudden for *C. inscripta* when an enemy came near. Occasionally two or three might be seen attending one of the *Cyaneæ*; and when attacked or alarmed, rushing under its umbrella and among the tentacula, so as to shelter themselves in the large folds connected with the ova, where they remained until the danger had passed, and then emerged again to sport and play around their sheltering friend. When under the umbrella seeking shelter, they lay so close as to allow themselves to be taken into a bucket with the *Medusa,* from beneath which after a short time they would come out and gambol as while in the sea. In this way Mr. Peach captured many young whitings, measuring from less than an inch to $2\frac{1}{2}$ inches in length. It was evident that they resorted to the *Medusæ* for protection, and not, as sometimes stated, that they are preyed upon by these glass-like creatures; and it is probably with a view to greater security that they prefer the stinging species, with its eight bunches of long tentacula and large fringed ovaries, to *Cyanea aurita*, with its single, and frequently short row of delicate appendages. What, then, Mr. Peach asks, becomes of the paralysing influence of the tentacles of this *Medusa* on fishes? This, he thinks, opens a new field for observation. He believes, too, that the facts which he has observed, if not conclusive against, at least throw considerable doubt on the fish-eating propensities ascribed to the *Medusæ*; for he is convinced that in these instances the fishes resorted to the *Medusæ* as to protectors, and not enemies. In no instance did he observe a fish in the stomach of the *Medusæ*, but all were free to depart when they pleased. The *Cyanea aurita*, he adds, is called at Peterhead "Loch Lobberton" and "Loch Robertson," and the other species "the Doctor." In an instance subsequently recorded in his journal, Mr. Peach states that a small whiting, which was gliding round a small weak *Cyanea aurita*, was attacked by a young pollack, or "baddock," whose movements it easily evaded by dodging round the *Medusa*. A second baddock, however, soon joined in the pursuit; but both were for some time baffled, until an unlucky move drove the whiting from its poor shelter, and then a severe chase took place. The pursuers were joined by others, who followed like a pack of hounds, until the whiting became exhausted, and was left by its enemies, who were unable to swallow it, to all appearance dead. In this state the tide gently drifted it along with the *Cyanea*, until after a time it recovered, swam slowly to its protector, and took refuge as before. The pack soon observed it, drove it again into open water, and this time succeeded in really killing it. During their attack upon it, Mr. Peach repeatedly threw stones among them to induce them to desist; but so intent were they on the pursuit, that they dashed on unheedingly, although at any other time the smallest stone would have alarmed and driven them aside.

April 18.—William Yarrell, Esq., Vice-President, in the Chair.

Read a letter from Robert Wakefield, Esq., F.L.S., to John Curtis, Esq., F.L.S., "On some of the Habits of Ants."

In this letter Mr. Wakefield relates some observations, made by himself many years ago, with reference to that curious insect called by Horace "magni Formica laboris." Most modern writers, he observes, including Huber, have relinquished the old idea that Ants amass grain for their winter store; but he states that he has seen the black species (*Formica nigra*, L.?) for days and nights together industriously occupied in dragging to its cells the seeds of the common violet (*Viola odorata*, L.). He first noticed this fact on the

3rd of July 1832; and he regards it as a subject of curious inquiry for what purpose, if not for their own future provision, they could accumulate these stores? Could they be intended as food for the *Aphides* during winter? That they work all night has long been known; Pliny says only during the full moon, but Mr. Wakefield observed them at work at midnight on two successive nights, the 6th and 7th of June, in rainy weather and without any reference to the full moon. The late Mr. Joshua Milne, F.L.S., was summoned by a neighbour one morning in February to see a colony of red ants, which he had turned up while digging in his garden; and mixed with the ants Mr. Milne saw many living *Aphides*, and also some vegetable substance on which they had probably subsisted during the winter. Many observers have noticed ants caressing *Aphides* during the summer; but Mr. Wakefield had never before met with any one who had seen them together during their winter retreat.

In confirmation of the storing up of food for winter provision by some species of Ant, Mr. Adam White, F.L.S., referred to Colonel Sykes's Observations on the Storing Ant of Poonah, the *Atta providens*, described and figured in the 'Transactions of the Entomological Society;' and to a Monograph of the East Indian Ants by Mr. Jerdon, published first in the 'Asiatic Journal,' and subsequently in the 'Annals of Natural History.'

Mr. Adam White, F.L.S., also exhibited the type-specimen of a fine Prionidous Beetle (*Baladeva Walkeri*), described by Mr. Waterhouse, from the collection of the late Sir Patrick Walker, and closely related to *Dorysthenes rostratus*, Vig., the type-specimen of which, described by Fabricius under the name of *Cyrtognathus rostratus*, from the cabinet of Sir Joseph Banks, forms part of the collection presented to the Linnean Society by that distinguished patron of science. Mr. White regretted that he had been unable to attend the last meeting of the Society, at which Mr. Curtis's paper on *Hypocephalus* was read. He thought, however, that Mr. Curtis laid too great stress on the tarsal system, which Mr. W. S. MacLeay had shown to be very weak when used alone as a leading character, a fact of which Latreille himself was well aware. He stated that having for years studied Longicorn Beetles, he could not fail to be struck, the first time he saw the specimen of *Hypocephalus*, with the correctness of Dr. Burmeister's determination, and with Mr. Westwood's observations on its Longicorn character. To Mr. Curtis's observation that it was pentamerous, he replied that the *Parandridæ* are all so, and yet are essentially Longicorn in type; that *Tricteno-toma* of Mr. G. R. Gray, of which four species are now recorded, is heteromerous, and is even sublamellicorn in its antennæ; that insects, and indeed animals generally, which are fossorial or internal feeders, or aquatic, are often in external characters wonderfully similar to genera in totally different groups, and have (what are often deemed) essential characters of the group so adapted and changed as to be quite altered in external appearance. Of these modifications he gave several instances both in vertebrated and articulated animals; and in particular directed attention to such Longicorn *Coleoptera* as *Erichsonia, Thaumasus* (regarded by Olivier as a species of *Ips*), *Torneutes, Cantharocnemis, Sipylus,* and *Anoploderma* of Guérin, and a pentamerous Australian genus (*Dorx pentamera*), known to him only by Mr. Newman's description.

Mr. White next proceeded to exhibit a small but valuable collection of Thibetan Coleopterous Insects, made by Dr. T. Thomson, F.L.S., which he proposes hereafter to make the subject of a paper. He remarked on the Mediterranean character of these denizens of an Alpine plateau, such as exists at Iskardo, where they were collected; and in reference to the destruction of species, drew attention to the remarkable genus *Deucalion,* a Longicorn insect discovered on barren rocks near Madeira by Mr. Wollaston, F.L.S., which will shortly be published in Mr. Wollaston's work on the Coleoptera of Madeira.

MISCELLANEOUS.

ALPHEUS AFFINIS.

To the Editors of the Annals of Natural History.

Elmore Court, Nov. 10, 1854.

GENTLEMEN,—On reading over my paper upon the new *Alpheus* in the October Number of the 'Annals and Magazine of Natural History,' I find that I have by some strange inadvertence overlooked an incorrectness, which has the effect of exactly neutralizing a point upon which I especially desire to insist.

At page 277, commencing at the ninth line from the bottom, are these words—"Differs in *not* having the moveable finger longer than the immoveable one," which is exactly the reverse of the fact; it should have run thus—"Differs in *not* having the moveable finger SHORTER than the immoveable one."—which constitutes one of the main points of difference between my "*A. affinis*" and the "*A. ruber*" of Milne-Edwards.

In the description of "*Alpheus affinis*" in the following page (278) the characteristics are correctly given.

Begging you kindly to give insertion to this communication in your next Number,

I remain, Gentlemen, yours sincerely obliged,

W. V. GUISE.

On a new species of Rock Kangaroo. By Dr. J. E. GRAY.

Yellow-legged Rock Kangaroo, Petrogale xanthopus.

Pale brown, minutely grisled; chin and beneath white; streak on side from the back of shoulder, and along the side of the face under the eye whitish; dorsal streak narrow, brown; legs, feet and tail bright yellow; end of tail more bushy and brown, varied; ears red.

Australia; Richmond River?

This species has all the markings like *Petrogale lateralis*, but differs in being of a much paler and yellower colour, and in the bright yellow colour of the legs and basal part of the tail.

It is about the same size as *P. penicillatus*, or rather between it and *P. lateralis*.

There are two specimens of this species (male and female) in the collection of the British Museum, procured from Mr. Strange, but unfortunately not accompanied by their precise habitat, and sent with specimens from South Australia and Richmond River.

METEOROLOGICAL OBSERVATIONS FOR OCT. 1854.

Chiswick.—October 1. Foggy: drizzly: overcast and fine: foggy. 2. Dense fog: very fine. 3, 4. Very fine. 5. Fine, but windy. 6. Rain. 7. Overcast. 8. Cloudy and fine. 9. Fine: overcast. 10. Foggy: exceedingly fine: rain at night. 11. Fine throughout. 12. Clear. 13. Foggy: very fine. 14. Foggy: hazy: slight drizzle. 15. Foggy and drizzly: cloudy: rain. 16. Very fine. 17. Foggy: rain. 18. Rain: overcast and windy. 19. Fine: rain at night. 20. Showery. 21. Cloudy. 22. Densely clouded: fine. 23. Fine: clear. 24. Very fine: heavy rain. 25. Constant rain. 26. Clear and very fine. 27. Frosty and foggy: very fine. 28, 29. Very fine. 30. Foggy: very fine: cloudless. 31. Exceedingly fine.

Mean temperature of the month	48°·20
Mean temperature of Oct. 1853	49 ·99
Mean temperature of Oct. for the last twenty-eight years	50 ·06
Average amount of rain in Oct.	2·68 inches.

Boston.—Oct. 1, 2. Foggy. 3. Cloudy. 4. Fine. 5. Fine: rain P.M. 6. Cloudy. 7, 8. Fine. 9. Cloudy: rain A.M. 10. Fine. 11. Cloudy: rain A.M. 12, 13. Fine. 14. Cloudy. 15. Cloudy: rain P.M. 16. Fine. 17. Cloudy: rain P.M. 18. Rain A.M. and P.M. 19. Cloudy. 20. Cloudy: rain A.M. and P.M. 21. Fine. 22. Cloudy: rain A.M. 23, 24. Fine. 25. Cloudy: rain A.M. and P.M. 26, 27. Fine. 28. Cloudy. 29. Fine. 30. Cloudy. 31. Cloudy: rain P.M.

Sandwick Manse, Orkney.—Oct. 1. Cloudy A.M.: clear P.M. 2. Rain A.M. and P.M. 3. Showers A.M.: clear P.M. 4. Cloudy A.M. and P.M. 5. Showers A.M.: clear P.M. 6. Hail-showers A.M.: clear P.M. 7. Showers A.M.: clear P.M. 8. Clear, fine A.M.: fog P.M. 9. Rain A.M.: cloudy P.M. 10. Clear, fine A.M.: showers P.M. 11. Showers A.M.: sleet, showers P.M. 12. Clear, fine A.M.: clear P.M. 13. Drizzle A.M.: clear P.M. 14. Clear, fine A.M.: cloudy P.M. 15—17. Showers A.M. and P.M. 18. Hail-showers A.M.: cloudy P.M. 19—22. Showers A.M. and P.M. 23. Bright A.M.: showers P.M. 24. Clear, frost A.M.: clear, frost, aurora P.M. 25. Cloudy, frost A.M.: sleet-showers, aurora P.M. 26. Sleet-showers A.M. and P.M. 27. Bright A.M.: cloudy P.M. 28. Rain A.M.: cloudy P.M. 29. Cloudy A.M.: clear P.M. 30, 31. Clear A.M. and P.M.

Mean temperature of Oct. for twenty-seven previous years	47°·68
Mean temperature of this month	46 ·39
Mean temperature of Oct. 1853	48 ·66
Average quantity of rain in Oct. for fourteen previous years	5·07 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London*; *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1854. Oct.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	30·222	30·130	29·73	29·82	29·86	67	41	50	55	54	sw.	calm	w.	·01	......	......
2.	30·073	29·851	29·66	29·77	29·55	74	36	51	56	53	sw.	calm	se.	......	......	·37
3.	29·798	29·736	29·27	29·65	29·73	65	31	57·5	43	46	w.	wnw.	nw.	......	......	1·08
4.	29·856	29·694	29·44	29·54	29·03	62	52	49	46	52	sw.	calm	w.	......	......	·29
5.	29·585	29·510	29·06	29·03	29·23	71	50	58	44	42½	sw.	sw.	nw.	·01	·03	......
○ 6.	29·571	29·491	29·15	29·48	29·91	58	47	51	42½	40	ne.	calm.	nnw.	·52	......	......
7.	30·080	29·869	29·56	30·09	30·06	59	42	52·5	42	42	e.	ene.	sw.	......	......	·30
8.	29·960	29·847	29·68	29·97	29·83	60	52	50	47	44	se.	se.	sw.	·03	......	......
9.	29·823	29·662	29·25	29·64	29·60	70	43	57	53½	52	sw.	se.	se.	......	·05	·14
10.	30·014	29·992	29·52	29·62	29·61	65	54	51	55½	48	sw.	w.	nw.	·13	......	......
11.	30·297	30·009	29·55	29·81	30·10	62	28	55	49	49	nw.	nw.	w.	......	·24	·27
12.	30·482	30·454	30·06	30·32	30·18	58	29	41	50½	49½	n.	nw.	s.	......	......	......
13.	30·419	30·338	30·02	30·08	30·06	60	34	38	51½	49	n.	calm	sw.	......	......	......
☾ 14.	30·291	30·211	29·83	30·00	29·75	56	44	53	52½	57	w.	w.	ssw.	·06	......	......
15.	30·135	30·058	29·70	29·82	29·84	54	37	55	47	46	sw.	sw.	w.	·16	......	·13
16.	30·028	29·671	29·65	29·79	29·68	56	28	40	43	38	ne.	nw.	calm	......	·08	·18
17.	29·396	29.258	29·10	29·79	29·93	49	41	41	48	41½	e.	calm	n.	·04	......	·17
18.	29·419	29·227	28·92	29·90	29·80	50	31	48	40½	37½	n.	n.	n.	·03	·20	·05
19.	29·786	29·469	29·35	29·44	29·07	51	40	41	47	48	w.	nw.	nw.	·61	·10	·08
20.	29·433	29·356	28·97	29·06	29·42	57	39	47	44½	47	w.	w.	nnw.	·04	·26	·15
● 21.	29·638	29·439	29·20	29·48	29·24	57	45	46	45	48	nw.	nnw.	wnw.	......	·04	·23
22.	29·550	29·303	28·84	29·11	29·13	60	31	54·5	45½	43	w.	nnw.	w.	......	·02	·34
23.	29·400	29·356	28·96	29·04	29·06	60	28	40	43½	39½	w.	wsw.	sw.	......	......	·30
24.	29·444	29·093	29·03	29·06	29·02	56	33	37	37½	34½	sw.	w.	calm	·52	......	·05
25.	29·219	28·974	28·77	29·02	29·15	50	29	42	39½	39½	ne.	nnw.	nnw.	·44	·23	......
26.	29·793	29·523	29·15	29·37	29·61	54	24	37	43½	42	w.	w.	nw.	......	......	·28
27.	30·253	30·175	29·80	29·93	29·94	53	31	33	42½	45	sw.	w.	sse.	......	......	·27
☽ 28.	30·287	30·175	29·83	29·61	29·73	58	26	48	50	51½	s.	s.	ssw.	......	......	·50
29.	30·163	30·098	29·65	29·66	29·81	56	34	42	51	47½	sw.	s.	ssw.	......	......	·02
30.	30·172	30·061	29·74	29·95	29·72	65	36	52	48	51	sw.	sse.	sse.	......	......	·01
31.	30·159	30·035	29·81	29·70	29·83	67	33	50	50	45	sw.	s.	s.	·01	......	......
Mean.	29·895	29·744	29·43	29·630	29·628	59·35	37·06	47·3	46·90	45·88				2·61	1·25	5·21

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END OF THE FOURTEENTH VOLUME.

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