THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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

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

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

J. Taylor, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

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

No. 61. JANUARY 1863.

I.—*Notes on the* Hydroida. By Prof. Allman.

I. *On the Structure of* Corymorpha nutans.

I AM indebted to one of my pupils, Mr. John W. Macfie, for my attention having been called to the occurrence of specimens of a *Corymorpha* among the contents of a dredge brought up from about 14 fathoms' depth, during a dredging expedition in the Firth of Forth with the Natural-History Class of the University of Edinburgh. Though the species found does not entirely agree with the diagnosis proposed by Sars (Wieg. Arch. 1860, transl. in Ann. Nat. Hist. 1861, vol. viii.) for his *C. nutans*, I believe nevertheless that it must be regarded as identical with the *C. nutans* of the eminent Norwegian zoologist. A considerable number of specimens were obtained, and thus this interesting Tubularidan has been for the first time added to the recorded fauna of the Forth.

The largest specimens found were about 2 inches in height, the polype measuring from tip to tip of its extended tentacula about $\frac{3}{4}$ of an inch.

Corymorpha presents among the *Hydroida* the very unusual condition of a solitary polype, the complication from budding being confined to the production of gonophores. For greater facility of description, it will be convenient, in the following account of the structure of this Hydroid, to divide the animal into the *polype*, the *stem*, and the *gonophores*.

The Polype.—The polype may be described as flask-shaped; it bears towards its base a zone of about thirty-two long and imperfectly contractile tentacula arranged in a single series, while at a considerable interval in front of this zone, and a little behind the oral extremity, is a brush-like group of about eighty very contractile tentacula, much smaller and finer than the posterior, and arranged in six or seven closely placed alternate series.

Immediately within the zone of posterior tentacula are the branched stalks of the gonophores; their axis is occupied by a continuous tube, which communicates freely with the cavity of the polype, and they carry the gonophores in clusters upon the extremities of the branches. They are usually from fifteen to twenty in number, arranged in two alternate series. The gonophores will be afterwards described.

When a longitudinal section is made through the polype from the mouth to the stem, it will be seen that the body, as far back as the zone of posterior tentacula, presents a continuous cavity, with the endodermal lining of the narrow anterior portion thrown into prominent rugæ, and with the floor of the cavity projecting as a broad conical elevation into the wide posterior portion. This conical projection consists of a very much vacuolated endoderm; and the same vacuolated structure is continued backwards as far as the origin of the stem, giving to the whole of the posterior part of the polype the appearance of being filled with the vacuolated tissue, and destitute of any distinct cavity. A careful examination, however, will show that this vacuolated mass is perforated in its axis by a tubular prolongation of the cavity of the polype, though, in consequence of temporary obliteration by the approximation of its walls, this continuation of the polype-cavity is usually very difficult to detect. It is continued to the summit of the stem, and then, becoming somewhat wider, receives the longitudinal canals of the stem, to be presently described.

The posterior tentacula are destitute of any trace of a cavity, and consist of a simple prolongation of the vacuolated endoderm of the body, surrounded by a layer of ectoderm, the endoderm becoming somewhat closer in texture as it enters the tentacula.

The anterior tentacula seem to admit the cavity of the polype for a short distance into their interior; but their tube soon becomes obliterated by the vacuolation of their endoderm, which assumes the usual septate appearance. For some distance from their extremities the ectoderm is thrown into slightly elevated verrucæ in which minute thread-cells are accumulated, but towards the base it becomes smooth. An accumulation of thread-cells takes place also at the tip of the tentacle, where they seem to indicate a tendency to the formation of capitula, as in *Coryne*, &c. The anterior tentacula, both by their structure and their disposition in alternate series, remind us of the tentacula of *Coryne*; and I believe that we must regard them as the true equivalents of the latter, while the posterior set must be viewed as superadded structures.

The endodermal lining of the polype-cavity, as far back as the vacuolated portion, contains great abundance of brownish-red pigment-granules, which are included in the inner cells of the endoderm. The same pigment is continued into the stalks of the gonophores, from which it may be traced into the manubrium of the medusoids, and, in their young state, into the radiating canals. The whole of that portion of the body of the polype which lies behind the posterior tentacula is destitute of pigment-granules, and is accordingly colourless.

The Stem.—The form of the stem is subcylindrical, usually, however, enlarging towards the base, and again contracting and tapering away to a blunt point. I have always found this pointed posterior part of the stem bent at nearly a right angle to the rest, and, when the animal is in its natural position, plunged into the sandy sea-bottom.

To the naked eye, the stem is seen to be traversed from one extremity to the other by narrow longitudinal bands or striæ. Under a low magnifying power, these bands are seen to inosculate here and there with one another, while towards the base of the stem they usually become broader and fewer by coalescence. They owe their distinctness to the accumulation in them of opake corpuscles.

I have satisfied myself that the longitudinal bands represent canals excavated in the endoderm of the stem. They lie just within the ectoderm, while the whole of the axis of the stem is occupied by a sort of pith composed of a large-celled, or, perhaps, more correctly speaking, vacuolated tissue. Occasionally, very distinct currents may be seen in the canals; so that the whole structure and phenomena presented by these parts closely correspond to what we meet with in the stem of different species of *Tubularia*.

Under a high power of the microscope, delicate parallel longitudinal striæ may be detected lying external to the canals just described. They are situated between the ectoderm and endoderm, apparently more intimately connected with the former, and may be traced upwards on the body of the polype as far at least as the zone of posterior tentacula. They seem to consist of fine tubular fibres, and are apparently the equivalents of the fibres (muscular?) visible beneath the ectoderm of *Clava, Coryne*, &c.

Still finer striæ may also be occasionally witnessed running in a circular direction round the stem; but I have not been able to determine whether these represent fibres or mere rugæ in the ectoderm.

Peculiar processes are given off from the stem towards its posterior end. They are in the form of short blunt cones, and are arranged in longitudinal series, which follow the course of the canals, the stem immediately over each canal bearing two alternating rows. They are tubular, with the cavity apparently communicating with the canal, and with the free extremity imperforate. They appear to be extensile, for they may occasionally be here and there seen much elongated, and then with their extremities slightly clavate. In the form now described they are confined to a region of the stem at some distance from its lower end. They do not seem to be here employed as organs of adhesion; and I am unable to throw any further light upon their nature. When, however, a specimen of *Corymorpha*, after being captured, has the lower end of its stem free from sand, and is then transferred to a jar of sea-water, it soon begins to fix itself to the bottom of the vessel, and at the end of about twenty-four hours its base is seen to be surrounded by a delicate web, which closely adheres to the vessel, and in a few days has spread itself over a surface of a square inch or more in extent. Under the microscope this web is found to be composed of a multitude of fine tubular filaments, which are given off from the stem all round, close to its lower end; and after repeatedly crossing one another so as to form an entangled web-like tissue, they terminate each in a slightly expanded or clavate and imperforate extremity. The filaments are composed of a granular substance, which, as it continues to elongate, invests itself with an exceedingly delicate structureless tube or polypary. In these filaments of adhesion it is impossible not to recognize structures essentially similar to the conical tubular processes given off from the stem a little higher up.

The entire stem is invested by a very delicate, colourless, and transparent polypary. For the greater part of the length of the stem the polypary lies close to it, and may be easily overlooked; but further down it becomes separated by a considerable interval, and here constitutes a loose corrugated sac, in which the lower end of the stem is enveloped.

Gonophores.—The gonophores are borne on the extremities of the branched tubular stalks already mentioned, where they are grouped in compact clusters consisting of buds in every stage of development, from the minute tubercle in which no medusoid structure can as yet be detected, to the completely formed actively contracting medusoid on the point of becoming free.

I have been unable to demonstrate in the gonophores any trace of an ectotheca. They are thus truly naked medusoids. When arrived at that stage in which they detach themselves from the stalk and become free, they present a deep umbrella (*nectocalyx*, Huxley), becoming slightly narrower towards the aperture, and having its summit continued into a short conical projection traversed by a narrow canal which had kept the cavity of the manubrium in communication with that of the stalk. There are four radiating canals, each of which expands into a bulb at the point where it enters the circular canal. Of these bulbs one is much larger than any of the other three; this bulb is continued into a tentacle, while none of the others present any trace of such an appendage: they all contain reddish-brown pigment-granules; and an obscure ocellus may generally be recognized in a little accumulation of granules of a somewhat redder colour situated beneath the ectoderm of the outer side of the bulb. There is a broad velum.

The solitary tentacle is largely developed, and consists of a very extensile moniliform cord, presenting, when extended, the appearance of ten or twelve little spherules distributed at equal distances upon a cylindrical string: the last of these spherules exactly terminates the string, and is larger than the others, while one or two situated near the proximal end are smaller and less distinct. The spherules are composed of accumulations of thread-cells; and the connecting cord seems to have its axis occupied by an uninterrupted tube directly prolonged from the cavity of the bulb at its root. During contraction, the spherules assume the form of circular disks; and in extreme contraction, the connecting cord disappears, and the surfaces of the disks are brought into contact.

The manubrium is large and subcylindrical, and the mouth is without tentacula or lobes.

From the above description it will be at once apparent that the medusoid of *Corymorpha nutans* belongs to a form to which Edward Forbes has given the generic name of *Steenstrupia*. Of this relation between *Steenstrupia* and *Corymorpha* Forbes himself had a suspicion; indeed, he expresses a belief that his *Steenstrupia rubra* will turn out to be the free medusoid of *Corymorpha nutans*.

The medusoids, when they become free, are about $\frac{1}{25}$ inch in diameter, and as yet show no trace of generative elements; and though I kept them alive for more than a week, they scarcely increased in size, and never showed any appearance of ova or spermatozoa.

I obtained, however, by means of the towing-net, in the neighbourhood of the locality which produced the *Corymorpha*, a little Medusa regarding which there can be no doubt that it is a more advanced stage of the medusoid of our *Corymorpha*, with which in all essential points it is identical. It was about four times the size of the newly liberated medusoid; and the tentacle had proportionately increased in length, and presented upwards of forty spherules, while the radiating canals at their origin curved upwards towards the summit more decidedly than in the younger form. The generative elements (not yet, however, fully developed, and apparently male, though, from their immature condition, no active spermatozoa could be detected) were very distinctly visible as a pale yellow mass between the endoderm and ectoderm of the manubrium, which was rendered tumid by their presence. In all other respects the little Medusa was identical with the younger ones, and continued to present the acuminated summit, which was even still traversed by the canal which originally maintained a communication between the tube of the supporting stalk and the cavity of the manubrium.

Development of the Medusoid-bud.—The medusoid first shows itself as a minute tubercle consisting of ectoderm and endoderm, and containing a simple diverticulum from the cavity of the supporting stalk. It is very difficult to follow satisfactorily the several steps by which this primordial tubercle becomes ultimately converted into the complete medusoid; but if I am right in my interpretation of the appearances which I have observed during a laborious examination of the bud in its different stages, the steps of its development would seem to be as follows:—

First, a differentiation takes place in the ectoderm of the summit or distal portion of the bud, by which this layer becomes here divided into two laminæ, an outer and an inner—the latter remaining adherent to the endoderm.

Next, the cavity of the bud extends itself upwards in the form of four thick cæcal processes occupying a peripheral position and placed symmetrically round the axis. They are composed of the endodermal lining of the bud-cavity, having outside of it the general ectoderm of the bud; while the inner of the two laminæ into which this ectoderm splits at the summit extends itself downwards as the processes continue to elongate, and invests them on the inner side, or that turned towards the axis of the bud, the space between the two laminæ becoming at the same time larger and larger, and ultimately forming the cavity of the nectocalyx.

The four processes are destined to form the four radiating canals of the medusoid; and shortly after their first appearance another cæcal process has begun to grow up between them, in the axis of the bud; it gradually elongates itself, and is to become the manubrium of the medusoid.

The four peripheral processes continue to elongate, and are soon seen to be dilated into bulb-like expansions at their extremities. The bulbs increase in size, and come in contact by their sides; while one of them, enlarging much more rapidly than the other three, gives a marked preponderance to its side of the bud, and makes the distal end of the bud appear as if obliquely truncated. It then begins to extend itself beyond this distal end into a thick hollow tentacle.

In the mean time the four bulbs which had come in contact have coalesced, and their cavities now communicate with one another; but by the gradual enlargement of the distal end of the bud the bulbous ends of the radiating canals are again drawn away from one another; the communication, however, between their cavities is not thereby interrupted, but continues to be maintained by a tubular elongation of their original points of union; and in this tube we now recognize the circular canal of the medusoid.

The cavity of the nectocalyx is still closed by the more external of the two laminæ into which the ectoderm had originally split at the distal end of the bud. In the final stage this lamina becomes perforated in the centre, and forms the velum of the medusoid; while the manubrium, previously imperforate, acquires a mouth at its extremity. The solitary tentacle, too, has now become elongated, and presents its characteristic moniliform structure; the nectocalyx rapidly contracts and expands with vigorous systole and diastole; and the medusoid at last hangs upon its stalk, a true *Steenstrupia*, ready to break away from the restraint of its fostering polype and enter upon an independent existence.

Besides the production of medusoid sexual buds, I have also witnessed in *Corymorpha nutans* another process of reproduction, very remarkable, but of whose exact significance I am unable to speak with entire confidence. In a glass jar containing living specimens of *Corymorpha*, which had been in my possession for more than a fortnight, I observed attached here and there to the surface of the glass minute oblong bodies, about $\frac{1}{2}$ a line in their longer diameter, and $\frac{1}{8}$ line in the shorter. They appeared to be composed of a soft, minutely granular, white substance; and their interior was occupied by a very distinct cavity. They were destitute of cilia, and were invested by an extremely delicate membranous or mucous tube, quite structureless, which extended for some distance beyond their ends, and adhered for its whole length to the sides of the jar.

Besides these little bodies, others, which I do not hesitate to regard as the same bodies in a more advanced stage, were also found attached to the sides of the jar. They consisted of a white tubular filament, about 4 lines in length, attached to the glass by one extremity, and developed at the opposite into a minute polype having a general resemblance to the polype of *Corymorpha*, but with only six or eight tentacles composing the posterior verticil, while the anterior tentacles were about the same in number, thicker and shorter than the posterior, with blunt, almost capitate extremities, and, like the posterior tentacula, disposed in a single verticil.

Other still more advanced stages were also found attached to the sides of the jar. They had attained to about double the size of the last, had the posterior tentacles composed of a verticil of sixteen or twenty, while the anterior tentacles, though still disposed in a single verticil, had become multiplied to about the same extent.

Beyond these three stages I was unable to trace the development through any further steps; the last of them, however, manifestly requires little to convert it into the form of the adult *Corymorpha*.

If it were not that the medusoids thrown off from the adult polype in my jars had, so far as I could find, all perished before the formation in them of generative elements, I should have regarded the little organisms just described as presenting three stages in the development of the embryo from the ovum. In the absence, however, of all evidence of the presence of ova, I believe it will be safer to view them as different stages in the development of a gemmule liberated, in some way unknown, from the adult specimens in the jar.

II. *Diagnoses of new Species of* Tubularidæ *obtained, during the Autumn of* 1862, *on the Coasts of Shetland and Devonshire.*

Clava diffusa, mihi.

Polypes about $\frac{1}{4}$ inch in height, light rose-colour, developed at intervals upon a creeping reticulated stolon; tentacula about twenty.

Gonophores scattered, commencing just behind the posterior tentacula, and thence extending singly or in small clusters for some distance backwards upon the body of the polype.

In rock-pools at low-water spring-tides, Out Skerries, Shetland Isles.

The present species differs from all other described species of *Clava* in the gonophores being scattered and extending for some distance backwards, instead of being aggregated in closely approximated clusters immediately behind the posterior tentacula.

TUBICLAVA, mihi, nov. gen.

Polype claviform, supported on the summit of free stems, which rise at intervals from a creeping stolon, and are invested by a chitinous polypary. Tentacula filiform, scattered.

Gonophores dense clusters of sporosacs aggregated immediately behind the posterior tentacula.

T. lucerna, mihi.

Zoophyte about two lines in height; stems quite simple, or rarely with a short lateral branch; polypary clothing the stem, corrugated, dilated at the base of the polype, pale yellowish-brown. *Polype*, when extended, about equal to the stem in height, white, with pale ochreous centre; tentacula about twenty, confined to the anterior third of the polype.

Creeping over the surface of loose stones in the bottom of a rock-pool, Torquay. On stones between tide-marks, Dublin Bay.

In none of the Torquay specimens were gonophores present; but I do not hesitate to identify the present species with a Tubularidan obtained several years ago in Dublin Bay, and which I had carefully figured at the time, though I never published a description of it. In the Dublin Bay specimens the gonophores were present, and exactly resembled in structure and position those of *Clava multicornis*.

The genus *Tubiclava* differs from *Clava* in the fact that the polypes are no longer sessile upon the basal stolon, but borne upon distinct branches enveloped by a polypary. This character, taken in connexion with the form of the polypes, shows an affinity also with *Cordylophora*, from which, however, it is separated by the entirely different plan and position of the gonophores.

Eudendrium humile, mihi.

Zoophyte delicate, rising to about $\frac{3}{4}$ inch in height, much and irregularly branched; main stems and branches distinctly annulated throughout. *Polype* yellowish-vermilion, vase-shaped, with a circular groove near its base, and a trumpet-shaped proboscis; tentacula twenty or twenty-three, with the alternate ones elevated and depressed in extension.

Gonophores (male) surrounding the body of the polype, and springing each by a short stalk from the circular groove which passes round the polype near its base, each gonophore consisting of two superimposed chambers. Female gonophores consisting of a single chamber, borne both by the base of the polype and by the cœnosarc immediately behind it.

Rooted to the bottom of rock-pools near low-water spring-tides, Torquay.

Male specimens of a Zoophyte closely resembling the above, but rather more delicate, and with the polypes which bear the gonophores all destitute of tentacula and mouth, so that they become converted into *gonoblastidia*, have also occurred to me in a rock-pool near Torquay. Though I am tempted to regard this as a distinct species, I believe it will be safer for the present to view it as a variety of *Eudendrium humile*. I shall therefore provisionally designate it as *E. humile*, var. *corymbifera*.

Eudendrium vaginatum, mihi.

Zoophyte much branched, rising to about $1\frac{1}{4}$ inch in height; polypary deeply and regularly annulated throughout. *Polypes* vermilion, with about eighteen tentacula, and having the body as far as the origin of the tentacula enveloped in a loose corrugated membranous sheath, which loses itself posteriorly upon the polypary.

Gonophores not known.

In rock-pools at extreme low-water spring-tides, Shetland.

This beautiful little *Eudendrium*, though in considerable abundance, had, at the time of my finding it (August), evidently passed the period of its greatest perfection, gonophores having been in no instance present, while in many specimens the polypes had fallen from the branches. In the absence of all knowledge of the gonophores, the above diagnosis must accordingly be regarded as incomplete.

Perigonymus serpens, mihi*.

Zoophyte consisting of short simple erect stems, about 2 lines in height, terminated by the polypes, and rising at short intervals from a creeping stolon, which forms an irregular network upon the surface of other bodies; the whole of the stems and stolon occupied by a reddish-orange cœnosarc and clothed with a delicate transparent polypary, which does not form a cup-like dilatation at the base of the polypes. *Polypes* reddish-orange, with about twelve or fourteen tentacula, so disposed that, in complete

* The dismemberment of Ehrenberg's genus *Eudendrium* into two genera, *Eudendrium* and *Atractylis*, was proposed some years ago by Dr. T. Strethill Wright. Dr. Wright was apparently not aware, when he gave the name of *Atractylis* to one of these subdivisions, that Sars had already proposed the name of *Perigonymus* for a genus identical with the *Atractylis* of Wright. Dr. Wright had undoubtedly a more accurate appreciation than Sars of the characters on which the separated genus should be based, finding these characters mainly in the form of the polype, rather than in the position of the gonophores; but the laws of priority render necessary the retention of the original name of *Perigonymus* rather than the later one of *Atractylis*.

extension, they are held with alternate tentacula elevated and depressed; body of polype oval, with proboscis conical.

Gonophores medusiferous, borne by the creeping stolon and elevated each upon a rather long peduncle. *Medusoids* dome-shaped, with the vertical slightly exceeding the transverse diameter; manubrium reaching to about one-half the depth of the bell, with a simple mouth destitute of tentacula; marginal tentacula two, opposite, very extensile, and with large reddish-orange bulbous bases, without evident ocelli, the intermediate radiating canals terminating each in a very small bulbous dilatation.

Growing over the stems of *Plumularia setacea*, dredged from about 12 fathoms, Torbay.

Perigonymus minutus, mihi.

Zoophyte very minute, consisting of simple stems rising to the height of about $1\frac{1}{2}$ line from a creeping stolon, and bearing the polypes upon their summit; polypary dilated round the base of the polype. *Polypes* ash-brown, with seven or eight, rarely twelve, tentacula, held irregularly during extension, and with little or no curvature.

Gonophores pyriform, medusiferous, borne at various heights upon the stem, and supported on rather long peduncles. *Medusoid* with the summit suddenly contracted, so as to give a somewhat conical form to the nectocalyx, and having two opposite radiating canals terminating each in a pale brown bulb which is continued into a very extensile filiform tentaculum, and two alternate canals terminating each in a much smaller bulb without tentacle; no evident ocellus; manubrium short, with a four-lobed lip, but without oral tentacula.

Forming a fringe round the edge of the operculum of *Turritella communis* dredged in Busta Voe, Shetland. Out of between twenty and thirty specimens of living *Turritella* examined, not one was free from this remarkable little Zoophyte.

The present species manifestly comes very near to *Atractylis repens* of Dr. T. S. Wright. Judging, however, from Dr. Wright's description and figures (Proc. Roy. Phys. Soc. Edinb. 1858, p. 450, pl. 22. figs. 4, 5), *Perigonymus minutus* differs from *A. repens*, Wright, in the form of the umbrella of the medusoid, which in *A. repens* shows no approach to the conical figure presented by the species here described, and in the entire absence from the medusoid (at least at the time of its liberation) of the small intermediate tentacula. It also comes very near to the *Eudendrium pusillum* of the same author (*op. cit.* 1857, p. 231, pl. 11. figs. 8 & 9); but the conical form of the medusoid separates it also from this species, from which it still further differs in the much longer peduncles of its gonophores.

Perigonymus Muscus, mihi.

Zoophyte consisting of numerous erect stems, about half an inch in height, not composed of coalesced tubes, springing at intervals from a creeping stolon, and sending off short branches, which are themselves for the most part without further ramification; polypary light brown, slightly corrugated, and with a well-marked cup-like dilatation at the base of the polype. *Polypes* semi-retractile, light reddish-brown, with about sixteen tentacula directed, in extension, alternately backwards and forwards.

Gonophores medusiferous, borne upon a rather long peduncle, and springing from the branches at a short distance behind the polype. *Medusoid* dome-shaped, with the four radiating canals terminating below, each in a large reddish bulb, which sends off two very extensile filiform tentacula, having an ocellus at the base of each; manubrium extending to about a third of the entire depth of the umbrella, and with four short oral tentacula. The medusoid is thus in all points undistinguishable from that of *Perigonymus ramosus*, Van Beneden.

In a rock-pool, Torquay, where it occurred abundantly, creeping over the bottom in small moss-like tufts.

The small size and general habit of the present species, its more simple ramification, and the fact that its stems consist of a single tube, instead of being composed of numerous tubes coalesced into a dense bundle, at once separate it from *P. ramosus*, Van Beneden, notwithstanding the fact that the medusoids of the two species are indistinguishable.

Tubularia Bellis, mihi.

Basal portion of *cœnosarc* prostrate, creeping, and sending up short, free, sparingly branched stems, which rise to $\frac{3}{4}$ inch or 1 inch in height; polypary, where it covers the lower part of the upright stems, and the whole of the prostrate portion, marked by wide but distinct annulations; cœnosarc orange, deepening in tint towards the base, expanding into a collar immediately below the polypes. *Polypes* measuring, in full-sized specimens, about 5 lines from tip to tip of the extended tentacula; body of polype scarlet.

Gonophores borne upon short, erect, branched peduncles; each gonophore with four well-marked tentaculoid tubercles on its summit; peduncles and spadix scarlet.

A beautiful little Zoophyte, conspicuous by the bright colour and large size of its polypes. It occurs attached to the bottom of rock-pools at extreme low-water spring-tides, Shetland.

II.—*On the Raphides of British Plants.* By GEORGE GULLIVER, F.R.S., Professor of Comparative Anatomy and Physiology to the Royal College of Surgeons.

IT appears to me that these Raphides are deserving of more attention than they have yet received, both in relation to the structure and economy of vegetables, and as affording a wide, interesting, and scarcely cultivated field of research for the chemical phytologist. The raphides may also be often useful as diagnostic characters in systematic botany when others are not available; for example, a mere fragment of one of the Onagraceæ or of the Lemnaceæ may be so surely distinguished, simply by its raphides, from some of its near allies in other orders, that this fact ought henceforth to be added to the description of the orders just mentioned, independently of its value in other respects. At present, I believe, the raphides have not thus been used; nor, indeed, do I know that they have been described in the majority of the British plants in which they occur, or even mentioned in Lemnaceæ and *Epilobium* before my notice of them *. Though common in some orders, it is remarkable that the raphides are so rare where they might be most expected, that I have not a single note of their presence in young parts of the stem, leaves, and flowers of British Oxalidaceæ, Umbelliferæ, Labiatæ, Euphorbiaceæ, or Polygonaceæ; and even among Crassulaceæ, no crystals were found in *Sedum Telephium* and *S. acre*. In old decaying or diseased portions of Polygonaceæ, and in many other orders, crystals are frequent; but on the present occasion they are only noticed in young growing or healthy structures.

That raphides are part of the regular structure, useful in the economy of certain plants, and by no means only a result of chemical changes connected with decay, would appear from the present observations. The remarkably constant abundance and situation of the raphides in some species supports this view. Thus, in *Lemna trisulca* the bundles of crystals are contained within the cells of the parenchyma, but are so much longer in *L. minor* as to extend beyond the cell-wall, and are very abundant in both species; while in *L. polyrrhiza* and in *L. gibba* the raphides are comparatively scanty. They occur, too, in growing parts of other plants, either in the cells or intervening spaces of young leaves and of the pistils. In some orders, as Compositæ, the crystals are chiefly confined to the ovary and testa; while they occur indiscriminately in all parts of the plant in other orders, as Onagraceæ and Orchidaceæ. Further research is much required as to their precise office in the vegetable economy, though no

* Ann. Nat. Hist. May 1861.

doubt they are of use both for food and manure. In such plants as *Lemna minor* there is a store of phosphate of lime and starch, just the kind of nutriment that young growing animals would want; and the abundance of crystals in the ovary and testa of Compositæ seems to be connected with the nutritious properties of the seeds. Thus we perceive one of the means by which such humble plants are important in nature. It has long been known how greedily water-fowl feed on the common duck-weed; and, making sure of the identity of this plant by the raphides, I have found it in the stomach of young water-rats.

Though the term 'raphides' has been used indiscriminately for all kinds of crystals in the tissues of plants, it will be confined below, in accordance with its etymological import, to the acicular or needle-like forms, and all the others will be noted simply as "crystals." The former are known to be composed chiefly of phosphate of lime, and some of the latter of oxalate of lime; but we are still ignorant of the composition of a great number of these crystals.

From my notes, extending over six years, of dissections of several hundred plants, I find that raphides or crystals were seen in the following Phanerogamia, but not in a much larger number; so that they were not detected, though often looked for, in many other orders which are not mentioned here. The names of the plants are taken from the fourth edition of Prof. Babington's excellent 'Manual of British Botany.'

Caryophyllaceæ.—*Silene Armeria*. Square or cubic crystals, in clumps $\frac{1}{1333}$ inch diameter, in the ovary. The only plant of the order in which I have seen crystals.

Onagraceæ.—True raphides occur in such abundance as to be quite characteristic of this order among the net-veined class. All parts of the plant abound in them; so that by these alone a minute fragment of it may be easily distinguished from Lythraceæ and Haloragaceæ. There were examined seven species of *Epilobium*, three garden ones of *Œnothera*, and *Circæa lutetiana*. The willow-herbs should be useful and often easily available for manure.

Rubiaceæ.—Raphides common in this order, but less plentiful than in Onagraceæ. They may be generally seen in the ovary, and occur in the corolla, leaves, and other parts; and were found in *Sherardia, Asperula,* and in six species of *Galium,* which include all that were examined. It is remarkable that raphides are common in the corolla and young fruit and scanty in other parts of *Galium Mollugo,* though plentiful also in the leaves of its variety *β scabrum.*

Compositæ.—Raphides are less common in this order than other crystals, and I have only found them in the ovary or fruit. They were seen in Corymbiferæ, Cynarocephaleæ, and Cichoriaceæ. In *Pulicaria dysenterica*, single oblong crystals with angular pointed ends; in *Senecio Jacobæa* and *S. aquaticus*, short acicular crystals; in *Arctium intermedium* and two other species, cubical crystals $\frac{1}{3000}$ inch diameter; in *Centaurea nigra*, single and double crystals shaped like those of *Pulicaria*; in *Carduus lanceolatus*, *C. palustris*, and *C. acaulis*, some acicular forms and a greater number like those of *Pulicaria* and *Centaurea*; in *Hypochœris radicata*, *Apargia autumnalis*, and *Crepis virens*, minute square or cubical crystals.

Dioscoreaceæ.—*Tamus communis*. Raphides plentiful in the stem and leaves, and still more so in the perianth and stamens.

Orchidaceæ.—The only species examined were *Orchis Morio*, *O. mascula*, *O. maculata*, and *Habenaria chlorantha*, in every one of which raphides were abundant in all parts of the plant.

Iridaceæ.—*Iris Pseud-acorus*. Long, prismatic, slender, and blunt crystals, generally occurring singly, in the leaves.

Liliaceæ.—*Endymion nutans*. Raphides abundant in all parts of this plant, from the perianth to the bulb; though not found at all in *Allium ursinum*.

Typhaceæ.—*Sparganium ramosum* and *S. simplex*. Raphides abundant in the perianth, fruit, stem, and leaves, though not found at all in *Typha latifolia* and *T. angustifolia*.

Araceæ.—*Arum maculatum*. Raphides throughout the plant.

Lemnaceæ.—Raphides (as described in Ann. Nat. Hist. for May 1861) in all our plants, most abundant in *Lemna trisulca* and *L. minor*, and comparatively scanty in *L. polyrrhiza* and *L. gibba*. In *L. minor* the raphides (phosphate of lime) are plentifully associated with starch-granules—thus indicating the valuable fertilizing and nutritious properties of this most common, abject, and despised weed.

III.—*On the proposed Change in Name of* Gracula pectoralis.

By Alfred R. Wallace.

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

Gentlemen,

May I be permitted to make a few remarks on Mr. G. R. Gray's proposal (in the 'Annals' for December 1862, p. 472) to change the name of my *Gracula pectoralis*, described and figured in the 'Proceedings of the Zoological Society' for June last, into *Gracula Anais*, that name having been given by Lesson to a bird which Mr. Gray believes to be the same species.

I am far from denying, or even doubting, that Lesson's bird was *in part* the same as mine; but I wish to inquire if the name given to *any part* of a bird, or to a manufactured bird in which more is false than genuine (and the description of which must therefore be quite unrecognizable), can claim priority over that given to the first specimens obtained of the perfect bird.

Mr. G. R. Gray believes that the wings and feet of Lesson's bird were "restorations;" I believe that the head and tail were also "restorations,"—and for this reason: Lesson describes the whole head as "*noir-velours,*" in contradistinction to the back and belly, which he terms "*noir-bronzées.*" In my bird there is no such distinction; the head is the same metallic blue-and-greenish-black as the other parts. Bonaparte, in the 'Comptes Rendus,' also says, "*capite nigro-holosericeo,*" but the other parts "*nigro-æneis,*" showing that it was no mistake of Lesson's description.

Now for the tail. One of the most characteristic features of my bird is its *white* under tail-coverts, which are tinged with yellow only at the base, where the vent for a small extent is also yellow. Now, both Lesson and Bonaparte describe this patch of orange on the vent, but neither say a word about the white under tail-coverts, which are very ample and cover the tail to within an inch of its extremity. If, now, we conclude that the wings were false, from the conspicuous white band across them not being mentioned by either author, the absence of any mention of the equally conspicuous white under tail-coverts must also lead us to conclude that the tail had been replaced by that of some other bird; and every one who has seen much of the native New-Guinea skins must know that the tails are very liable to come off.

It seems probable, therefore, that Lesson's specimen was made up of the *trunk* of my bird, with the *head, wings, tail,* and *legs* of one or more other birds; and the name given to this ingenious work of art (the description of which is of course inapplicable to any natural object) must, it is said, be retained according to the law of priority, and that given for the first time to the *perfect* bird be quoted as a synonym. Now, I contend that this is not a case for the application of the law of priority, and would inevitably lead to further confusion; for an inquirer possessing the bird is sent back to Lesson for a description of the species, and finding a palpable disagreement, unhesitatingly describes his specimen as new; and we must always be liable to such mistakes if descriptions acknowledged to be not merely insufficient, but false, are allowed to be quoted as the authority for specific names.

Turning now to Mr. Cassin's description, we find that his specimen is fairly stated to have been a mutilated one—the legs and wings wanting, and the head much injured; yet his description is recognizable if we allow for the absence of the wings. His name, however, is very faulty, as *black* is the colour of fully two-thirds of the perfect bird, the *yellow* appearing only as a band round the body and a patch on the rump and vent: *luteocinctus* would therefore have been appropriate; *nigrocinctus* is a complete misnomer; and, in fact, it was that very name which prevented me from inquiring further about the bird, which I had long seen included in Dr. Sclater's list of New-Guinea birds.

The question, then, is, Shall a name, given to a mutilated skin, and which is erroneous and inapplicable as regards the perfect bird, be perpetuated by the law of priority? Many naturalists are now of opinion that where a description is palpably incorrect or insufficient to distinguish a species among its allies, or when a name is plainly inapplicable to the species to which it has been applied, such names and descriptions should be passed over as altogether void; for it is evidently more to the interest of our science that the inquirer should be at once referred to a good description, which will settle his doubts, than to an imperfect or incorrect one, which must only increase his difficulties. A general conflagration of every work describing species, published more than fifty years back, would be an unmixed blessing to zoology.

In this case we have, first, a name and description of a made-up specimen, of which probably one-fifth part only is genuine, and, secondly, a specimen confessedly mutilated in its most important parts, and the name given to which is inapplicable to the entire bird; and in both cases the absence of the legs and wings has led to the species being placed in a wrong genus. I now leave ornithologists to decide, in the interest of science, by what name this bird shall be called; and I would further beg to suggest, as a useful and necessary supplement to the law of priority, that it be decreed *that where the first description of a species is absolutely insufficient to determine the same, and a new name has, owing to such insufficiency, been given to the species, with a good and sufficient description attached, such new name shall be for ever retained, notwithstanding at any future time the former name may be proved to have been applied to the same species.*

I remain, Gentlemen,

Your most obedient Servant,

ALFRED R. WALLACE.

IV.—*Descriptions of Five New Genera of Mollusca.* By Henry and Arthur Adams.

Many interesting forms of Mollusca have been made known since the publication of their 'Genera' by the authors; and many, doubtless, yet remain undiscovered. Several entirely new types from Japan have recently been described in the 'Annals' by one of the authors; and in this communication will be found notices of five others, which are also supposed to be forms new to science. Some of these, unfortunately, are from localities at present unknown to us.

Genus Leuconyx, H. & A. Adams.

Testa interna? unguiformis, spathulacea, alba, extus convexa, intus concava, impressione musculari nulla, marginibus inflexis, apice involuto, uncinato, producto, cryptiformi.

This genus is founded on a remarkable shell in the possession of R. Tyler, Esq., and appears at first sight to belong to Capulidæ. The interior, however, is not marked by any horse-shoe muscular impression. After repeated examination and comparison, we have arrived at the conclusion that its real affinities are with Aplysiidæ, and especially with the genus *Dolabella*, from which it differs principally in the contorted unguiculate apex, which forms a cryptiform cavity somewhat similar to that of *Navicella* and *Crypta* (*Crepidula* of Lamarck). On account of its colour, form, and texture, we may consider it to have been an internal shell, and covered by the mantle of the animal.

Leuconyx Tyleriana, H. & A. Adams.

L. testa spathuliformi, antice dilatata, postice unguiculata, alba, tenui, superficie longitudinaliter substriata lineisque concentricis incrementi insculpta; margine dextro concavo, breviore, sinistro rectiusculo, longiore; apice intorto, intus concamerato.

Hab. ——?

Genus Bacula, H. & A. Adams.

Testa subulata, claviformis, imperforata, tortuosa, solida, tota transversim striata. Apertura ovata, antice integra, producta; labio incrassato, calloso; labro simplici, margine acuto, in medio producto.

In its subulate form and tortuosity this little genus resembles *Eulima*, all the species of which, however, are glabrous or polished. In *Bacula* the whorls are transversely striated, and the inner lip is circumscribed and callous.

Bacula striolata, H. & A. Adams.

B. testa subulato-claviformi, imperforata, sordide alba, tota transversim striata; anfractibus circa duodecim, planatis, ultimo ad peripheriam vix angulato; apertura acuminato-ovata; labio arcuato, incrassato; labro in medio subproducto.

Hab. China Sea.

Genus Leiopyrga, H. & A. Adams.

Testa turbinato-turrita, perforato-umbilicata, tenuis, porcellana, lævsi, nitida. Apertura subcircularis, spira brevior; labio tenui; columella angusta, excavata, incurvata; labro simplici, margine acuto.

This genus is established on a shell which by some would be regarded as a thin, umbilicated *Phasianella* or *Eutropia.* It has, indeed, somewhat of the aspect of *Bankivia,* the interior of the aperture not being nacreous; but the columella does not end in the Achatinoid truncation peculiar to that genus. The animal and operculum of *Leiopyrga* are unknown.

Leiopyrga picturata, H. & A. Adams.

L. testa subturrita, perforata, tenui, lævi, lineolis longitudinalibus undulatis, rufescentibus, ad suturas saturatioribus et punctatis pulcherrime picta; anfractibus $6\frac{1}{2}$, convexis, subimbricatis, longitudinaliter substriatis, transversim obsolete sulcatis; suturis profundis, marginatis.

Hab. ——?

The shell is thin, porcellanous, shining, and very prettily marked with red-brown wavy lines, which assume, at the sutures and at the periphery of the last whorl, the appearance of dark round spots. The specimen from which our description is taken is in the collection of R. Tyler, Esq.

Genus Taheitia, H. & A. Adams.

Testa elongata, subcylindrica, decollata; anfractibus longitudinaliter costellatis. Apertura ovata, anfractu penultimo late sejuncta; peristomate continuo, extrorsum expanso.

Operculum testaceum, laminis erectis, radiantibus, excentricis instructum.

We have considered it necessary to distinguish this remarkable Taheitian shell from the other species of *Truncatella* on account of the shelly operculum, which is furnished with erect, radiating lamellæ. The last whorl is curiously porrected, as is the case in the genus *Cylindrella.*

Taheitia porrecta, Gould.

Truncatella porrecta, Gould, Otia Conch. p. 40.

Genus Chromotis, H. & A. Adams.

Testa ovata, auriformis, imperforata, tenuis, lævis, polita; spira obtusa, brevissima; anfractibus rapide crescentibus, ultimo magno. Apertura elliptica; columella complanata.

Operculum calcareum.

Chromotis neritina, Dunker.

Phasianella neritina, Dkr. Zeitschr. für Malakoz. 1846, p. 110; Krauss, Südafrik. Moll. tab. 7. f. 6; Phil. Kuster's Chem. Conch. Cab., Phasianella, taf. 5. f. 6.

Gena lineata, A. Adams, Proc. Zool. Soc. 1850; Sow. Thesaur. Conch., Stomatellinæ, pl. 178. f. 26, 27.

Hab. Cape of Good Hope.

Dr. Krauss observes that the operculum is the same as that of *Phasianella capensis*, Dkr.

V.—*On new Species of Snakes in the Collection of the British Museum.* By ALBERT GÜNTHER, M.A., M.D., Ph.D.

[Plate III.]

THE following species of Ophidians, previously desiderata in the Collection of the British Museum, have been procured since the publication of a paper on the same subject in this Journal (January 1862, p. 52). The total number of species in that collection is now raised to 627, and that of the typical specimens to 189. Those marked with an asterisk (*) are new.

*Cercocalamus collaris. Central America. A. Günther.

*Brachyurophis semifasciata. Baranquilla, at the mouth of the River Magdalena (New Granada). Purchased.

*Leptodira leucocephala. Bahia. Dr. O. Wucherer.

Leptognathus variegatus, *Schleg.* British Guiana.

Hoplocephalus bitorquatus (Alecto bitorquata, *Jan*). Clarence River. This snake is rare. Two specimens were contained in the collection sent by Mr. Krefft to the International Exhibition.

Hoplocephalus signatus (Alecto signata, *Jan*). Clarence River. Sent by Mr. Krefft.

Furina bimaculata, *D. & B.* Western Australia. Purchased.

Neelaps calonotus (Furina calonotus, *D. & B.*). Baranquilla. Purchased.

Bothrops pictus (Lachesis pictus, *Tschudi*). Peru. Presented by Professor Nation, of Lima.

Teleuraspis brachystoma (Bothriechis brachystoma, *Cope*, Proc. Acad. Nat. Sc. Phil. 1861, p. 295). Lower Vera Paz. Messrs. Godman & Salvin.

—— nummifera, *Rüpp.* Lower Vera Paz. Messrs. Godman & Salvin.

*Pœcilostolus Burtonii. West Africa. Major Burton.

Fam. Calamaridæ.

Cercocalamus.

Body rounded, of moderate length; head rather narrow, depressed, not distinct from the neck; tail of moderate length. Rostral shield low; two pairs of frontals; one nasal; loreal none, replaced by nasal, anteorbital, second labial, and postfrontal. Scales smooth, rhombic, without groove, in fifteen rows; anal and subcaudals entire. Eye small, with elliptical pupil; the posterior maxillary tooth longest, grooved.

Cercocalamus collaris. Pl. III. fig. A.

This snake has the habit of *Geophis lineata.* Its rostral shield is much broader than high, not recurved backwards; præfrontals half as large as postfrontals, which are bent downwards on the side; vertical not quite twice as long as broad, hexagonal, with an obtuse angle in front, and with an acute one behind. Occipitals tapering behind, somewhat longer than the vertical. The single nasal is elongate, touching the præorbital, which is not raised to the upper surface of the head; one postorbital. Seven upper labials, the third and fourth of which enter the orbit. The fifth upper labial is in immediate contact with the occipital, separating the anterior temporal from the postorbital. There is a large elongate posterior temporal shield (probably formed by two confluent shields) on the side of each occipital. Six lower labials; the first pair do not form a suture together behind the median labial shield, as is the case in almost all other snakes. Two pairs of elongate head-shields. Ventral shields 142, subcaudals 46. Upper parts brownish-olive; a broad black collar across the neck; a very narrow indistinct blackish vertebral line on the anterior part of the trunk.

Length of head $\frac{1}{3}$ inch, of trunk 9 inches, of tail 2 inches.

This snake is said to have come from Central America. It appears to be allied to *Olisthenes*, Cope!

The figure represents the head twice its natural size.

Brachyurophis.

Body rounded; head short, not distinct from neck; tail short. Rostral shield large, as in *Rhinostoma,* with a sharp anterior edge, but not recurved; two pairs of frontals; one nasal; no loreal, replaced by the hinder portion of the nasal. Scales smooth, rhombic, without groove, in seventeen rows; anal bifid, subcaudals two-rowed. Eye small, with circular pupil; the posterior maxillary tooth longest, grooved.

Brachyurophis semifasciata. Pl. III. fig. B.

Yellowish-white, with sixty or seventy dark brown cross bars on the head, trunk, and tail; they do not extend downwards on the sides of the trunk; each occupies two cross series of scales, and is as broad as the interspaces of the ground-colour; the first occupies the end of the snout, the second covers the interocular and occipital regions, and is separated from the third by a narrow white collar.

This snake has the physiognomy of a *Rhinostoma*; its rostral shield is produced, with a sharp anterior edge, a convex upper and a slightly concave lower surface; its posterior angle extends far between the præfrontals, without entirely separating them; præfrontals rather smaller than postfrontals. Vertical five-sided, as broad as long; occipitals not much longer than vertical. Nasal shield single, elongate, replacing the loreal; the single præorbital extends nearly to the vertical; two small postorbitals in contact with the anterior temporal; temporals three, the two posterior scale-like; five upper labials, the third and fourth entering the orbit, the last sometimes separated into two; seven lower labials; chin-shields very small, scale-like. Ventral plates 148, anal 1/1, subcaudals 22–24.

Head...........................	5 lines.
Trunk	132 „
Tail	15 „
Total length	13 inches.

Two specimens from Baranquilla (New Granada) are in the British Museum.

Dryophis Kirtlandii.

Hallowell, Proc. Ac. Nat. Sc. Philad. vii. 1854, p. 100.

Rostral angular in front, slightly reverted on the upper side of the head; anterior frontals not much smaller than posterior; occipitals rather longer than the vertical, obtusely rounded behind, and with a pair of large nuchal scales, which are larger than the hinder temporal. Nasal single, oblong, pierced on the middle by the round nostril; loreal single, very long; one anteorbital, reaching the upper surface of the head, but not extending on to the vertical. The anteorbital region deeply concave. Three postorbitals; four temporals, the anterior of which is in contact with the postorbitals. Eight upper labials, the fourth and fifth entering the orbit; ten pairs of lower labials, six of which are in contact with the chin-shields. Scales (in nineteen series) very narrow, long, imbricate, disposed in cross series, with a single groove at the apex, those of the vertebral series slightly grooved, not larger than the others.

Uniform olive-green above, yellowish on the lower parts of the sides and on the belly.

Specimens of this snake were found by Major Burton, H. M. Consul at Fernando Po, during an excursion on the Camaroon Mountains.

Leptodira leucocephala.

Anal entire; scales in nineteen rows. Posterior maxillary tooth longest, grooved. White (in spirits), with large rhomboid black blotches; head and nape of the neck white, with black dots.

One specimen, sent by Dr. O. Wucherer from Bahia.

Head rather broad and depressed, distinct from neck; body compressed, with the ventrals angularly bent upwards; tail slender. Snout rounded, depressed, short; eye of moderate size, with elliptical pupil. Rostral broader than high, reaching the upper surface of the head; anterior frontals nearly square, one-third as large as the posterior, which are slightly bent downwards to the side of the snout; the vertical is pentagonal, much longer than broad, but shorter than the occipitals, which are rounded posteriorly. Nostril between two small plates; loreal a little longer than high; one anterior and two posterior oculars. Eight upper labials, the third, fourth, and fifth of which enter the orbit. Eight scale-like temporal shields, the two anterior of which are in contact with the oculars. Five of the lower labials are in contact with the chin-shields. Scales in nineteen rows, each of those on the back with two grooves. Ventral shields 230; one anal; 114 subcaudals.

Ground-colour white, with twenty-five large, irregularly rhombic black blotches; they extend downwards on the ventrals; the first is behind the nape; those on the tail are rather irregular and partly confluent; the head is white, with small black dots, those on the temple confluent into an obsolete band.

Total length	$31\frac{1}{3}$	inches.
Length of head	$\frac{2}{3}$	,,
,, trunk	$21\frac{2}{3}$	,,
,, tail	9	,,

Brachysoma diadema.

Calamaria diadema, Schleg. Ess. ii. p. 35.
Elaps ornata, Gray, Zool. Misc. p. 55.
Brachysoma diadema, Fitz. Syst. Rept. p. 25 (not Gthr.).
Furina diadema, Dum. & Bib. p. 1239.
Rabdion occipitale, Girard, U.S. Explor. Exp. Rept. p. 120.
Glyphodon ornatus, Gthr. Colubr. Snakes, p. 210.

I have formerly confounded this snake with *Furina bimaculata*, D. & B. The genus, which has been characterized by myself with the name of *Glyphodon*, is valid, but must bear the name of *Brachysoma*; whilst for *Brachysoma*, Gthr., the name of *Furina*, D. & B., may be substituted.

Mr. Krefft's collection contained several very fine examples of this species, which has only one congener, viz. *Brachysoma triste* = *Glyphodon tristis*, Gthr.

Furina bimaculata.

Furina bimaculata, Dum. & Bib. p. 1240.
Brachysoma diadema, Gthr. Colubr. Snakes, p. 229 (not Schleg., Fitz.).

This is the type of a distinct genus, for which I had formerly adopted the name of *Brachysoma*, but for which that of *Furina* is better retained. It is readily distinguished by its protruding rostral shield. The species is a native of Western Australia.

Diemansia cucullata.

Günth. Ann. & Mag. Nat. Hist. 1862, p. 52.

Mr. Krefft has sent two other specimens of this species; they have the scales in fifteen rows.

Diemansia annulata.

Günth., Colubr. Snakes, p. 213.

This is the snake which Mr. Krefft has recognized as the young of a very large species, and to which he has applied the name of *Furina textilis**. Both species, however, are distinct, and may be readily distinguished by the number of the postorbitals, which is two in four examples of *D. annulata* examined by myself, whilst *Furina textilis* has three of those shields. Mr. Krefft has sent a stuffed example, 6 feet long, in which the dark cross bands have nearly entirely disappeared. This species has not the large rostral shield of *Pseudonaja nuchalis*.

Fam. Elapidæ.

NEELAPS.

No other teeth behind the fang. Scales smooth, polished, without a groove at the apex, of equal size, in fifteen rows. Rostral shield large, broad, depressed, rounded behind; nasal single, long, replacing the loreal. Two postoculars, the upper sometimes confluent with the superciliary. Ornamental colours arranged in longitudinal bands.

Central America.

Neelaps calonotus.

Furina calonotus, Dum. Bibr. Erpét. Génér. vii. p. 1241, pl. 75 (*bis*).

This snake has been described and figured in the work quoted, where it is said to be a native of Tasmania. However, we have received a specimen from Baranquilla, at the mouth of the River Magdalena, in New Granada, with the same collection which contained the genus *Brachyurophis*, described above. It must

* Proc. Zool. Soc. 1862, p. 149.

be removed from the Australian genera *Furina* and *Brachysoma*, which have a series of small teeth behind the fang.

Teleuraspis nummifera. Pl. III. fig. C.

Atropos nummifer, Rüpp. Verzeichn. Senckenb. Mus., Rept. p. 21.
—— *mexicanus*, Dum. & Bibr. vii. p. 1521, pl. 83 *bis*.
Teleuraspis nummifer, Cope, Proc. Ac. Nat. Sc. Phil. 1859, p. 339.
Bothriëchis mexicanus, Cope, *l. c.* 1861, p. 294.

Rüppell first noticed this snake: "Head that of a viper; a depression between the eye and nostril, as in *Trigonocephalus*; subcaudals entire, as in *Echis*; the anterior mandibulary teeth rather long. Perhaps it is merely a young *Crotalus* with the rattle not developed. Habitat unknown."

It being impossible to recognize the species or even the genus from this description, Duméril describes it for the second time as new, erroneously referring it to a genus "à urostèges doubles, et à surciliaires nulles" (p. 1370). In the figure the subcaudals are correctly represented as simple, and the supraorbitals are present; but, being drawn from a young individual, the figure is rather indifferent.

Cope is quite right in considering the snakes described by Rüppell and Duméril as identical, and refers them to his genus *Teleuraspis*.

Messrs. Salvin and Godman have collected splendid specimens in Lower Vera Paz. The species attains to a length of thirty inches.

The figure represents the head, of the natural size.

Fam. Viperidæ.

Pœcilostolus.

Head thick, broad, covered above with strongly keeled scales; body compressed; tail prehensile. Subcaudal shields entire.

This genus differs from *Echis* in its compressed body, prehensile tail, and bright colours. Whilst *Echis* is confined to dry, sandy plains, *Pœcilostolus* inhabits trees or bushes. *Vipera chloroëchis*, Schleg., probably belongs to the same genus.

Pœcilostolus Burtonii.

Scales strongly keeled, in nineteen rows; upper labials nine, none of which enter the orbit. Rostral shield very low, linear, with other scale-like shields above. Entirely bright yellow; single scales green.

This beautiful species was discovered by Major Burton, in the Camaroon country. It appears to be very scarce, as only one specimen, 14 inches long, has been found. We intend to give a figure of it in the 'Proceedings of the Zoological Society.'

VI.—*On new Species of Batrachians from Australia.*

By Albert Günther, M.A., M.D., Ph.D.

[Plate IV.]

In a paper on new species of Snakes, I have frequently had occasion to mention a collection of reptiles sent by G. Krefft, Esq., Curator of the South Australian Museum at Sydney, to the International Exhibition. Although, in consequence of a want of the necessary literature, Mr. Krefft could not determine all the species collected by him, the collection nevertheless proved to be one of the most valuable contributions to zoology; the specimens are beautifully preserved; and all of them being collected by the exhibitor himself, we are thus supplied with most reliable information on the habitat of many species, particularly of the reptiles found in the neighbourhood of Sydney. We have seen that many of the species of snakes sent by Mr. Krefft have been known only for a very short period, and were previously not represented, or only very scantily, by specimens in the British Museum. We give in the present paper the descriptions of the new Batrachians, and intend to publish a similar report on the Saurians at a future time.

Limnodynastes Krefftii.

This species is very closely allied to *L. tasmaniensis*, from which it will be readily distinguished by the presence of only one tubercle on the metatarsus.

No large gland on the hinder extremity; skin of the back smooth; metatarsus with a single tubercle. Greenish-olive, spotted with blackish; the lower parts whitish.

In habit this Frog is entirely similar to *L. tasmaniensis*, a figure of which may be found in the 'Batrach. Salient.' pl. 2. fig. B; also the tongue, teeth, nasal openings, &c., are the same as in that species; but the carpus has only two tubercles below, and the metatarsus only one. A whitish vertebral line is scarcely indicated; the blackish spots on the back are more or less confluent into irregular longitudinal bands; a black band along the canthus rostralis, continued behind the eye, towards the shoulder; its postocular portion is edged with white below; legs with short blackish cross bands. Young specimens have a brighter coloration, their ground-colour being yellowish or yellowish-olive, and the black band behind the eye having a rose-coloured inferior margin.

An adult male and female, and several half-grown and young specimens, were in the collection. It appears to be a rather common species in the neighbourhood of Sydney.

Length of the body (male) 28 lines, of the hind leg 42 lines, of the fore leg 18 lines, of the fourth hind toe 13 lines.

Limnodynastes affinis.

This species also is very closely allied to *L. tasmaniensis* and *L. Krefftii*, but is distinguished by the following characters:—

No large gland on the hinder extremities; skin of the back smooth; carpus and metatarsus each with two tubercles. Brownish-olive, with a few brown blotches on the back; a whitish vertebral line is scarcely indicated; a brown streak along the canthus rostralis, continued behind the eye towards the shoulder, its hinder portion having a whitish inferior edge; lower parts uniform whitish.

A single female specimen, from the Clarence River, is in the collection.

Length of the body 15 lines, of the fore leg 8 lines, of the hind leg 21 lines, of the fourth toe 7 lines.

PLATYPLECTRUM.

(Fam. **Cystignathidæ.**)

Fingers and toes tapering, free, the latter with a very narrow fringe of a web; maxillary teeth; vomerine teeth in a straight transverse line. The internal openings of the nostrils and of the eustachian tubes very small; tympanum covered by the skin. Tongue circular. No parotids. The transverse process of the sacral vertebra not dilated. Metatarsus with a flat sharp-edged spur (as in *Sphærotheca*).

This genus is distinct from *Limnodynastes*, which has only one or two small tubercles on the metatarsus.

Platyplectrum marmoratum. Pl. IV. fig. A.

Habit stout; snout as long as the eye, with the canthus rostralis very obtuse; nostril on the canthus rostralis, in the middle between the eye and end of the snout; upper parts with very small smooth tubercles; legs short. Olive, the upper parts marbled with brown; a narrow light cross band between the orbits, edged with brown in front and behind; the lower parts uniform whitish.

Length of the body 18 lines, of the fore leg 9 lines, of the hind leg 24 lines, of the fourth toe 7 lines, of the fifth 5 lines.

A single specimen, from the Clarence River, is in the collection; it is a male, with a wide slit on each side of the tongue for the vocal sac.

CRYPTOTIS.

(Fam. **Asterophrydidæ.**)

Fingers and toes tapering, free to the base; maxillary teeth;

a pair of long, tooth-like, erect processes at the symphysis of the lower jaw. The internal openings of the nostrils and of the eustachian tubes very small; tympanum small, entirely covered by the skin, situated behind and above the angle of the mouth. No parotids. The transverse process of the sacral vertebra slightly dilated. Vomerine teeth present; the upper eyelid without appendages.

Cryptotis brevis. Pl. IV. fig. B.

Habit stout; head rather large; snout of moderate extent, much longer than the eye, which is rather small; canthus rostralis very obtuse; the nostril is on the canthus rostralis, in the middle between the eye and end of the snout. The mandibulary processes at the symphysis are not true teeth, but are covered with the mucous membrane, one line long, and slightly bent inwards; vomerine teeth in two very short oblique groups situated behind the inner nostrils. All the upper parts with numerous small and smooth tubercles. Legs rather short; carpus with two, metatarsus with one small tubercle. Grey, upper and lower parts marbled with brownish; a brown streak along the canthus rostralis. A whitish cross band between the eyes, bordered by a large brown spot behind. An opening on each side of the tongue for the vocal sac in the male.

Length of the body 20 lines, of the fore leg 10 lines; of the hind leg 26 lines, of the fourth toe 9 lines, of the fifth 7 lines.

A single specimen, from the Clarence River, is in the collection.

Hyla Krefftii. Pl. IV. fig. C.

Vomerine teeth in two short transverse groups, situated between the inner nostrils; snout rather short, rounded, a little longer than the eye; canthus rostralis obtuse, loreal region slightly concave. Tongue with a very small notch behind; the inner nostrils small; tympanum distinct, half as large as the eye. Back smooth; a very distinct fold across the chest. Fingers one-fourth webbed, with the disks of moderate size; toes broadly webbed. Reddish-olive, with a very broad dark dorsal band, commencing between the eyes and extending on to the vent. This band is much more distinct in young specimens than in adult ones.

Length of the body 22 lines, of the fore leg 13 lines, of the hind leg 33 lines, of the fourth toe 8 lines, of the fifth $6\frac{1}{2}$ lines.

Sydney.

VII.—*Descriptions of newly discovered Spiders captured in Rio Janeiro by* John Gray, Esq., *and* the Rev. Hamlet Clark. By John Blackwall, F.L.S.

[Concluded from vol. x. p. 439.]

Epeïra audax.

Length of the female $\frac{3}{5}$ths of an inch; length of the cephalothorax $\frac{3}{20}$; breadth $\frac{1}{8}$; breadth of the abdomen $\frac{1}{4}$; length of an anterior leg $\frac{1}{2}$; length of a leg of the third pair $\frac{1}{4}$.

The eyes are seated on the anterior part of the cephalothorax; the four intermediate ones are placed on a prominence and form a square, the two anterior ones being the largest of the eight; the eyes of each lateral pair are seated on a tubercle, and are near to each other, but not in contact. The cephalothorax is compressed before, rounded on the sides, convex, particularly in the cephalic region, immediately behind the eyes, glossy, thinly clothed with whitish hairs, and has a large transverse indentation in the medial line; the falces are strong, conical, vertical, convex in front, and armed with teeth on the inner surface. These parts are of a brown colour, the latter being tinged with yellow at the extremity, on the inner side. The maxillæ are short, straight, powerful, and enlarged and rounded at the extremity; the lip is semicircular, but slightly pointed at the apex; and the sternum is heart-shaped, with small prominences on the sides, opposite to the legs: the colour of these parts is very dark brown, the extremity of the maxillæ and the apex of the lip having a pale yellowish hue. The legs are moderately long and robust, and are provided with hairs and fine spines; the first and second pairs are of a yellowish-brown colour, the metatarsi and tarsi being the darkest, and the tibiæ are marked with brown annuli, which are most conspicuous on their inferior surface; the femora of the third and fourth pairs are of a brownish-black colour, with the exception of the base, which has a pale yellowish hue, and the genual joint, the base and extremity of the tibiæ and of the metatarsi, and the whole of the tarsi, have a dark brown colour, that of the intermediate space of the tibiæ and metatarsi being yellowish-brown; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by claws of the usual number and structure. The palpi have a brown hue, the humeral and cubital joints being tinged with yellow, and have a curved pectinated claw at their extremity. The abdomen is triangular, with its vertex directed backwards, and is sparingly clothed with whitish hairs; it has three tubercles at its anterior extremity, two constituting the lateral angles and one intermediate, four disposed on each side, and three in a vertical row at its posterior extremity, fourteen in all; the upper part is of a dull yellow colour, with three small dark brown depressions on each side of the medial line, forming an angle whose truncated extremity is directed forwards; the anterior part, which projects over the base of the cephalothorax, is of a brown colour; a short fusiform band of a brownish-black hue extends backwards from the anterior intermediate tubercle; it has an angular point on each side, near the middle, and comprises six minute pale yellow spots, two situated longitudinally between the lateral points, and four at its posterior extremity, forming a small trapezium; the sides and under part have a brown-black colour; each of the former is marked with three large, oblong, dull yellow spots, and the anterior side of the four tubercles situated thereon has a pale yellow hue; four obscure pale yellow lines extend along the under part, and the two intermediate ones meet at the spinners; the sexual organs are prominent, and have a long acute process, connected with their anterior margin, which is directed obliquely backwards and downwards; their colour is dark reddish-brown, and that of the branchial opercula is brown.

This spider is nearly allied to the *Epeïra mexicana* of M. Lucas. (See the 'Hist. Nat. des Insect. Apt.' of M. Walckenaer, tom. ii. pp. 130, 131.)

Epeïra edax.

Length of the female $\frac{11}{16}$ths of an inch; length of the cephalothorax $\frac{1}{4}$; breadth $\frac{1}{5}$; breadth of the abdomen $\frac{2}{5}$; length of an anterior leg $\frac{9}{10}$; length of a leg of the third pair $\frac{1}{2}$.

The cephalothorax is compressed before, rounded on the sides, convex, pubescent, and has an indentation in the medial line; the falces are powerful, conical, vertical, and armed with teeth on the inner surface; the maxillæ are strong, and enlarged and rounded at the extremity; the lip is nearly semicircular, but somewhat pointed at the apex; the sternum is heart-shaped, with small eminences on the sides, opposite to the legs. The legs are long, and provided with hairs and spines; the first pair is the longest, then the second, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure; the palpi are short, and have a curved pectinated claw at their extremity. These parts are of a dull yellow colour, the falces having a tinge of brown at their extremity. The eyes are disposed on the anterior part of the cephalothorax in two transverse rows, those of the anterior row being the larger and darker; the four intermediate ones are placed on a prominence and nearly form a square, those of the anterior pair, which are rather the largest of the eight, being a little wider apart than those of the posterior pair; the eyes of each lateral pair are seated obliquely on a prominent tubercle, and are separated by a moderately wide interval. The abdomen is broad, triangular, and terminates in a point situated high above the spinners; it is clothed with light-coloured hairs, which are longest in front, is convex above, projects over the base of the cephalothorax, and is of a brownish-yellow colour, with a large brown triangular mark on the upper part, comprising within its broad anterior base four indented spots, which nearly form a square; the two posterior ones are larger and rather wider apart than the two anterior ones, and there is a small glossy convexity near its vertex, bearing a strong resemblance to a small eye; the sides are marked with obscure, slightly oblique, brown lines, and on the under part there is a large soot-coloured angular mark, whose vertex is near the spinners, which are encircled by pale yellow spots; the sexual organs are highly developed, with a long, pointed, spine-like process directed downwards from their anterior margin, and have a yellowish-brown hue.

The sexes bear a general resemblance to each other in colour; but the male, which is the smaller, differs from the female in various particulars. The anterior prominence of its cephalothorax, on which the four intermediate eyes are seated, is narrower and more protuberant. The legs are more abundantly supplied with spines, those on the inner side of the somewhat enlarged extremity of the slightly curved tibiæ of the second pair being the most numerous; a transverse row of short spines occurs at the extremity of the coxa of each posterior leg, on the under side, and there is a short, curved, red-brown process on the under side of the extremity of the coxa of each anterior leg: these limbs are somewhat irregularly marked with dark brown. The falces are slender, have a conical process at the base, in front, and are not tinged with brown at the extremity. The base of the maxillæ, lip, and margins of the sternum have a brown hue. The abdomen has some long coarse hairs, more or less erect, on its upper part, and the branchial opercula have a dark brown hue. The palpi are short; the cubital joint has a long bristle directed forwards from its extremity, and the radial joint is very protuberant underneath; the digital joint is large, of an oblong-oval form, tapering to a point, and has a long process at its base, greatly curved outwards, whose enlarged extremity has a dark red-brown hue; it is convex and hairy externally, concave within, and with this concavity the palpal organs are connected; they are very highly developed, very prominent and complicated in structure, with a pale yellow transversely striated piece at the base, in front, and a large slightly curved process extending along the upper side, whose broad recurved extremity projects two short strong processes curved towards each other; on the under side there is a prominent obtuse process, and between these processes there are the extremities of two others; the colour of these organs is dark brown, red-brown, and pale yellow intermixed. The convex sides of the digital joints are directed towards each other.

Epeïra rapax.

Length of the male $\frac{9}{32}$nds of an inch; length of the cephalothorax $\frac{5}{32}$; breadth $\frac{1}{9}$; breadth of the abdomen $\frac{1}{8}$; length of an anterior leg $\frac{11}{24}$; length of a leg of the third pair $\frac{1}{4}$.

The four intermediate eyes, which are seated on a frontal prominence of the cephalothorax, are nearly equal in size, and almost form a square, the two anterior ones being slightly wider apart than the posterior ones; the eyes of each lateral pair are placed on a tubercle, in a horizontal line, and are separated by a small space. The cephalothorax is compressed before, rounded on the sides, somewhat pointed in front, convex, glossy, and has a large indentation in the medial line; it is thinly clothed with pale yellowish hairs, and is of a reddish-brown colour, with a broad brown band extending along each side, whose margins are somewhat sinuous. The falces are conical, vertical, and armed with a few teeth on the inner surface; the maxillæ are short, straight, and enlarged at the extremity, and the lip is semicircular, but somewhat pointed at the apex. The colour of these organs is brown, their extremities having a brownish-yellow hue. The sternum is heart-shaped, with minute eminences on the sides, opposite to the legs; its colour is yellowish-brown, a few obscure dark brown streaks passing from the lateral margins to the medial line. The legs are robust, provided with hairs and spines, the latter being strongest and most numerous on the inferior surface of the somewhat enlarged tibiæ of the second pair, and there is a short spine-like process at the extremity of the coxæ of the first, third, and fourth pairs, on the under side; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by claws of the usual number and structure: these limbs have a brownish-yellow hue, and are marked with dark brown annuli. The palpi are short, and of a brownish-yellow colour, a brown transverse bar occurring near the middle of the digital joint; the cubital is smaller than the radial joint, and has a long bristle in front; the radial joint is protuberant on the inner and outer sides, and is supplied with long hairs; the digital joint is oval, with a process at its base, curved outwards, whose dark red-brown obtuse extremity is glossy; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, protuberant, complex in structure, with a large, prominent, curved, pointed process on the outer side; and their colour is pale and dark red-brown intermixed. The convex sides of the digital joints are directed towards each other. The abdomen is oviform, thinly clothed with hairs, convex above, projecting over the base of the cephalothorax, and has a small conical prominence on each side of its anterior extremity; it is of a yellowish-brown colour, reticulated with fine brown lines; a pale yellow longitudinal streak in front of the upper part is followed by a large leaf-like band, with sinuous margins, which tapers to the spinners; this band is soot-coloured, freckled with yellowish-brown, and is marked with black transverse lines, whose extremities are curved forwards; the anterior part comprises a transverse pale yellow band, reticulated with brown, whose pointed extremities are in contact with the lateral conical prominences, and on each side of the medial line there are two dark brown indented spots, disposed in pairs, which describe a quadrilateral figure whose posterior side is the longest; the sides are the darkest in the medial line, and are marked with oblique black streaks; the middle of the under part is of a dark brown colour, freckled with yellowish-white, and there are two conspicuous spots of the latter hue placed transversely near the spinners.

Epeïra munda.

Length of the male $\frac{7}{20}$ths of an inch; length of the cephalothorax $\frac{1}{5}$; breadth $\frac{3}{20}$; breadth of the abdomen $\frac{1}{8}$; length of an anterior leg $\frac{7}{12}$; length of a leg of the third pair $\frac{5}{16}$.

The cephalothorax is compressed before, somewhat pointed in front, rounded on the sides, thinly clothed with hairs, convex, glossy, and has a large oblong indentation in the medial line; the falces are powerful, conical, vertical, convex in front, near the base, and armed with a few teeth on the inner surface; the sternum is heart-shaped, with minute eminences on the sides, opposite to the legs; the legs are robust, provided with hairs and spines, the latter being the strongest and most abundant on the inner surface of the tibiæ of the second pair; the first pair is the longest, the second and fourth pairs are equal in length, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. These parts are of a brownish-red colour; the sternum is the palest, and the extremity of the joints of the legs, the middle of the anterior part of the cephalothorax, and the medial indentation have a brown hue. The maxillæ are short, straight, and enlarged at the extremity; and the lip is semicircular, but somewhat pointed at the apex. These organs have a reddish-brown hue at the base, that of their extremities being brownish-yellow. The palpi are short, and of a reddish-yellow colour, with the exception of the digital joint, which has a brown hue; the cubital joint has a long bristle in front, and the radial joint is prominent on the outer side; the digital joint is oval, with a brownish-black, glossy process at its base curved outwards; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, very protuberant, complex in structure, with two processes at their extremity, one of which is much larger and more obtuse than the other, and two on the outer side, the posterior one, which is somewhat convex, being much the most prominent; the colour of these organs is dark and light reddish-brown intermixed. The convex sides of the digital joints are directed towards each other. The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones are placed on a prominence, and nearly form a square, the two anterior ones, which are the largest of the eight, being rather wider apart than the two posterior ones; the eyes of each lateral pair are seated obliquely on a tubercle, and are near to each other, but not in contact. The abdomen is oviform, hairy, moderately convex above, and projects over the base of the cephalothorax; the upper part is soot-coloured, with some dull yellow intermixed; it has three short yellow streaks in front, and a row of depressed brownish-black spots on each side of the medial line; the sides, which are soot-coloured, are palest in the medial line, and a yellow band, comprising a series of somewhat triangular black spots, extends along the upper part of each; the under part has a brownish-yellow hue; a large brownish-black quadrilateral mark, surrounded by a pale yellow border, occurs in the middle, and there are a few pale yellow spots about the base of the spinners.

Epeïra Grayii.

Length of the female $\frac{2}{5}$ths of an inch; length of the cephalothorax $\frac{1}{6}$; breadth $\frac{1}{8}$; breadth of the abdomen $\frac{3}{20}$; length of an anterior leg $\frac{1}{2}$; length of a leg of the third pair $\frac{5}{16}$.

The legs are moderately long, slender, provided with hairs and fine spines, and are of a brownish-yellow hue, with black annuli; the first pair is the longest, then the fourth, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi, which are short, resemble the legs in colour, and have a curved pectinated claw at their extremity. The cephalothorax is compressed before, rounded on the sides, truncated in front, sparingly clothed with short grey hairs, convex, glossy, and marked with furrows on the sides, which converge towards a large indentation in the medial line; the falces are powerful, conical, vertical, and armed with teeth on the inner surface. These parts have a brownish-red colour, that of the extremity of the falces being brownish-black. The maxillæ are short, strong, straight, and greatly enlarged and rounded at the extremity; the lip is semicircular, but somewhat pointed at the apex; and the sternum is heart-shaped, with small prominences on the sides, opposite to the legs. These parts are of a brownish-black colour, the extremity of the maxillæ and the apex of the lip having a pale yellowish-brown tint. The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones are placed on a prominence and nearly form a square, the two posterior ones being the largest of the eight; the eyes of each lateral pair are seated on a small tubercle, and are near to each other, but not in contact. The figure of the abdomen is oblong-oviform, with three conical protuberances at the anterior extremity of the upper part, the intermediate one of which is much the largest, and is directed forwards; the posterior extremity is rounded, and extends considerably beyond the spinners; it is glossy, thinly clothed with short hairs, and projects greatly over the base of the cephalothorax; the colour of the upper part is black, a longitudinal pale yellow band extending from the point of each protuberance to its posterior extremity; the intermediate band is the broadest, and in the black space on each side of it there is a longitudinal row of orange-brown spots; the sides are black, with a row of orange-brown spots extending along their upper part, and immediately below it there is a parallel row of minute pale yellow spots; the inferior surface of the anterior extremity has an orange-red hue, and the under part is of a pale yellow colour, with a broad black band, including the sexual organs and spinners, extending along the middle; beyond the spinners three transverse pale yellow spots occur; the branchial opercula have a brown hue, and the sexual organs, which are prominent and glossy, have a small, obtuse, slightly curved process, connected with their posterior margin, which is directed backwards. Some individuals have a short yellow streak in the medial line of the anterior part of the sternum.

The male is smaller and less distinctly marked than the female, but the design formed by the distribution of their colours is similar in both sexes. The legs of the only male I have seen were mutilated, but judging from the dimensions of the femora, which remained entire, it would appear that in their relative length they do not differ from those of the female: the colour of the femora of the first and second pairs is brownish-black, with the exception of the base, which has a brownish-yellow hue. The palpi are short, and of a brownish-yellow colour, the digital joint excepted, which has a brown-black hue; the radial is stronger than the cubital joint, and is prominent on the outer side; the digital joint is oval, with an obtuse, glossy, black process at its base curved outwards; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, prominent, complicated in structure, with several obtuse and acute processes at their extremity, the most conspicuous of which is crescent-shaped, and are of a dark reddish-brown colour intermixed with yellowish-brown. The convex sides of the digital joints are directed towards each other.

I have much pleasure in connecting the name of that enterprising traveller and zealous naturalist, John Gray, Esq., of Bolton, with this elegant *Epeïra*, which is remarkable for having the fourth pair of legs longer than the second pair.

Epeïra astuta.

Length of the female $\frac{5}{16}$ths of an inch; length of the cephalothorax $\frac{3}{20}$; breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $\frac{13}{24}$; length of a leg of the third pair $\frac{7}{24}$.

The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones form a square, the two anterior ones, which are placed on a prominence, being rather the largest and darkest of the eight; the eyes of each lateral pair are seated obliquely on a tubercle, and are near to each other, but not in contact. The cephalothorax is compressed before, rounded on the sides, sparingly clothed with whitish hairs, convex, glossy, and has an indentation in the medial line; the falces are powerful, conical, convex in front, vertical, and armed with a few teeth on the inner surface. These parts have a brownish-red colour, a brown band extending along the middle, and another, of the same hue, above each lateral margin of the former. The maxillæ are short, straight, and enlarged and rounded at the extremity; and the lip is semicircular, but somewhat pointed at the apex. These organs are of a dark brown colour, their extremities having a yellowish-white hue. The sternum is heart-shaped, with small eminences on the sides, opposite to the legs, and has a reddish-brown hue, with a tinge of yellow in the medial line. The legs are long, provided with hairs and spines, and have a brownish-yellow hue, the extremity of the joints being tinged with brown; the first pair is the longest, then the fourth, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi resemble the legs in colour, and have a curved pectinated claw at their extremity. The abdomen is oviform, moderately hairy, convex above, and projects over the base of the cephalothorax and slightly beyond the spinners; the upper part is of a yellowish-brown colour; a yellowish-white medial band, whose sinuous margins are finely bordered with black, tapers from the anterior to the posterior extremity, and comprises a pale brown dentated band, tinged with dull yellow in the medial line; a series of minute oblong black spots, bordered externally with yellowish-white, extends along each side of the medial band; and the sides, which are marked with numerous longitudinal black streaks, have a yellowish-white band extending along their upper part; the colour of the under part is brownish-black; there is a pale yellowish-white band on each side, whose posterior extremity is enlarged, and a spot of the same hue occurs on each side of the dark brown inferior pair of spinners; the sexual organs, which are well developed, and of a dark red-brown colour, have a strong process connected with their anterior margin, which is directed downwards, slightly curved backwards, and is hollowed at its extremity.

Epeïra scitula.

Length of the female $\frac{1}{4}$th of an inch; length of the cephalothorax $\frac{1}{10}$; breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{10}$; length of a posterior leg $\frac{1}{4}$; length of a leg of the third pair $\frac{3}{16}$.

The legs are slender, provided with hairs, and have a yellowish-brown hue, with black annuli; the fourth pair is the longest, then the first, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi resemble the legs in colour, and have a curved slightly pectinated claw at their extremity. The cephalothorax is compressed before, rounded in front and on the sides, thinly clothed with short hairs, convex, glossy, and has an indentation in the medial line; the falces are powerful, conical, vertical, convex at the base in front, and armed with teeth on the inner surface. These parts have a brownish-red hue, the falces being soot-coloured at the extremity. The maxillæ are short, straight, and enlarged and rounded at the extremity; the lip is semicircular, but somewhat pointed at the apex; and the sternum is heart-shaped, with small eminences on the sides, opposite to the legs. These parts are of a red-brown colour; the lip is the brownest, and obscure brown lines converge from the margins of the sternum to its centre. The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones are placed on a prominence, and form a square, those of the posterior pair being the largest of the eight; the eyes of each lateral pair are seated obliquely on a small tubercle, and are near to each other, but not in contact. The abdomen is somewhat oviform, terminating in a conical protuberance situated high above the spinners; it is thinly clothed with hairs, convex above, and projects over the base of the cephalothorax; it is of a yellowish-olive colour, with a few black spots distributed irregularly; a yellowish-white band, comprising several longitudinal and transverse dark-coloured streaks, tapers from the anterior extremity of the upper part to the posterior conical protuberance; a yellowish-white band extends along the upper part of each side, and a line of the same hue passes from each red-brown branchial operculum nearly to the spinners, which are of a dark brown colour, and have at their base yellowish-white spots on the sides and underneath; the sexual organs are highly developed, prominent, of a dark brown colour, slightly tinged with red, and have in connexion with their anterior margin a short, somewhat pointed process, hollowed on the outer side, which is directed obliquely downwards and backwards.

This species differs remarkably from the more typical forms of its congeners in having the posterior legs the longest.

The genus *Epeïra*, as at present characterized, requires amending with regard to the relative length of the legs, which is now known to vary in different species.

Genus Plectana, Walck.

Plectana tricuspidata.

Length of the female $\frac{1}{6}$th of an inch; length of the cephalothorax $\frac{1}{16}$; breadth $\frac{1}{20}$; breadth of the abdomen $\frac{3}{16}$; length of a posterior leg $\frac{3}{16}$; length of a leg of the third pair $\frac{1}{8}$.

The cephalothorax, which is nearly concealed by the projecting abdomen, is slightly compressed before, rounded on the sides, depressed in the posterior and convex in the cephalic region; the falces are small, conical, and vertical; the maxillæ are short, straight, powerful, and greatly enlarged and rounded at the extremity; the lip is semicircular, and the sternum is heart-shaped; the legs are short and sparingly provided with hairs; the fourth pair is the longest, then the first, and the third pair is the shortest; the palpi are short and slender. These parts are glossy and of a dark brown colour, tinged with red, the cephalothorax being the darkest, and the palpi and sternum much the palest. The eyes are situated on the anterior part of the cephalothorax, and are nearly equal in size; the four intermediate ones almost form a square, but the two posterior eyes are rather wider apart than the anterior ones, which are seated on a tubercle and are prominent; those of each lateral pair are placed obliquely on a tubercle, and are nearly in contact. The abdomen is triangular, with its vertex directed backwards; its integument is corneous and glossy, and a long acute spine projects obliquely upwards from each angle of the upper part, that at the vertex being rather the longest; it is depressed above, convex underneath, where the spinners are situated, and has several deep furrows on the sides and posterior part; the colour of the upper part is dull yellow, the spines having a reddish tint, which is darkest at their point; a fine ramified dark brown line extends along the middle, on each side of the anterior part of which three parallel, minute, dark brown depressions are disposed longitudinally; four similar depressions extend in a row along the posterior part of each side, which is obscurely reticulated throughout its entire length with fine dark lines; the under part has a brownish-black hue; a dull yellow spot occurs on each side of its anterior extremity, near the cephalothorax, and a space of a similar colour surrounds the prominent black rim which encircles the spinners, except at its posterior part, from which a brownish-black band extends along the under side of the long spine at the vertex of the triangle formed by the abdomen, where it terminates in a point; the sexual organs have a brownish-black hue, and that of the branchial opercula is reddish-brown.

Genus Galena, Koch.

Galena zonata.

Galena zonata, Koch, Die Arachn., Band xii. p. 105, tab. 419. fig. 1032.
Epeïra galena, Walck., Hist. Nat. des Insect. Apt., tom. iv. p. 562.

Length of the female $\frac{1}{4}$th of an inch; length of the cephalothorax $\frac{1}{8}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{6}$; length of an anterior leg $\frac{3}{5}$; length of a leg of the third pair $\frac{7}{24}$.

The legs are very long, the first and second pairs in particular, and are provided with hairs and spines; on the anterior side of the tibiæ and metatarsi of the first and second pairs a series of long, prominent, slightly curved spines occurs, and in each of the rather wide intervals by which they are separated a row of shorter curved spines is situated, which gradually increase in length as they extend down the limb; the femora, genua, extremity of the tibiæ, metatarsi, and tarsi of the first and second pairs are of a reddish-brown colour, the metatarsi and tarsi being the palest, and the tibiæ, with the exception of their extremity, have a dull yellow hue; the third and fourth pairs are slender, and of a dull yellow colour; a fine reddish-brown line extends along the upper surface of the anterior part of the femora and the entire length of the tibiæ of both pairs, and one of the same hue passes along the superior surface of the metatarsi of the fourth pair; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi are slender, and have a curved pectinated claw at their extremity; they are of a dull yellow colour, the cubital joint being the palest, and have a fine reddish-brown line extending along the upper part of the humeral and radial joints. The cephalothorax is long, compressed before, rounded on the sides, gibbous in the middle, glossy, and has a small circular indentation in the medial line; the colour of the anterior part is red-brown, diminishing gradually in breadth towards the medial indentation, near which it terminates in a point; the sides are tinged with the same hue, and the colour of the remaining portion is yellow-brown. The falces are long, conical, vertical, and armed with a curved fang and some long and very fine teeth near the extremity, on the inner surface; the maxillæ are straight, except at the extremity, which is somewhat enlarged, obliquely truncated on the inner side, and curved upon the lip; the lip is large, longer than broad, and rounded at the apex. These parts are of a red-brown colour, the extremity of the maxillæ and lip having a yellow-brown hue. The sternum is heart-shaped, and of a pale reddish-brown colour, with a transverse dark red-brown line between the coxæ of the second pair of legs. The eyes are disposed on the anterior part of the cephalothorax, and are unequal in size; the two anterior eyes of the four intermediate ones are the largest of the eight, are seated on a prominent tubercle, and are wider apart than the two posterior ones, and those of each lateral pair, which are the smallest, are placed obliquely on a minute tubercle, and are contiguous. The abdomen is short, broad, thinly clothed with hairs, convex above, and projects over the base of the cephalothorax; the upper part is of a pale-yellow colour, finely reticulated with reddish-brown; on each side of the anterior part there is a conspicuous, oval, yellowish-white spot bordered with reddish-brown; to these spots succeed four pale, narrow, transverse bands bordered by fine reddish-brown lines which are confluent in the medial line; and a large triangular reddish-brown spot, having its vertex directed forwards, and comprising near its base a small spot of a dull yellowish hue, is situated immediately above the spinners; at the extremity of the under part there is a large, reddish-brown, and somewhat crescent-shaped mark whose extremities extend to the sides; the sexual organs are rather prominent, and of a dark reddish-brown colour, with a longitudinal yellowish-brown septum in the middle.

The male differs from the female in several particulars: it is smaller, the cephalothorax is shorter, and, with the falces and sternum, is of a pale dull-yellow colour; a transverse red-brown line occurs on its gibbosity, and there is a fine line of the same hue across the sternum, between the coxæ of the second pair of legs. The maxillæ and lip have a yellowish-brown hue. The colours of the abdomen are paler in the male than in the female, but the design formed by their distribution is the same in both sexes. The palpi are remarkably long, measuring $\frac{2}{5}$ inch, very slender, and of a yellowish-brown colour, the radial joint being the brownest; this joint greatly exceeds the cubital in length, and is somewhat enlarged at its extremity, which is supplied with several long and fine spines; the digital joint is short and of an irregular figure; the extremity is depressed, with a transverse, curved, dark red-brown rib underneath, terminating in a protuberance on the outer side, and is much broader than the base, which is convex and hairy externally, concave within, and comprises the palpal organs; these organs are highly developed, prominent, and consist of a red-brown spiral process, whose pointed termination is black, and has some pale yellowish-brown membrane contiguous to it.

The collection of *Araneidea* made in Rio Janeiro by Messrs. Gray and Clark contained three adult females and one male of this handsome and remarkable spider, which appears to be most nearly allied to the *Epeïridæ* by its organization; but I am not able to state in what degree its habits and economy tend to establish this relation of affinity.

An imperfect description and figure of the male have been given by M. Koch from a specimen in the museum at Berlin, probably the only one then known to arachnologists; but he has fallen into the error of supposing it to be indigenous to Africa. Walckenaer has evidently made his brief description of this species from Koch's figure of the male.

Genus Tetragnatha, Latr.

Tetragnatha splendens.

Length of the female $\frac{5}{24}$ths of an inch; length of the cephalothorax $\frac{1}{10}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $\frac{7}{10}$; length of a leg of the third pair $\frac{1}{4}$.

The eyes, which are seated on black spots, and are nearly equal in size, are disposed in two transverse rows on the anterior part of the cephalothorax; the four intermediate ones form a trapezoid whose anterior side is rather the shortest, and those of each lateral pair are placed on a small tubercle and are nearly in contact. The cephalothorax is compressed before, rounded on the sides, truncated in front, moderately convex, glossy, with slight furrows on the sides converging towards a large indentation in the medial line; the falces are short, strong, conical, vertical, and armed with a few teeth on the inner surface; the sternum is heart-shaped; the legs are long, slender, and provided with hairs and fine spines; the first pair is the longest, then the second, and the third pair is much the shortest; each tarsus is terminated by claws of the usual number and structure;

the palpi are slender, and have a curved slightly pectinated claw at their extremity. These parts are of a dull yellow colour, the metatarsal and tarsal joints of the legs and the digital joint of the palpi being tinged with brown. The maxillæ are slightly divergent, and increase in breadth from the base to the extremity, which is somewhat angular on the outer side; and the lip is semicircular. These organs are of a red-brown colour. The abdomen is subcylindrical, sparingly clothed with short hairs, and projects a little over the base of the cephalothorax; the upper part and sides have a bright silvery lustre, with a slight golden tinge, which is deepest on the latter, and a dark brown ramified band extends along the middle of the former; the posterior extremity, which projects considerably beyond the spinners, has a yellowish-brown colour, and comprises two parallel spots of a silvery lustre placed transversely; the under part has a yellowish-brown hue, with minute spots and a somewhat semicircular transverse band of a silvery lustre with a slight golden tinge; the sexual organs are small, and of a dark reddish-brown colour, with a yellowish-brown longitudinal septum in the middle; and the branchial opercula have a dull yellow hue.

Tetragnatha formosa.

Length of the female $\frac{1}{4}$th of an inch; length of the cephalothorax $\frac{1}{10}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $\frac{2}{3}$; length of a leg of the third pair $\frac{7}{24}$.

The abdomen is robust, subcylindrical, very prominent at the anterior extremity, and projects greatly over the base of the cephalothorax; the upper part and sides have a bright silvery lustre, the latter having a slight golden tinge; along the middle of the former a black band extends, which is crossed near its anterior extremity by a strongly curved brownish-black line, within whose curvature there is a short transverse line of the same hue; on each side of the medial band a shorter parallel black band occurs; these bands, which commence near the extremities of the curved line, are connected anteriorly by a transverse black line, and laterally by four oblique lines of the same hue, disposed in pairs and inclined towards each other; on each side there are two longitudinal brownish-black bands, the superior one of which is connected at its posterior extremity with the lateral band of the upper part by a black bar; the posterior extremity of the abdomen is black, and comprises eight silvery spots disposed in pairs, which diminish in size as they approach the spinners, towards which they converge; the under part is of a brown colour, with minute spots, a short streak directed backwards from the posterior margin of each branchial operculum, and a somewhat semicircular band, of a silvery lustre, with a slight golden tinge; the space comprised within the semicircle and the spinners has a brown-black hue, and a minute silvery spot occurs on each side of the latter, at their base; the sexual organs are moderately developed, with a longitudinal septum in the middle, and are of a dark reddish-brown colour, that of the branchial opercula being yellow-brown. The cephalothorax is compressed before, rounded on the sides, truncated in front, slightly convex, glossy, with furrows on the sides, converging towards a large indentation in the medial line; it is of a dull yellow colour, the lateral margins and a small cruciform spot in the medial indentation having a brown hue. The falces are short, powerful, conical, vertical, armed with a few teeth on the inner surface, and of a dull yellow colour, tinged with brown towards the outer side, and of a dark brown hue at the extremity. The maxillæ are divergent, and increase in breadth from the base to the extremity, which is angular on the outer side; and the lip is semicircular and prominent at its apex. These organs have a brown-black hue. The sternum is heart-shaped, with small prominences on the sides, opposite to the legs, and is of a red-brown colour. The legs are long, slender, provided with hairs and are of a dull yellow colour; the joints have a dark brown hue at the extremity, and the metatarsi and tarsi are tinged with brown; the first pair is the longest, then the second, and the third pair is much the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi are slender, and have a curved slightly pectinated claw at their extremity; they resemble the legs in colour, but the joints are not marked with dark brown at the extremity. The eyes are seated on black spots, and are disposed in two transverse rows on the anterior part of the cephalothorax; the four intermediate ones form a trapezoid whose anterior side is rather the shortest, and those of each lateral pair are placed on a small tubercle, and are nearly in contact; the two anterior eyes of the trapezoid are somewhat the largest and darkest of the eight.

This and the preceding species of *Tetragnatha* belong to M. Walckenaer's second family of the genus, the *Coadunatæ*, and bear a marked resemblance to certain spiders of the genus *Nephila*.

Tribe Senoculina.

Family Dysderidæ.

Genus Dysdera, Latr.

Dysdera crassipalpus.

Length of the male $\frac{3}{8}$ths of an inch; length of the cephalothorax $\frac{1}{6}$; breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{8}$; length of an anterior leg $\frac{7}{12}$; length of a leg of the third pair $\frac{2}{5}$.

The cephalothorax is large, oval, glossy, moderately convex, with slight furrows on the sides converging towards a small indentation in the medial line, and is of a dark brown colour tinged with red. The eyes are nearly equal in size, and are grouped on the anterior part of the cephalothorax in the form of a small oval open in front; the two intermediate ones are near to each other, and those of each lateral pair are seated obliquely on a tubercle, and are almost in contact. The falces are small, conical, rather prominent, and are armed with a short curved fang at the extremity, but have no teeth on the inner surface; the maxillæ are straight, greatly dilated at the base, where the palpi are inserted, and somewhat enlarged at the extremity, which is rounded on the outer side; the lip is long and truncated at the apex; the sternum, which has an oval form, is narrower at its anterior than at its posterior extremity, and has small prominences on the sides, opposite to the legs. These parts have a red-brown hue, the sternum and the base of the lip being much the darkest. The legs are robust, provided with hairs and with sessile spines on the inferior surface of the tibiæ and metatarsi of all except those of the posterior pair, and are of a yellowish-brown colour; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is small and inflected near its base. The palpi are strong and of a yellowish-white colour, with the exception of the axillary joint, which has a red-brown hue; the radial is very much larger than the cubital joint, and has the appearance of being swollen; the digital joint is short, oval, convex and hairy externally, and the palpal organs are connected with its inferior surface by a short pedicle; these organs are highly developed, and somewhat resemble Rupert's drops in form, being subglobose at the base and terminating in a long curved process gradually tapering to a point; they are of a pale red-brown colour, with a transverse yellowish-white band extending from the base of the subglobose part to its extremity. The abdomen is short, oviform, convex above, thinly clothed with fine hairs, and of a dull olive-green hue; a large semicircular mark at its anterior extremity, from which a fusiform band, bifid at its termination, extends along the middle of the upper part rather more than a third of its length, and a series of short transverse curved bars between this band and the spinners are of a dark puce-colour; an oblong spot of the same hue is directed forwards from each side of the spinners, which have a pale yellowish-brown tint; the branchial opercula and tracheal stigmata are of a pale dull yellow colour; an obscure line of the same hue extends from each of the latter nearly to the spinners, where the two meet, and between the former a reddish-brown protuberance is situated.

VIII.—*On some new British Hydroids.* By the Rev. Thomas Hincks, B.A.

[Plate IX. vol. x. figs. 3, 4.]

Fam. Tubulariadæ.

Genus Atractylis, Strethill Wright.

A. margarica, n. sp. Pl. IX. fig. 4.

Polypary a network of delicate anastomosing tubes, from which rise at intervals small chitinous cups, somewhat funnel-shaped, which invest the base of the polypes and of the gonophores. *Polypes* white, scattered, slightly retractile; the body elongate, expanding towards the upper extremity, which is encircled by a verticil of about twenty-four muricate tentacles, alternately erect and depressed. Half of them are furnished near the base with a prominent cluster of large bean-shaped thread-cells, which projects outwards as a pearly boss or tubercle. This gem-like setting round the tentacular ring gives a very beautiful and distinctive appearance to the species. *Gonophores* produced on the creeping stem, close to a polype, either singly or in pairs, of large size, pedunculate, the pedicle tapering towards the point of attachment, and sheathed at the base in a chitinous tube, sub-globular, crowned by a kind of lid (Pl. IX. fig. 4 *b*), which seems to be cast off as development proceeds. From the bottom of the sporosac, which occupies the whole interior of the gonophore, rise four branched processes, of an orange-colour (representatives of the gastrovascular canals), which, as it were, embrace the ova. The latter are produced in great numbers (300 in a single gonophore), and exhibit a very distinct vesicle and spot.

Habitat. Ilfracombe; abundant on *Flustra foliacea*, and on this only, from about 10 fathoms.

In this very singular and beautiful species, the character which at once attracts attention is the series of projecting bosses round the base of the tentacular ring. When examined with the microscope, these are seen to consist of a number of elongate bean-shaped thread-cells (fig. 4 x), which are piled together so as to form silvery-white prominences on the lower side of the tentacles. They occur, I believe, only on the alternate arms, and constitute a unique garniture.

The polypes, with their numerous tentacles, of moderate length, surrounding a large and expanded oral disk, bear some resemblance to a full-blown flower. When withdrawn, the arms bend inwards.

The gonophores, which are produced on the creeping stolon (fig. 4 *e*), rise, as the polypes do, from within a cup-like extension of the polypary. They are supported on a peduncle of some length, and, when fully developed, exceed the polypes considerably in size. I have not succeeded in making out all the details of the structure, nor in tracing the whole course of development. The sac which immediately contains the ova is enclosed in a more or less transparent envelope, which, at a certain stage, exhibits at the summit the appearance of a ribbed covering or lid. I conjecture that this lid is cast off, and that the outer envelope sloughs away, leaving the inner sac free for the discharge of the generative products. From the base of the sporosac proceed four much-branched vessels, terminating near the top of it in blind extremities, and immediately enclosing the ova, which fill with a dense mass the interior of the cavity. I have counted about 300, which had been pressed out of a single gonophore. The ovum consists of a cream-coloured granular substance, the germinal vesicle showing as a depression, and the spot as a circle with a raised rim.

I could detect no trace of a *manubrium*, nor did I witness the liberation of the reproductive elements.

The outer envelope of the gonophore is filled with the long bean-shaped thread-cells, which are also present in amazing numbers in the ectoderm of the cœnosarc.

All the known members of the genus *Atractylis* are propagated by means of free gonozooids, with the exception of *A. arenosa* and the present species.

Fam. Campanulariadæ.

Genus Laomedea, Lamouroux.

L. fragilis, n. sp. Pl. IX. fig. 3.

Polypary very minute and delicate. Stem flexuose, giving off a branch at every flexure, which is annulated and tapers upwards, terminating in a much elongated and very narrow cell, with an even rim. The stem exhibits three or four rings (often very indistinct) above the origin of each branch.

Height about $\frac{1}{8}$ inch.

Habitat. In pools on the lower ledges of the Capstone, Ilfracombe, forming miniature groves on the under side of stones.

This species is smaller and more delicate in habit even than the *L. neglecta* of Alder, and is as graceful in form as it is fairy-like in size. The markedly flexuose character of the stem, the great length and narrowness of the cells, the plain margin, and the Lilliputian size, are the distinctive points.

IX.—*On the Transformations of the* Porcellanæ. By Dr. Fritz Müller, of Desterro*.

[Plate I.]

For two years I have been acquainted with a *Zoëa* which is distinguished from its allies by the want of the dorsal spine and the unusual length of the straightly extended frontal horn; but it is only a few months since I found it to be the offspring of the same *Porcellana* whose extraordinary parasites I described in my recent memoirs†. In the mean time I met with opportunities of examining the young brood of two other *Porcellanidæ*. One of these is a smaller *Porcellana* with a nearly circular carapace, which occurs rarely on rocks amongst Polypes and Polyzoa; the other (Pl. I. figs. 1–3) lives parasitically upon some species of Starfishes, and differs so much from the true *Porcellanæ* in its whole appearance, in its claws, and especially in the shortness of the external antennæ, that I regard it as the representative of a peculiar genus, and call it *Porcellina stellicola* ‡.

As these *Porcellana*-larvæ agree in all essential characters with the *Zoëa*-form of the young Crabs, I leave their detailed description for a larger work on the young state of the Crabs, for which I have long been collecting materials, and confine myself at present to a superficial description of their structure.

The carapace is of an oval form, and covers not only the upper part and sides of the anterior unsegmented part of the body, but also the first five segments of the abdomen. From its anterior margin issues a straight spine or horn, which is as much as five times the length of the carapace (three times in the smaller *Porcellana*). Two similar spines extend straight backwards from the hinder margin of the carapace; these are usually parallel, but sometimes divergent in *Porcellina*; in the smaller *Porcellana* (fig. 10), in which they attain only two-thirds the length of the carapace, they are slightly bent downwards at the apex, and bear, near their origin, a considerable spine directed

* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1862, p. 194.

† See Annals, July and August 1862.

‡ Another *Porcellana* (*P. Creplinii*, n. sp.) is still more singular in its mode of life: it resides in pairs in the tube of *Chætopterus pergamentaceus*.

obliquely forwards and downwards; in the common *Porcellana* they are beset beneath with an entire series of small spines, and exceed the carapace in length; in *Porcellina* they attain more than three times the length of the carapace. Thus, in the latter species, the carapace of the newly-hatched young, with its processes, is twice as long as that of the mother.

Besides this remarkable carapace, the only structure which differs remarkably from other young Crabs is that of the last segment, which is dilated into a fin. It is well known that the last segment of the larvæ of Crabs is extended on each side into a horn, often of considerable size, and that in the emargination between these horns, three short plumose bristles usually stand on each side. In the *Porcellanæ* the lateral horns are replaced by inconspicuous spines, and the middle part projects so far between them that the whole tail acquires nearly a rhomboid form. In *Porcellina* this is particularly elongated, more than twice as long as broad. On each of the two posterior sides of the rhombus there are five long plumose bristles. (An intermediate form, but approaching most closely to the *Porcellanæ,* is presented by the tail of the young *Paguri.*)

In all other respects, in the structure of the eyes, antennæ, mouth, and feet, the young *Porcellanæ* agree entirely with the young Crabs, and exhibit no greater difference from them than the latter do among themselves.

In both, the anterior antennæ (Pl. I. fig. 5 *a*) are not jointed, and have a strong nervous knot in the vicinity of their apex, from which, besides a few minute bristles, two (three in *Porcellina*) longer peculiar filaments issue. These are of uniform thickness, or rarely a little tapering; they terminate in a rounded extremity, and are further distinguished from other bristles by their very delicate outline and dull turbidity. The same filaments, however, recur on the anterior antennæ of young *Bopyridæ* (they are especially distinct in *Entonitæs cancrorum,* n. sp.) and Cirripedes; in the latter they spring singly from a minute basal joint close to the eye.

The posterior antennæ (fig. 5 *b*) in *Porcellina stellicola* already exhibit a great resemblance to those of the mature animal (fig. 2) —the same inflated basal joint with the well-known opening of the still problematical sensorial organ, the same acutely triangular second joint, from the outside and upper part of which issues, in the one case, a multiarticulate flagellum, and in the other a simple spine-like process. The same pieces occur in the same form in the other species*.

* In the *Zoëa* of a small *Xantho,* the outer antennæ (fig. 11) attain the length of the frontal horn, and the future flagellum is so small as to be almost imperceptible.

The parts of the mouth (fig. 5) consist of a very large upper lip (*c*), of two strong sharply toothed mandibles, apparently without palpi (*d*), of a bipartite lower lip (*e*), and two pairs of maxillæ (*f*, *g*). The anterior maxilla (fig. 8) is split up into three, and the posterior one (fig. 9) into five leaves armed with strong bristles, which are partially denticulated or feathered; the latter also bears on the outside a larger membranous plate, which is produced posteriorly into a finger-like process; the process bears one, and the plate itself anteriorly and at the margin six, plumose bristles. This plate is bent upwards, and is in constant motion between the body and the carapace.

The two pairs of natatory feet consist of a strong cylindrical basal joint and two terminal rami; the inner ramus, which the animal is fond of extending forward, has four joints, and the outer one, which is usually turned outwards and upwards, two, less distinctly separated. At the extremity of the outer ramus stand four long plumose setæ; a single plumose seta is at the end of the third joint of the inner ramus of the last pair, and there are simple bristles on all the joints of the inner ramus of both pairs.

Behind the origin of the natatory feet commences the six-jointed abdomen, which bears no appendages; this separates from the carapace a little behind the middle of its upper part.

The stomach is somewhat dilated, and already exhibits (at least in *Porcellina*) longitudinal ridges beset with bristles; close to it on each side there are two hepatic cæca directed forwards, and two others directed backwards; the intestine has a straight course, and opens a little before the middle of the caudal segment.

The heart, situated at the posterior end of the thorax (in young Crabs under the origin of the dorsal spine), appears to be already formed exactly as in the mature animal, and to give off the same vessels. The anterior single vessel may be readily traced almost to the apex of the frontal horn, to the upper wall of which it is applied. Blood-corpuscles are exceedingly few in the first days (but this does not apply to all *Zoëæ*).

In each abdominal segment there is a ganglion of considerable size, united to its neighbours by two separate cords; in the anterior part of the animal I could not quite clearly make out the nervous system in its connexions.

If it be easy to procure in abundance the earliest stages of the most various Crustacea, it is all the more difficult to obtain a clue to their ultimate fate. Although the *Porcellanæ* are among the most generally distributed of Crustacea, I only once (in December of last year) met with an older larva (Pl. I. figs. 6, 7). At the spot where I found it, neither *Porcellina stellicola* nor

Porcellana Creplinii lived; but the larvæ of the common and of the smaller *Porcellanæ* are distinguishable at the first glance by the posterior processes of the carapace; and thus this larva may without hesitation be referred to the former species, from the earliest form of which it differs only by having twelve (instead of ten) setæ on the caudal segment, and by the presence of a pair of short inarticulate appendages on each of the four preceding segments. This single larva was, fortunately, uncommonly instructive, inasmuch as, being near its change of skin, it already showed the new limbs, with variable distinctness, within the old ones.

The new external antennæ had a multiarticulate flagellum; feet with large chelæ; and other members, which could not be completely made out, were situated *behind* the natatory feet; and within the caudal segment was a fan-shaped fin (fig. 7).

Hence, although the larva itself approaches closely to the earliest stage, the animal issuing from the next change of skin could scarcely differ essentially from the mature *Porcellana.*

So far my observations adapted for a preliminary communication. Their results may be summed up in a few short propositions:—

The *Zoëa*-form of the Crabs is completely destitute of the five pairs of true feet, and even of the segments bearing these.

The natatory feet of the *Zoëa* become the foot-jaws of the Crab.

The *Porcellanæ* are Crabs which have remained stationary at the *Megalops*-stage*.

EXPLANATION OF PLATE I.

Fig. 1. *Porcellina stellicola*, n. g. and sp.; magnified 5 diameters.
Fig. 2. Its external antenna; magn. 25 diam.
Fig. 3. Fifth pair of feet of the male; magn. 45 diam.
Fig. 4. Its youngest *Zoëa*-form, from above; magn. 15 diam.
Fig. 5. Cephalic portion of the preceding, from below; magn. 90 diam.: *a*, anterior, and *b*, posterior antennæ; *c*, upper lip; *d*, mandible; *e*, lower lip; *f*, first, and *g*, second pair of maxillæ.
Fig. 6. Older *Zoëa*-form of the common *Porcellana* of Santa Catharina; magn. 6 diam.
Fig. 7. Caudal extremity of the preceding; magn. 45 diam. In its interior is seen the fan-like caudal fin of the next state.
Figs. 8 & 9. First and second maxillæ of the youngest *Zoëa*-form of the common *Porcellana.*
Fig. 10. Posterior process of the carapace of the youngest *Zoëa*-form of a smaller *Porcellana.*
Fig. 11. External antenna of the youngest *Zoëa*-form of a small *Xantho*: *g*, flagellum.

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* Milne-Edwards even places *Megalops* and *Porcellana* in the same family.

BIBLIOGRAPHICAL NOTICES.

The Student's Manual of Geology. By J. Beete Jukes, M.A., F.R.S. New Edition. 1862.

The order of the subjects in this Manual is well adapted to the requirements of the student. Firstly, we have the facts and principles respecting the internal structure of rocks, their mineral composition, texture, and other characters, such as may be recognized by the aid of hand-specimens in the cabinet. This is the Lithological division of the work. Under "Petrology" the author arranges the study of rock-masses, their strata and joints, and the mutual relations of rocks; this has reference to field-geology. Fossils, their relation to living forms, and the distribution of life in time and space, are next brought forward as Palæontology. The history of the formation of the crust of the globe, with the chronological classification of rocks and fossils, forms the fourth and last division.

Each class of subjects above indicated is systematically and carefully treated, and the requirements of the student are kept well in view. The chemical and mineralogical chapters, however, are not intended to supersede special manuals on mineralogy. The chapters on the formation of rocks, chemical, igneous, and aqueous, contain much instructive matter, carefully arranged and digested from the special works of Cotta, Durocher, Naumann, and others. But the author's genuine geological experience and personal acquaintance with rocks of every kind enable him, in this as in other divisions of the work, to present good and well-arranged material for the student. There are few works (excepting perhaps Prof. Phillips's Manual) that treat so well of stratification and the nature of joints and cleavage as this work; and in this case also we have the advantage of the author's wide experience in the field. The palæontological portion taken together with the concluding division, that relating to geological classification, is of itself a manual of much value; and these chapters are the better on account of the diagrams, illustrative of the geological order of the formations, being really sections, and the figures of the fossils being newly and carefully selected by an experienced palæontologist. Indeed, throughout his work Mr. Jukes has availed himself (with full acknowledgments) of the friendly help of his colleagues in the Geological Survey and the Museum of Irish Industry, with the best results. The 'Manual' is greatly improved in this second edition: the author has been able to work up more closely to his original conception of what geological students now-a-days require, and he has made those corrections which former oversight and the continual advance of geological observation have made requisite.

The relations of granite both to metamorphic and to unaltered strata have careful consideration in this Manual, and, when compared with the teaching of older works, have a certain freshness of treatment which is pleasant to find, and is redolent of truth as far as observed facts go. Possibly, however, sufficient credit is not given to the views of Naumann and Scrope on the original plasticity of some of the gneissic rocks associated with granite. The true relationship of granite, trap-rocks, and lava is another important point prominently brought forward. The "form of ground," or modification of the surface, has also had much attention from the author, who has just recently produced a masterly essay on the origin of the great valley-systems of the South of Ireland, which he considers to have been mainly produced by atmospheric agencies.

A large portion of the book is devoted to palæontological subjects (pp. 373–710); and the treatment of this branch of the science, which is not one of the author's "specialties," and is itself far from perfection, allows of critical animadversion to a greater extent than any of the other chapters. Of the very numerous errors in the orthography, especially of the technical terms, the author has corrected many; we do not propose to point out any of the others, excepting "Emmonds," a mis-spelling for Emmons, at pp. 438, 457, &c., and especially "Guep," disguising the good Viennese geologist Suess (p. 555). Mr. Jukes is usually careful to mention his authorities and sources of information, and the discoverers of facts and originators of good theories; we regret, however, to see the omission, no doubt inadvertent, of Hislop's name in connexion with the coal-bearing beds of Central India (p. 533), and of Harkness when the Permian age of the Ichnites of Corncockle Muir are referred to (p. 546). The chapter on the Triassic or New Red Sandstone Period will require careful revision in a new edition of the Manual; for the reptilian *Placodus* is enumerated among the Fishes (page 548), and the *Microlestes* of Stuttgart is kept in the Keuper, though stated in the same page (541) to have been found in an osseous breccia equivalent (as is well known) to the infra-liassic Bone-bed of England, which is duly assigned to the Rhætic Series at page 555. Not only the *Microlestes*, but the other osseous remains from these bone-beds, English and German, are reckoned as truly Triassic; and at pages 555 and 560, the mistaken position of *Microlestes* is repeated, and said to be in the Keuper. Dr. Plieninger found his specimens in the bone-bed above the Keuper; and Mr. C. Moore found his in a cleft of the Mountain-limestone filled with drifted material derived from the limestone, the Rhætic bone-bed, and the Oolite.

Palæontology (to say nothing of palæobotany) now finds work for very many separate naturalists, taking up their attention, more or less fully, by this or that class of animal, recent and fossil; and it is impossible for one man to construct a correct Palæontological Manual: the latest English Manual of Palæontology proves our statement. Let Mr. Jukes, therefore, in his next edition of his Manual, get the combined assistance of his many palæontological friends to critically examine his lists of fossils; otherwise he may almost despair of ever effecting more than a patchwork of chronological geology.

In the other parts of the Manual there are still a few things to be noticed. At p. 174, flint and chert are said to be derived "probably from animals;" certainly it should be *animals and plants*, if not *plants* alone. At pp. 166 and 175, certain limestones are said to be "saccharine;" the sugar-character of the rock being more readily recognizable by the sight than the taste, we think the accepted term "saccharoid" better in every respect. Lastly, we believe that, by referring to some of the "Explanations of Maps and Sections," of the Geological Survey, relating to Wilts and Oxfordshire, Mr. Jukes will find that his proposed term "Inlier" (p. 201) has already been invented by some of his colleagues as a good and useful word for valleys-of-elevation and such like.

Few of the foregoing remarks at all affect the intrinsic value of the 'Student's Manual of Geology.' It is a good work, already enhanced by careful emendations and by the detersive process of being re-edited by an author who has truth alone in view whilst striving to serve the rising generation in mastering the intricate history of the globe,—a task becoming more and more necessary for the young, from the exigencies of the period, and more and more useful to man in every part of the globe.

An Appendix "On Geological Surveying," of considerable value, and a full Index, which is also glossarial, complete the work. We think that a careful pruning of the theoretical portions, and condensation of some descriptive parts, will be required to balance the additional information that the author must have accumulated, however soon a new edition of this really serviceable Manual is called for.

The Coal-fields of Great Britain: their History, Structure, and Resources. With Notices of the Coal-fields of other parts of the World. By Edward Hull, B.A. With Map and Illustrations. Second Edition, 1861.

The history of coal-mining affords an interesting chapter at the commencement of this little volume. Possibly used by the aborigines, coal seems to have been worked in Britain by the Romans, and was certainly in household use among the Saxons, and has continued to be an article of commerce, with a gradually increasing consumption, until the quantity now annually raised from the British area alone is nearly 80,000,000 tons. The difficulties in arriving at exact information as to the quantity of coal raised in Great Britain and Ireland are being mastered by the energy of the Mining Record Office; and an approach to an exact knowledge of the extent and thickness of the available coal-seams is being gradually made by the Geological Survey,—the labours of previous as well as contemporary geologists, and the willing co-operation of coal-owners and practical coal-workers, aiding these researches to a very great extent. To put together in a tangible form the results of the elaborate coal-statistics already made, and to define with anything like accuracy the coal-areas, so that the scientific geologist might have a useful work of reference, and the public be supplied with a compendious and readable treatise, was a laudable and somewhat difficult undertaking. Mr. E. Hull, one of the Geological Surveyors, and hence personally acquainted with the real character and condition of some of the English coal-fields, boldly took in hand the large and important subject of coal-resources, and has treated it very satisfactorily, bringing to the task good geological knowledge and conscientious exactitude.

The second edition of this work has quickly followed on the first, with additional information, partly derived from the experience of others (chiefly colleagues in the Geological Survey), and partly elaborated by the author.

The probable duration of our coal-supply is, of course, a most interesting point of inquiry, and has been the subject of innumerable treatises and newspaper articles. Mr. Hull, on careful consideration of known facts, states that possibly, if the increase of coal-consumption continue to enlarge in future years in the same ratio that it has of late progressed, our coal will barely last for 325 years; but he adds that various causes may interfere with this rapidly progressing ratio, some, however, accelerating rather than diminishing it.

To the naturalist a wide field of research is opened by the working of the coal-measures and the associated strata. The fossils, as the palæontologist knows, are numerous and highly interesting. Besides the plants, some are terrestrial, and many are referable to genera that now inhabit the sea; others have apparently such close relationship to some existing fluviatile and estuarine animals that many strata in the old Carboniferous Formation have been regarded as having been formed in brackish, if not fresh, water. The wholly marine condition, however, of the coal-beds is at present recognized by several authoritative geologists; and nowhere perhaps is this view better supported than in H. D. Rogers's great work on the Geology of Pennsylvania. Mr. Binney, too, and Mr. Salter have their own facts and arguments in support of the theory that coal-jungles grew in shallow *seas*. The combination, however, of sea, estuary, lagoon, and river in the formation of coal, on an oscillating sea-board, is succinctly stated in Mr. Hull's chapters (II. & III.) on the Formation of Coal; but the possibly freshwater or brackish character of some of the Mollusks found in certain beds (*Anthracomya*, *Anthracosia*, &c.) is perhaps allowed to lapse too readily. The presence of *Estheria* (whose existing species have freshwater habitats) in the Coal-formation, as lately announced in the 'Neues Jahrbuch,' 1861, may also be found to influence opinions on this subject.

The fossil flora of the Coal is still imperfectly known. Geinitz, of Dresden, has produced a work on the Carboniferous plants of Saxony, which may well serve as a model for British palæobotanists. Exact observation on the relative distribution of the fossil plants and other organisms, hitherto collected far too indiscriminately to serve the purpose of exact geology, has already been insisted upon by Mr. Salter and others. Many a good specimen of reptile, fish, crustacean, mollusk, &c., has been stored, described, and figured, without its position in the coal-measures having been noted with sufficient exactness; and it has therefore proved of about as much use to the geologist as a medal of unknown origin could be to a numismatist.

The physical structure of the Coal-fields is a life-study for any geologist. The Geological Surveyors of Great Britain and Ireland are steadily adding to the stock of knowledge on this subject, and their maps, sections, and explanations are diffusing correct information. They can work but slowly, however; and much can be done by others: and of this the valuable and lucid memoir by Mr. Marcus Scott, recently published in the Geological Society's Journal, on the unconformability of the Upper and the Lower Coal-measures of Coalbrook Dale, is a striking example.

The study of coal and the coal-measures has been greatly advanced by Mr. Hull's treatise; for the subject is therein carefully and clearly presented in its many different aspects, with much light derived from his own and others' experience; and his map and sections bring to the eye much valuable practical and theoretical information, in which the results of Mr. Hull's own labours have a conspicuous and most worthy standing*. Doubtless further editions of the work before us will be called for. The increasing interest shown by the public in geology, and the direct interest we all feel in the coal-supply, will induce the author to still further improve his work with amendments of condensed information. Even now, few books are more worthy to bear the motto "scientia et utilitas."

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 27, 1862.—Prof. Huxley, F.R.S., V.P., in the Chair.

On a New Species of Chlamydera, or Bower-Bird. By John Gould, Esq., F.R.S., etc.

I am indebted to the researches of F. T. Gregory, Esq., the West Australian explorer, for a knowledge of a new species of this group of birds, which are rendered remarkable by their habit of constructing bowers or playing-places. It was collected by Mr. Gregory in North-western Australia, and is doubtless the species which constructs the bowers described by Captain (now Sir George) Grey in the first volume of his 'Travels,' pp. 196 and 245, where he states that, on gaining the summit of one of the sandstone ranges forming the watershed of the streams flowing into the Glenelg and Prince Regent's Rivers, "we fell in with a very remarkable nest, or what appeared to me to be such. We had previously seen several of them, and they had always afforded us food for conjecture as to the agent and purpose of such singular structures." This "very curious sort of nest, which was frequently found by myself and other individuals of the party, not only along the sea-shore, but in some instances at a distance of six or seven miles from it, I once conceived must have belonged to a Kangaroo-rat, until Mr. Gould informed me that it is

* Mr. Hull's elaboration of the probable limits of the Carboniferous deposits in England, and of the distribution of the sandstones, clays, and limestones of that formation, is published, with a map, in the 'Journal of the Geological Society,' No. 70, May 1862.

the run or playing-ground of the bird he has named *Chlamydera nuchalis*. These nests were formed of dead grass and parts of bushes, sunk a slight depth into two parallel furrows in sandy soil, and then nicely arched above. But the most remarkable fact connected with them was, that they were always full of broken shells, large heaps of which protruded from each extremity of the nest; these were invariably sea-shells. In one instance, in the nest the most remote from the sea that we discovered, one of the men of the party found, and brought to me, the stone of some fruit which had evidently been rolled in the sea. These stones he found lying in a heap in the nest; and they are now in my possession."

The specimen sent to me by Mr. Gregory bears a very general resemblance to the *Chlamydera maculata*, being spotted all over like that species; but it differs in the guttations of the upper surface being of a larger size and much more distinct, in the abdomen being buff, and in the shafts of the primaries being straw-yellow. In all probability, the specimen is a female, since there is no trace of the beautiful lilaceous nuchal mark seen in the males only of *Chlamydera maculata* and *C. nuchalis*. Of this well-defined group there are now known three very distinct species, viz., the *C. maculata*, of the east coast; the *C. nuchalis*, which frequents the northern parts; and the *C. guttata*, of the north-western provinces of Australia.

CHLAMYDERA GUTTATA, Gould.

General tint of the upper surface and wings deep-brownish black, with a spot of rich buff at the tip of each feather, those of the head and nape being very small, while those on the body and wings are of large size, accordant, in fact, with the increased size of the feathers; the spots on the tips of the greater wing-coverts are not so round as those on the back; the primaries are very pale brown, fading into white on the basal portion of their inner webs, which is yellow on the under surface; their shafts straw-yellow; tail-feathers pale brown, with buff shafts and white tips; throat-feathers brown at the base, with an arrowhead-shaped mark of pale buff at the tip of each, the buff tips becoming much larger on the chest; centre of the abdomen pale buff; flanks, thighs, and under tail-coverts buff, barred with light brown; bill black; gape rich yellow; feet apparently very dark olive.

Total length $11\frac{1}{2}$ inches; bill $1\frac{1}{4}$; wing 6; tail $4\frac{3}{4}$; tarsi $1\frac{3}{4}$.

Hab. North-western Australia.

Remark.—The primaries of the specimen described are much worn; they are doubtless tipped with white in fresh-moulted specimens.

June 10, 1862.—Professor Busk, F.R.S., in the Chair.

ON SOME NEW AND RARE BIRDS FROM NEW GUINEA. BY ALFRED RUSSEL WALLACE.

The birds now brought before the Society were collected by my assistant, Mr. Allen, on his last voyage. They comprise several interesting species, hitherto only known by specimens in the French or Dutch collections, and now, I believe, for the first time exhibited in England, viz.:—

Nasiterna pygmæa, Q. & G. Remarkable as being the smallest of the *Psittaci*, and for its curious, rigid, spined tail.

Tanysiptera nympha, G. R. Gray. This specimen decides the locality of this interesting and beautiful bird to be the N.W. peninsula of New Guinea, in the interior.

Peltops Blainvillii, Garn. This rare bird also inhabits the island of Mysol, where a single specimen was obtained by Herr Rosenberg. Mine came from the N.W. of New Guinea.

Eupetes cærulescens, Temm. This bird and the last seem quite out of place in New Guinea, as we must pass over all the Moluccas and Celebes to find their nearest allies in Borneo, Java, and Sumatra.

Ptilorhynchus buccoides, Müll.

Hierococcyx leucolophus, Müll.

Campephaga melas, Müll.

Besides these, adult specimens of the fine *Talegalla Cuvieri* were also obtained, and Mr. Allen's collection also comprises five new species of great interest—a Pigeon, a Kingfisher, a Parrot, and two Passeres, of which the descriptions follow.

1. Coriphilus rubronotatus.

Above dark green; beneath yellow green; a large spot on the forehead, sides of the breast, and under wing-coverts bright red; a spot on the upper tail-coverts dull red; ear-coverts deep blue; wings and tail as in *C. placentis*. Bill and cere carmine-red; feet pale red.

Total length $9\frac{1}{2}$ in.; wing $3\frac{3}{10}$ in.

Allied to *C. placentis*, but smaller, and wants the red face and blue rump which distinguish that species, as well as the yellow-tinged crown, which is replaced by a red spot.

Hab. Salwatty, and the N.W. extremity of New Guinea.

2. Halcyon nigrocyanea.

Back, and sides of the head and neck, deep black; throat, lower part of the breast, and belly white; forehead and crown deep blue, margined from the eyes round the nape with lighter blue; a band across the breast, the shoulders, and wing-coverts deep blue; quills dusky black, margined with blue to near the tips; middle of the back narrowly white, shading into blue, which becomes dark on the tail-coverts; tail deep blue, inner margins of the feathers and beneath black; under tail-coverts black, tipped with blue; sides of the breast and flanks black; under wing-coverts black, with a white central band. Bill black, pale in the centre beneath; feet black.

Total length 9 in.; wing $3\frac{5}{8}$ in.

The young bird has slightly rufous lores, and the pectoral band rufous mingled with black and blue.

Hab. N.W. peninsula of New Guinea.

3. Todopsis Grayi.

Beneath bluish white, almost white on the throat; head light-greenish blue, the centre of the crown dusky; a black spot on the ear-coverts extending towards the nape; back dusky, the feathers margined with greenish blue; wings dusky, the quills margined with rufous olive, shoulder-coverts margined with greenish blue; tail dusky olive, with a minute whitish spot at the tips of the feathers; thighs rufous-tipped. Bill black; feet dusky.

Total length $5\frac{5}{8}$ in.; wing $2\frac{1}{2}$ in.; bill from gape $\frac{8}{10}$ in.

The bill in this species is nearly as broad as in *Machærirhynchus*. I have named this interesting bird after Mr. George Robert Gray, who has described the other species of this genus sent home by me.

Hab. N.W. peninsula of New Guinea: Mountains of Sorong.

4. Gracula pectoralis.

Black, the feathers broadly margined with metallic green and purple; plumes of the neck and breast decomposed, and of a rich orange-buff colour, as are also the vent, rump, and upper tail-coverts; on the nape a collar of whitish buff reaching round to the orange of the throat; under tail-coverts cream-white, tinged with orange at the base; a white band across the wings towards the tips. Iris yellow; bill and feet pale yellow.

Total length 10 in.; wing $5\frac{3}{4}$ in.

The young bird has the breast and belly black, uniformly margined with light orange.

This species differs from the rest of the genus in having neither wattles nor naked skin on the face, but in general structure and coloration closely resembles the other species.

Hab. N.W. peninsula of New Guinea: Sorong.

5. Ptilonopus humeralis.

Very near *P. iozonus*, G. R. Gray, but a little larger, and at once distinguished by the violet-grey patch on the shoulder having its lower half deep purple; the tail also wants the grey apical band of that species, which is replaced by a subapical narrow one, only visible on the lateral feathers and beneath. The wing-coverts are all of a rich violet grey, margined with green. Chin ashy; the rest as in *P. iozonus*. Bill greenish, tipped with bright yellow, base above red and swollen; feet purple-red.

Total length $8\frac{3}{4}$ in.; wing $4\frac{7}{8}$ in.

Hab. Salwatty, and the adjacent coast of New Guinea.

Descriptions of some New Genera and Species of Fishes obtained at Madeira. By James Yate Johnson, Corr. Mem. Z. S.

Order MALACOPTERYGII APODES, Cuv.

Sect. Phaneromycteres, Kaup.

Fam. Murænidæ.

Pseudomuræna, gen. nov.

Dorsal, anal, and caudal fins united; no pectoral fins; gill-openings lateral; no teeth on the mesial line of the palate; in the jaws uniserial serrate teeth, having a tubercle at the posterior base.

This genus differs from *Muræna* in having no teeth on the mesial line, and in the form of the jaw-teeth.

PSEUDOMURÆNA MADERENSIS, sp. n.

Body anguilliform, attenuating backwards from the nape, which is deep and thick. Skin soft, thick, scaleless. Colour a yellowish brown, darker on the head; the anterior fourth of the body marked with undulating lines, or narrow bands, of deeper brown, which are arranged longitudinally before the gill-openings, and transversely behind them, the change of direction being gradual.

The head is gibbous behind the small eyes, which are oval, covered with skin, and placed over the middle of the upper jaw. The snout is obtuse and rounded; the throat swollen. The posterior nostrils are small, with slightly raised borders, and are placed a little in front of the vertical through the middle of the eye. The anterior nostrils issue in free tubes, which do not quite reach to the tip of the snout. The jaws are of moderate length and subequal; the lips moderately thick; the inside of the mouth fuscous. The teeth are uniserial, rather stout, pointed, conico-compressed, with serrate edges, and a tubercle at the posterior base. They are slightly curved backwards, and are longer in front than behind. In the upper jaw there are about 16; in the lower jaw from 24 to 34. No teeth on the mesial line or on the vomer. Rictus moderate. No barbel. Gill-openings small, round, placed at the sides of the body about the middle of the height. No pectorals or visible lateral line. The dorsal fin commences at the nape, in front of the gill-openings, and is continuous with the caudal and the anal fins; it is higher behind than in front. The vent is in the hinder half of the body, and about $\frac{1}{16}$th of the total length behind the middle. The anal fin commences within a short distance of the vent; it is very low in front, where it is cloaked by thick skin, and where there is a furrow at each side of and parallel with its base; further behind, there are two parallel furrows. The tail is compressed, the fin narrow and rounded. All the fins are covered with a thick skin.

Although several specimens of this Eel have been obtained (some of which have been sent to the British Museum), it must still be considered as a rare fish. In colouring it resembles *Thyrsoidea unicolor*, Kaup, from which it differs generically in the uniserial dentition.

The following measurements were taken from a specimen having a total length of $40\frac{3}{4}$ inches, with a depth, near the gill-openings, of $3\frac{1}{2}$ inches:—

	Inches.
Rictus	$2\frac{4}{10}$
Gill-openings, distance from snout	5
Vent, distance from snout	$22\frac{1}{4}$
Dorsal fin, distance from snout	$4\frac{1}{2}$

In another specimen, $36\frac{1}{2}$ inches long, the longer axis of the eye measured $\frac{3}{10}$ inch, and the longest teeth were less than $\frac{1}{5}$th of an inch in length. The rictus was $1\frac{8}{10}$ inch in depth.

THYRSOIDEA ATLANTICA, sp. n.

Anguilliform, compressed; attenuate both ways from middle of body. Skin smooth, scaleless, white, with one dusky oval blotch on one side of body, and two or three such blotches on the other side, unsymmetrically placed. The longer axis of these blotches is from one-third to one-half an inch across. On the fins near the posterior extremity of the body are several similar blotches.

A single specimen of this Eel has occurred, the dimensions of which are embodied in this description.

Total length 23 inches; depth $1\frac{4}{10}$ inch, taken about an inch in advance of the vent.

Head compressed, rising behind the eyes; depth through head and swollen throat, $1\frac{4}{10}$ inch. Eyes covered with skin, placed a little in advance of the middle of the upper jaw, rather less than one-fifth of an inch in diameter. Hinder nostril-tubes shorter than anterior, placed a little in front of the vertical from the anterior orbit of eye. Front nostril-tubes reaching a little beyond lip. Mouth cleft rather more than an inch deep. Jaws rather slender, somewhat curved, and not capable of shutting closely on account of the length of the front teeth and the curvature of the jaws. Lower jaw a little longer than the upper, without a barbel. Teeth in both jaws slender, pointed, somewhat compressed, curving backwards. In the upper jaw there are two rows at each side, those of the inner row being longer. A row of seven teeth along the middle of the palate. The longest teeth in the jaw are rather more than one-fifth of an inch in length. In the lower jaw there is a single row at each side; in front there appear to be two rows. Gill-clefts $\frac{3}{10}$ inch long, narrow, placed about the middle of the sides, a little posterior to commencement of dorsal fin, and $2\frac{1}{2}$ inches from snout. The dorsal fin commences at the nape, $2\frac{1}{10}$ inches from snout, is lower in front than behind, and unites with the caudal fin, like the anal fin, without a break. Vent about 9 inches from tip of mandible, in anterior half of body. Anal fin commences near vent, and is very low at first. All the fins are covered with skin like that of the body.

The specimen was taken in the sea near Madeira, in the month of June 1859, and has been deposited in the British Museum.

Fam. SYNAPHOBRANCHIDÆ.

SYNAPHOBRANCHUS, gen. nov.

Dorsal, anal, and caudal fins united. Pectoral fins present. Gill-openings in close proximity on the under side of the body, having a single external aperture, with an internal dividing membrane. Branchiæ four. A row of acute teeth in each jaw, with an external band of minute teeth. Teeth on the vomer and on the mesial line of the palate. Scales on the skin.

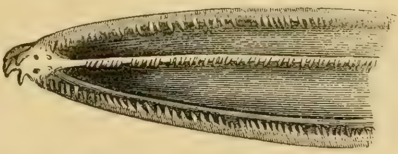
This genus forms the type of a new family of Malacopterygian

Apodals, which differs from all previously established families, except the *Symbranchidæ*, in having the gill-openings close together on the ventral aspect; and from the *Symbranchidæ* it is distinguished by the presence of fins. Moreover, from the *Murænidæ* it is separated by the possession of pectoral fins, and from the *Congridæ* by the possession of scales and by the vent being before the commencement of the dorsal fin.

SYNAPHOBRANCHUS KAUPII, sp. n.

Anguilliform, compressed, attenuate in both directions from the neighbourhood of the vent; of a dull brown colour, darker on the belly. The skin contains small oval scales, set obliquely and at right angles to each other.

The head is subcompressed, depressed, and flat above; it exhibits no gibbosity, nor is the throat swollen. The eye is covered with skin; it is of moderate size, and placed at the side of the head, over the middle of the oral cleft, three diameters distant from the tip of the snout. The posterior nostril is in front of the eye and has a raised border. The anterior nostril has a short tube, which does not quite reach to the lip, and is attached in front to the snout, the orifice being directed forwards. Rictus deep. The jaws are narrow, pointed, subequal, and without barbels. The lips are cartilaginous, especially the upper lip, which forms a conical snout, projecting much beyond the jaw. There are teeth in both jaws, consisting of an inner row of short, slender, conical, pointed, closely-set teeth, with an exterior band of scobinate teeth, which become reduced to a single row in front. On the vomer is a group of from nine to fifteen conical teeth, the first two or three of which are short, the others rather longer than those in the jaw. On the mesial line of the palate there is a row of minute, sharp teeth curving backwards; and the pharyngeals are armed with scobinate bands of teeth. The inside of the mouth is black, as well



as the tongue, which is small, toothless, and free at the tip. The gill-openings are side by side on the ventral aspect of the body, in advance of the pectoral fins; they are separated by a membrane placed inside a single external aperture. The dorsal fin commences behind the vent, a little posterior to the commencement of the second third of the total length, and joins the caudal, like the anal fin, without a break. It is higher behind, but is throughout much lower than the anal; the greater part of it is covered with a scaly skin, as is also the greater part of the anal fin. The pectoral fins are well developed, pointed, and situate a little behind the gill-openings, below the middle of the height. The ventral fins are wanting. The vent is in the first third of the total length. The anal fin commences just behind the vent; it is considerably higher about the middle and behind than in front. The caudal is rounded. The lateral line is distinctly marked; it falls gently from the shoulder, but for the greater part of its length is straight along the middle of the body. The air-bladder is long, being more than one-third of the length of the body. The food found in the stomachs of dissected specimens consisted of the remains of fishes and crustaceans. The peritoneal lining is of a dark blue colour.

Dedicated to Dr. Kaup of Darmstadt, who has well studied this order of fishes. Specimens have been sent to the British Museum.

The following figures give the dimensions in inches of one of the larger examples:—

Total length	32
Depth in the neighbourhood of the vent	3
Thickness	$1\frac{3}{10}$
Distance from snout to pectoral	$4\frac{1}{2}$
——— from snout to vertical of vent	$9\frac{1}{2}$
——— from snout to vertical of commencement of dorsal	$11\frac{1}{4}$
Eye, diameter, nearly	$\frac{1}{2}$
Rictus, depth	$2\frac{1}{5}$
———, width at back	$\frac{9}{10}$
Length of bone of upper jaw	$2\frac{8}{10}$
——— of gill-openings	$\frac{9}{10}$
——— of pectoral	$1\frac{1}{2}$
Width of base of pectoral, nearly	$\frac{1}{2}$
Length of rays at middle of anal	$\frac{17}{20}$
——— of rays of caudal	$\frac{7}{10}$

Order ANACANTHINI, Müll.

Fam. Gadidæ.

Læmonema, Günther, MS.

The genus *Læmonema*, established by Dr. A. Günther on a Mediterranean fish hitherto assigned to *Phycis*, is distinguished from the latter genus by the shortness of the base of the first dorsal fin, and by the rounded outline of the patch of vomerine teeth. A full diagnosis of the genus will appear in the forthcoming fourth volume of the 'Catalogue of Fishes in the British Museum.' A second species of the genus having occurred, I proceed to describe it.

Læmonema robustum, sp. n.

1st D. 5. 2nd D. 50, 51. A. 48. V. 1. P. 28. C. 16. M. B. 7. Scales of lateral line about 126.

Body *Phycis*-like, thick before, much compressed behind, of a dull-brown colour; the rays of the dorsal, anal, and pectoral fins being of a dull purplish-red. The scales are very small; between the base of the first dorsal fin and the lateral line fifteen rows of scales may be counted. The length of the head is equal to the height of the body under the first dorsal fin, and, compared with the total length of the fish, is as 1 to 4. It is depressed, unarmed, flat between the eyes, with a longitudinal depression at the nape; the snout short and rounded; the cheeks convex and scaly. The round eye is placed high up, so as to take part in the profile; it is contained four times on the head, and is distant one and one-third of its diameter from the tip of the snout; the space between the eyes is equal to one diameter. The nostrils are rather small; at the posterior edge of the anterior one there is a strap-shaped skinny appendage. The mouth is wide, and when open the jaws form a broad oval; its anterior, as well as the tongue, is of a pale-grey colour. The upper border of the mouth is formed by the premaxillary; the maxillary is broad below, and reaches back to the vertical from the middle of the eye; the skin covering it is colourless, for when the mouth is closed it slides underneath the skin covering the posterior bones. The under jaw closes inside the upper one. There are scobinate bands of conical teeth in both jaws, those of the outer rows being rather larger. The band of the upper jaw is broader in front than the band of the lower jaw, but it narrows behind. There is a small round patch of similar teeth on the vomer, and also patches on the pharyngeals; but the palatines and the tongue are unarmed. The tongue is thick, broad, and pointed.

The gill-openings are large. The edges of the opercle and preopercle are rounded; and the edge of the latter is distinctly visible, not concealed by the skin. The chin carries a barbel. The first dorsal fin is short, having only five rays, of which the first is elongate, its upper part being setaceous; the length of this ray to the total length of the body is as 1 to $5\frac{1}{4}$. The interval between the two dorsal fins is short. The second dorsal fin has its base about 16 times the length of the base of the first, and its highest portion is less than half the length of the first ray of the first dorsal; it falls about the middle, and then rises again, its termination being prolonged and pointed. The specimen has been wounded in the back during its life, and, though the wound has healed, a few (but probably not more than two or three) of the rays have been carried away. The remaining rays are forty-eight in number. None of the dorsal or anal fins are fleshy, neither are there any scales upon them. The pectoral fins are inserted a little in front of the first dorsal, and rather above the middle of the height; their apices are pointed, and they are of moderate length, reaching back beyond the commencement of the anal fin. The jugular ventral fins are forked, the longer division becoming filiform and reaching back considerably beyond the commencement of the anal fin, and a little beyond the tips of the pectoral fins. These fins are longer than the head, and, compared with the total length of the fish, they are as 1 to $3\frac{1}{2}$. The difference between the lengths of the two divisions of the ray is to the length of the longer as 1 to $4\frac{1}{3}$. The vent is surrounded by a black ring, and is placed under the fourth ray of the second dorsal fin. The anal fin commences under the seventh or eighth ray of the second dorsal fin. It is highest in front; at the middle it falls in, and then ends a short distance in front of the second dorsal with an acute prolongation. The caudal fin is truncate, and rather more than a ninth of the total length. The tail is much compressed and attenuate. The lateral line is a groove that forks above the opercle. After the junction of the divisions it rises a little, and then falls gradually; but under the anterior portion of the second dorsal fin there is a rapid descent, after which it is straight along the tail.

The single example on which this species has been founded was taken near Madeira, in the month of March, and is now in the British Museum. Its dimensions, expressed in inches, are given in the following table:—

Total length	$14\frac{1}{8}$
Height under first dorsal	$3\frac{1}{2}$
Thickness near base of pectorals	2
Head	$3\frac{1}{2}$
Eye, diameter	$\frac{7}{10}$
Mouth, width from side to side	$1\frac{3}{4}$
Barbel, length	$\frac{11}{20}$
First dorsal fin, distance from snout	$3\frac{9}{10}$
—— —— —, length of first ray	$2\frac{7}{10}$
—— —— —, length of second ray	$1\frac{9}{10}$
—— —— —, length of last ray	$\frac{7}{10}$
—— —— —, base of fin	$\frac{5}{10}$
Second dorsal, distance from first dorsal	$\frac{2}{10}$
—— ——, length of base	$8\frac{1}{4}$
—— ——, height in front	$1\frac{2}{10}$
Pectorals, distance from snout	4
——, length	$2\frac{7}{10}$
——, width of base	$\frac{6}{10}$
Ventrals, distance from tip of mandible, mouth open	$2\frac{8}{10}$
——, length	4
Anal, distance from tip of mandible, mouth open	$6\frac{1}{8}$
——, height in front	$1\frac{1}{4}$
Caudal, length	$1\frac{1}{2}$
Tail, height behind second dorsal	$\frac{4}{10}$

Order ACANTHOPTERYGII, Cuv.

Fam. TRICHIURIDÆ.

NESIARCHUS, gen. nov.

Body elongate, covered with small scales. Cleft of mouth deep. Several strong teeth in the jaws; none on the palatine bones or the vomer. First dorsal not extending to the second. No finlets behind either the dorsal or anal fin. Perfect thoracic ventral fins present. Caudal fin well developed. A dagger-shaped spine behind the vent. No keel on the tail. One lateral line. Seven branchiostegal rays. An air-bladder. Pyloric cæca in moderate number.

This genus may be entered in the Synopsis of Trichiuroid genera, given in the Cat. of the Brit. Mus. Collection, thus:—

"Ventrals present: a dagger-shaped spine behind the vent."

NESIARCHUS NASUTUS, sp. n.

1st D. 20. 2nd D. 2. 21. A. 22. P. 13. V. 1.4. C. vii. 8+7. vii. M. B. 7.

This fish has much of the external aspect of *Thyrsites Prometheus*. The body is very elongate, compressed, covered with small, deciduous, cycloid scales, which are elegantly marked with concentric striæ; the height of the body, compared with the total length, is as 1 to 13. The head is scaly in every part, but unarmed; it is compressed, and the cheeks are flat. There is a broad groove between the eyes and on the snout, as in *Aphanopus*. The length of the head, compared with the total length, is as 1 to $4\frac{3}{4}$. The round eye is placed at the side of the head, and does not quite reach to the outline; it is contained $9\frac{1}{2}$ times in the head, is rather more than a diameter distant from the other eye, and each is distant about $4\frac{1}{4}$ diameters from the tip of the snout. The members of each pair of nostrils are distant from each other, and the hinder one is a small oblique slit. The bones of the scaly opercle and subopercle are thin and radiato-striate; the border of the former has an angular projection. The gill-openings are wide. The snout is long, and is terminated by a large conical cartilaginous process, which projects much beyond the jaw. The mandible has a similar but longer cartilaginous process. These processes (some rudiments of which may be seen in *Aphanopus*) bestow on the head somewhat of the appearance of *Sphyræna vulgaris*. The rictus is large. The upper border of the mouth is formed entirely of the premaxillary, which is broad above and narrow below. The scaly maxillary, which lies exposed behind, and is broad below and narrow above, does not quite reach back to the vertical from the middle of the eye. The mandibular bones project a little beyond those of the upper jaw.

The dentition bears much resemblance to that of *Aphanopus*. In each jaw there is a single series of moderately strong teeth, which are pointed, compressed, and subtriangular; those of the lower jaw are about thirteen in number on each side, and are rather larger than those of the upper jaw, where there are also thirteen on each side, in addition to three pairs of considerably larger teeth, which stand a little within the line of the others, near the fore end of the jaw. These teeth increase in size backwards, the last pair being about four-tenths of an inch long.

All these are pointed and compressed, and have a slight double curvature. The three pairs stand opposite the second, third, and fourth pairs of teeth on the lower jaw. There are no teeth on the palatine bones or on the vomer. The tongue is smooth, narrow, and black like the pharynx and the inside of the gill-covers.

The first dorsal fin commences at the nape in front of the root of the pectoral fins. It rises from a groove, is moderately high, and its spines are weak, distant, and grooved, but not tuberculated. It is rather higher behind than in front, and there is an interval equal to about one-fifth of the length of the head between it and the second dorsal, which is high in front, where it is subtriangular. The fourth and fifth rays are the longest. The last four or five rays are short and much branched, the last ray being elongated*. The anal fin is preceded by a stout broad two-edged spine, similar to that possessed by *Aphanopus*. This fin is opposite and similar in shape to the second dorsal. The first ray is weak, but appears to be a simple spine; and the last ray is somewhat prolonged. The pectoral fins are pointed, and inserted below the middle of the height. The ventral fins are thoracic, being placed close together a little behind the pectoral fins; they are small, being only equal to one-eleventh of the head, but consist of a spine, which is stout below and slender above, and four soft rays connected by membrane. The ray next to the spine is the longest. The caudal fin is well developed and deeply cleft; its rays are very broad below.

The unarmed lateral line falls gently from the shoulder to the middle of the body, whence it is horizontal to the caudal fin. The tail has no keel, and is not depressed behind the second dorsal. There is no barbel nor any prominent papilla near the vent.

The body of the fish is uniformly lead-coloured, with black fins; its skin, when the scales have been removed, is black.

The peritoneum is black; the stomach long and simple; the intestinal tube straight. There are about eight pyloric cæca, and a long narrow air-bladder with thin walls.

Only a single specimen has occurred, and this was taken in the month of April last. It had a length of $36\frac{1}{2}$ inches, a height at the ventral fins of $2\frac{8}{10}$ inches, and a thickness at the same place of $1\frac{3}{10}$ inch. Decidedly Trichiuroid as it is, it differs from all the genera of that family hitherto known, and a new genus must be established for its reception. From *Aphanopus*, with which it agrees in having a dagger-shaped spine behind the vent, it differs in being possessed of scales and ventral fins; from *Lepidopus* it is distinguished by having two dorsals and scales, and by the absence of teeth from the palatine bones; from *Trichiurus* by having two dorsal fins, a well-developed caudal fin, and many-rayed ventral fins; from *Epinnula* by having a single lateral line, and by the separation of the dorsal fins; from *Thyrsites* by having no teeth on the palatine bones, and by the separation of the dorsal fins; from *Dicrotus* in having scales and many-rayed ventrals; and from *Gempylus* by the presence of scales and the absence of finlets. Moreover in the two known species of the last-named genus each ventral fin is represented by a spine. From the *Sphyrænidæ*, it may be mentioned in passing, it differs by the ventral fins being thoracic, and by the proximity of the dorsal fins.

The following are the dimensions in inches of the principal parts of the specimen, which has been added to the collection of fishes at the British Museum:—

Length of head	$7\frac{7}{10}$
Eyes, diameter..........................	$\frac{8}{10}$
——, distance apart	$\frac{9}{10}$
——, distance from tip of snout............	$4\frac{1}{4}$

* The membrane connecting the last four or five rays of the second dorsal and the last five or six rays of the anal fin is much torn in the specimen. In an older fish they might possibly form detached finlets, the structure of the rays bearing much resemblance to those of the finlets possessed by some Trichiuroid genera.

Upper jaw bones, length	$3\frac{3}{10}$
First dorsal, distance from tip of snout	$6\frac{3}{4}$
—— ——, length of base	$16\frac{1}{2}$
—— ——, highest spines	$1\frac{1}{2}$
—— ——, interval between first and second dorsal	$1\frac{1}{2}$
Second dorsal, length of base	6
—— ——, length of fourth and fifth rays	$2\frac{1}{2}$
Pectorals, length	3
———, width of base	$\frac{1}{2}$
———, distance from snout	$7\frac{1}{8}$
Ventrals, length	$\frac{7}{10}$
Vent, distance of its vertical from tip of mandible	24
——, distance from anal	1
Spine before anal, length	$\frac{7}{10}$
Caudal, length of external rays	$5\frac{1}{3}$

Fam. Scombridæ.

Schedophilus elongatus, sp. n.

D. 39. A. $\frac{3}{21}$. P. 21. V. $\frac{1}{5}$. C. iii. 9+7. iv. M. B. 7.

Uniformly purplish black, somewhat paler on the belly. The body is elliptico-oblong and much compressed, the height, compared with the total length, being as 1 to $4\frac{1}{2}$, and the length of the head to the total length as 1 to 5.

The head is scaleless above, gelatinous, punctate, and arched. The snout is abbreviate and abrupt, but does not form a quadrant with the head, as is the case in *S. Berthelotii*. The opercle and subopercle are scaly and striate, the striæ ending at the margin in minute teeth. The preopercle is scaleless, the border being striate, and the striæ projecting as blunt teeth*. The eye is round, its centre is placed about the middle of the height, and it is surrounded by radiating grooves; it is contained five times in the head; the space between it and the tip of the snout is equal to a diameter and a half. The mouth is of moderate size, and the jaws are equal; each is set with a single series of small sharp teeth. There are no teeth on the palatines or the vomer. The tongue is broad, smooth, and white.

The long scaly dorsal fin commences behind the root of the pectoral fin; it is low in front, highest at the middle, and has an angular termination. The spinous rays are not to be distinguished from the others. The pectoral fins are pointed, and have broad roots; they are inserted below the middle of the height, and their fourth and fifth rays are the longest; they scarcely reach more than halfway to the vent. The pointed ventral fins are inserted near together, just under the posterior angle of the root of the pectoral fins. The second soft ray is the longest; this fin does not reach halfway to the vent. The scaly anal fin is high in front and pointed behind; it terminates opposite, or perhaps a little behind, the termination of

* In describing *S. Berthelotii* (Ichth. Canarienne, p. 45), M. Valenciennes says that the opercle, subopercle, and interopercle are not scaly, whereas all the opercular pieces are most certainly scaly.

the dorsal; its base is about half as long as that of the dorsal fin. The caudal fin is deeply emarginate; its membrane has scales upon it between the rays.

The lateral line rises slightly on the shoulder, then descends gently to the middle of the height, and from a little behind the middle of the total length it is horizontal. The scales are very small, cycloid, and concentrically striate; those of the lateral line are about 160 in number.

The single individual from which these characters have been drawn up, though bearing considerable resemblance to *S. Berthelotii* (which occasionally occurs at Madeira), is sufficiently distinct from that and other known members of the genus to warrant the definition of a new species. From *S. Berthelotii* it is easily distinguished by the smaller scales, the longer body (height to length as 1 to $4\frac{1}{2}$, instead of 1 to 3), the shorter head (head to length as 1 to 5, instead of 1 to 4), the longer snout (equal to $1\frac{1}{2}$ diam. of the eye, whereas in *S. Berthelotii* it is less than one diameter of the eye), by the shorter pectoral and ventral fins only reaching about halfway to the vent (whereas in *S. Berthelotii* they extend backwards as far as the vent), and by the commencement of the dorsal fin being placed behind the root of the pectorals, whereas in *S. Berthelotii* that fin commences considerably in front of that point. A thick purple fluid exuded from the vent of the dead fish; and the same thing has occurred in the case of all the specimens of *S. Berthelotii* that have occurred. The fishermen give to both these species the name of "Praga."

The total length of the specimen (which was taken in the month of April last) is $14\frac{7}{10}$ inches; the height between the ventrals and the vent is $3\frac{3}{10}$ inches, and its thickness thereabouts is $\frac{11}{16}$ inch. The dimensions of the principal parts are expressed in inches in the following table:—

Length of head	$2\frac{8}{10}$
Diameter of eye, rather more than	$\frac{1}{2}$
Dorsal, length of base	$6\frac{1}{2}$
——, height at middle	$\frac{7}{8}$
——, distance from snout	$3\frac{5}{8}$
Pectorals, length	$1\frac{1}{2}$
———, breadth of base	$\frac{6}{10}$
———, distance from snout	$3\frac{1}{10}$
Ventrals, length	$1\frac{1}{4}$
Vent, distance of its vertical from snout	$6\frac{1}{4}$
——, distance from anal	$\frac{1}{2}$
Anal, length of base	$3\frac{3}{10}$
——, height in front	$\frac{9}{10}$
Caudal, length of longest rays	$2\frac{1}{2}$

Fam. TRIGLIDÆ.

SETARCHES, gen. nov.

Head and body compressed; no transverse groove at the occiput; vertex without spines; preoperculum armed; body covered with cycloid scales; without skinny appendages. One dorsal fin, divided by a notch into a spinous and a soft portion. No pectoral appendages.

Villiform teeth in the jaws, on the vomer, and on the palatine bones. Lateral line a broad scaleless groove. Six or seven branchiostegal rays. Pyloric appendages in small number. No air-bladder.

It will be observed that this new genus is closely related to *Sebastes* and *Scorpæna*, but more nearly to the former than to the latter. From both it is distinguished by the cycloid scales, the scaleless lateral line, and the absence of spines from the vertex. The single individual on which it has been founded was taken in the month of December 1861, and is now in the British Museum. It was at first assigned to the genus *Sebastes*, but was at once discriminated from all the species of that genus previously taken at Madeira. With these species I shall compare it throughout my description, with the view of aiding other observers in identifying specimens, if they should occur.

SETARCHES GÜNTHERI, sp. n.

D. $11\frac{1}{9}$. A. $\frac{3}{5}$. P. 22. V. $\frac{1}{5}$. C. iv. 7+7. iv.

The height, compared with the total length, is as 1 to 4. The head is large, being contained in the length only $2\frac{3}{4}$ times. It is scaleless, and without prominent spines on the vertex; the bones are cavernous; the space between the eyes is flat and marked by several low ridges. At the back of the head are two broad flat spines pointing backwards.

The eye is contained $5\frac{1}{3}$ times in the head, and is distant from the tip of the scaleless snout about a diameter and a half. The space between the eyes is considerably more than equal to the diameter, and is to the length of the head as 1 to $4\frac{1}{2}$. There are no spines above the postero-superior part of the orbit. The snout is rounded and truncate; its length is equal to one-third of the length of the head. There is a skinny appendage at the posterior margin of the anterior nostril. The opercle is scaly, and is crossed by two strong crests terminating in long spines, which reach up to its edge; the higher of these spines is to the length of the head as to 1 to $7\frac{1}{2}$. At the border of the scaly preopercle there are five spines, pointing backwards, of which the three highest are long, narrow, and parallel, the middle one of the three being equal in length to the larger of the opercular spines: these five spines occupy the position of those of *Sebastes dactylopterus*.

The mouth is moderately large. The maxillary is broad below, is vertically truncate, and reaches back to the posterior margin of the eye. The under jaw is a trifle longer than the upper, which is notched in front. Both jaws, the palatines, and the vomer are set with bands of villiform teeth. The tongue is free near the apex, is very thick, and has a thin spatuliform projection in front similar to that seen in front of the tongue of *S. Kuhlii*, which, however, does not reach so far forward as in the case of the present species. The tongue and pharynx are black. The branchiostegal membrane, when the mouth is closed, is almost concealed by the opercular pieces and the very broad mandibular bones.

The dorsal fin is long, commencing before the root of the pectoral; its spines are stout, and the soft portion rounded. The anal fin is short, and terminates opposite the termination of the dorsal fin; its third spine is the longest, and is to the length of the head as 1 to $3\frac{1}{3}$, but it is shorter than the first three soft rays. The pectoral fin is broad and long, reaching back to the commencement of the anal fin, its length being to the total length as 1 to $3\frac{2}{3}$. The first two and the last five rays are simple, the others branched. The tenth, eleventh, and twelfth rays are the longest, and the last rays are the shortest. None of them project beyond the membrane. The ventral fins are placed together under the roots of the pectoral fins; they are pointed, and extend over rather more than half the distance between their roots and the commencement of the anal fin. The spine is stout; the two first soft rays longer than the others. The caudal fin is truncate, and is scaly only at the base. The vent is far back, being under the base of the twelfth dorsal spine.

The scales are very small, and cycloid, offering no roughness to the finger when drawn from tail to head. The broad and scaleless lateral line descends gently from the shoulder to the tail, where it is straight; its membrane has thirty divisions, but the rows of scales that abut upon it are about eighty-six in number.

The cæcal stomach was found to be of moderate length, and there were only two pyloric cæca. The intestine was long, having one convolution. No air-bladder was observed. Its colour was a uniform pinky red, minutely dotted with black.

In consequence of the anterior part of the dorsal fin having been injured, the comparative length of the spines could not be ascertained. The number of the branchiostegal rays on one side is six, on the other seven.

From *Sebastes dactylopterus*, *S. Kuhlii*, and *S. maderensis*, the only three Madeiran species of that genus hitherto known, it is well distinguished by the flatness of the head between the eyes, by the absence of prominent spines from the vertex, by the third (not the second) anal spine being the longest, by the broad membranous lateral line, and by the cycloid scales. From the first-named species it is further distinguished by the soft rays of the dorsal fin being nine in number, in place of twelve; and from the two latter species by the black pharynx. With *Sebastes filifer*, Val. (Ich. Can. p. 21, pl. 2. fig. 2), this fish agrees in having scales with simple borders; but it differs (in addition to the characters by which the genus *Setarches* is separated from the genus *Sebastes*) in the number of the rays of the pectoral fin (22 in place of 16), in having, not all, but only the two first and the last five rays of that fin simple, in possessing five in place of four preopercular spines, and in the smaller scales (86 in place of 62 along the lateral line).

Dedicated to my friend Dr. A. Günther, the well-known ichthyologist, to whom I am indebted for much valuable instruction.

The following are the dimensions in inches of the principal parts of the specimen, which is now in the British Museum:—

Total length	9
Height	$2\frac{1}{4}$
Length of head	$3\frac{1}{10}$
——— of second preopercular spine	$\frac{4}{10}$
Diameter of eye	$\frac{11}{20}$

Length of maxillary	$1\frac{6}{10}$
——— of base of dorsal fin	$3\frac{1}{2}$
——— of pectoral fin	$2\frac{1}{2}$
——— of base of pectoral fin	$\frac{7}{8}$
——— of ventral fin	$1\frac{1}{2}$
——— of base of anal fin	$\frac{3}{4}$
——— of third anal spine	$\frac{19}{20}$
——— of caudal fin	$1\frac{8}{10}$
Distance of vertical of vent from snout	$5\frac{3}{4}$

Fam. Percidæ.

Priacanthus insularum, sp. n.

D. 10. 15. A. 3. 15. Scales of lateral line, about 76.

This species has a close resemblance to *P. macrophthalmus*, from which, however, the following differences distinguish it:—1. The height of the body to the total length is as 1 to $3\frac{3}{4}$, not as 1 to $2\frac{2}{3}$. 2. The diameter of the eye is to the length of the head as 1 to $3\frac{1}{5}$, not as 1 to $2\frac{2}{3}$. 3. The number of soft rays in the dorsal fin is 15, not 13 or 14. 4. The length of the second dorsal spine is to the last as 1 to 2, not as 1 to $1\frac{2}{3}$. 5. The edge of the opercle has one flat spine, and above this there is a rounded plate; whereas the edge of the opercle of *P. macrophthalmus* has two flat spines. 6. In *P. macrophthalmus* the two borders of the preopercle form a right angle, and the margins are strongly denticulated. In the present species the angle formed by the free borders of the preopercle is obtuse, and the margins are very finely serrate. 7. The caudal is slightly emarginate. 8. The fins have not black edges, as is the case with *P. macrophthalmus*.

This species is established on a single specimen, taken last May, which had a length of $14\frac{1}{4}$ inches, and a height of $3\frac{3}{4}$, the head being $3\frac{5}{8}$ inches long. The eye had a diameter of $1\frac{1}{5}$ inch. The example was coloured a uniform red, and it is now in the British Museum.

MISCELLANEOUS.

Use of the Weights and Measures of the Metric System in Scientific Pursuits.

On the 18th of November last, a numerous deputation, composed of individuals of great eminence and belonging to various occupations and professions, waited on the Rt. Hon. Milner Gibson, M.P., President of the Board of Trade, for the purpose of representing the expediency of carrying into effect the recommendations of the Committee of the House of Commons which was appointed last session to consider the advantages of an international system of weights and measures. This Committee, after a long and careful investigation of the whole question, had unanimously resolved to recommend the adoption, for all purposes and throughout the British Empire, of the weights and measures of the metric system. Mr. Wm. Ewart, as Chairman of the Committee, introduced the deputation to the minister, who listened to all the speakers with the greatest attention and courtesy, and returned a very encouraging answer.

The claims of natural history were advocated by Professor Owen, who showed that the labours of British naturalists are to a great degree frustrated, so far as regards weights and measures, by the intricacy and inconvenience of the English method, and its limitation to the British Islands. If an English anatomist gives the weight of the brain or lungs, for example, of some newly discovered animal in the terms of the national method, it may not be known whether he uses troy weight or avoirdupois; or if he gives the length of a bone or any other part in "lines," it is uncertain whether a "line" is the tenth or the twelfth of an inch. On the other hand, the metre, the litre, and the gramme, with their decimal multiples and subdivisions, are not only accepted and understood by cultivated persons in almost all foreign countries, but they are extensively used by British chemists and other men of science. They are learnt with the greatest ease; when once learnt, they cannot be forgotten, and their advantages are found to be indisputable. Under present circumstances, careful describers find themselves obliged to employ two systems, a bad and a good one. Professor Owen has for some time used the metric system in this way, appending the dimensions in decimal parts of the metre to the denominations of the English method. "Although," as he stated, "when the system of weight or measure is noted by the observer, its reduction in a single instance may be a small demand upon the time and attention of the reader, yet the repetition of that act takes a serious amount from the working hours of the individual; and, when multiplied by the number of students, who are obstructed by conflicting systems of weights and measures, the impediment to the progress of the sciences of observation becomes so great as to render the subject quite worthy of the consideration of legislative authority."

The Unicorn of the Ancients.

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

GENTLEMEN,—Dr. A. E. Brehm has favoured me with the following communication on the subject of the "Unicorn." As the remarks are those of an African traveller, I think they are quite worth publishing in your Magazine. Enough now of the Unicorn; *requiescat in pace*!

Your obedient Servant,

W. HOUGHTON.

Preston Rectory, Wellington, Salop.
Dec. 8, 1862.

"SIR,—In reference to your interesting paper in No. 59 of the 'Annals of Natural History,' I take the liberty to inform you that also in the interior of Africa, where I have travelled, the "Unicorn" (*Anasa* of the natives) is nothing more than the Rhinoceros. It will be interesting to you to learn that, at the present day, in the interior of Africa—for example, at Carthum (Cartoum)—drinking-vessels and cups are still made from the horn of the Rhinoceros, as they attribute to it the very same properties which Ctesias did (page 367 of your communication). They also use the horn for the purpose of making sword-handles.

"I am, Sir, yours respectfully,

"A. E. BREHM."

"Leipzig, Dec. 2, 1862."

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 62. FEBRUARY 1863.

X.—*Observations on some of the Fossil Fishes of Dura Den.* By Robert Walker*.

[Plate II.]

The following observations upon the Fossil Fishes of Dura Den are mainly based upon the examination of the large and valuable collection contained in the museum, for which we are much indebted to Mr. and Mrs. Dalgleish, on whose property they are found. I have endeavoured to make a careful examination of their external structure, with a view to determine some points regarding their generic and specific characters, which seemed to me to require further elucidation.

Before entering on this subject, it may be necessary to say a few words about some of the previous writings on this department of palæontology. The scales of *Holoptychius* were first described by the late Dr. Fleming, in 'Cheek's Edinburgh Journal,' 1831, as the scales of some "vertebrated animal, probably those of a fish;" they had been found, a year or two before, in the yellow sandstones of Drumdryan, about a mile to the west of Dura Den, by Dr. Fleming. A few years afterwards, entire specimens of *Holoptychius*, *Phaneropleuron*, *Pterichthys*, and some other fishes were found in the sandstones of Dura Den, and some of these were for the first time brought into notice by Dr. Anderson in his Geological Essay in 'Fife Illustrated.' It was not, however, till some of these fishes were submitted to the scrutiny of Agassiz that anything like correct generic and specific characters were assigned to them. These, with figures, were first published in the 'Poissons Fossiles du Vieux Grès Rouge,' the *Holoptychii* under the specific names of *Andersoni* and *Flemingii*.

* Communicated by the Author, having been read to the Literary and Philosophical Society, St. Andrews.

To the description of *H. Andersoni* perhaps little can now be added (what little may be hereafter added is more likely to affect its generic than its specific character). An additional description of this species has been given by Prof. Huxley in Dr. Anderson's 'Monograph of Dura Den,' and more recently in the 'Tenth Decade of the Geological Survey,' lately published, which contains a restoration of *Holoptychius*, and some descriptive remarks on that genus comprised in Prof. Huxley's excellent 'Preliminary Essay' on the Classification of the Devonian Fishes. The name *H. Flemingii* was founded by Agassiz on a piece of a fish which was found in Dura Den, I believe, by Dr. Fleming. It appears to have belonged to a fish of some size—fully larger than most fishes from that quarter. The same species, according to Agassiz, was afterwards found in the "Old Red of Russia."

Notwithstanding the distinct figure and clear description of the scales of this species given by Agassiz, it appears to have been overlooked by some geologists, and altogether disregarded as a distinct species by others. On the other hand, some palæontologists, while recognizing the distinct character of the scales of *H. Flemingii*, have asserted that they belonged to some part of *H. Andersoni*: among the latter was Prof. M'Coy, who was perhaps led into what seems to me to be an error in consequence of the fragmentary condition of his specimens; in his case, however, it appears the more remarkable, inasmuch as he had correctly observed and described the scales of *H. Flemingii* in his 'Palæozoic Fossils.' It would seem, however, that he had still doubts about the matter, as appears from the following sentence in the same work, in his description of *H. Sedgwickii*: "This species, like *H. Flemingii*, is remarkable for being found on its side, indicating apparently a compressed instead of a depressed form; it also resembles that species in the sculpturing of the scales." Nevertheless it appears to me that *H. Flemingii*, Agass., is not only a distinct species, but belongs also to another genus, viz. *Glyptolepis*. In general form *H. Flemingii* appears to have pretty closely resembled *H. Andersoni*; but in most specimens, if not in all, it was considerably deeper in proportion to the length. The pectoral and ventral fins appear to be strongly lobated; the latter, at any rate, in some specimens, were placed fully half their own length in front of the anterior dorsal, which was small, and placed far back. The caudal fin is not very distinctly exhibited in any specimen, but, so far as shown, it appears to be unequally lobed. The scales, as already described by Agassiz, are, when entire, a good deal higher than long, especially along the sides; on the dorsal and ventral areas they assume a rounder form. The ornamental lines on the exposed parts of the scales, on the sides, extend pretty horizontally to the free edges, and seldom anastomose; but along the belly and towards the back, above the lateral line, where the sculpturing becomes bolder and sharply defined, anastomoses more frequently take place between the lines or ridges.

So far as yet stated, there is nothing to indicate more than specific differences; but when these scales are closely examined, a number of small and very distinct points or tubercles are seen, which form a semilunar or crescentic area on the posterior part of the first half of each scale, and immediately in front of the exposed sculpture. These tubercles appear as radiating in straight lines from a centre, which is not itself apparent, and are best seen on the scales that cover the sides of the fish. I have found them, however, more or less distinctly indicated, on well-preserved specimens, on nearly all parts of the body, from the ventral to almost the extreme dorsal edge. When the scales are entire, these crescentic areas are almost hidden by the overlapping of the anterior scales, and, excepting a very small part, they may be said to be altogether concealed. When the scales are not well preserved, of course these tubercles are obliterated altogether; but when well-preserved specimens are met with, and the overlapping scales are absent or removed, then these tubercles are very distinct and easily recognized (fig. 2); and

Fig. 1.

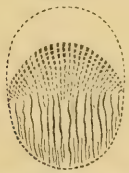


Fig. 2.

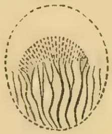
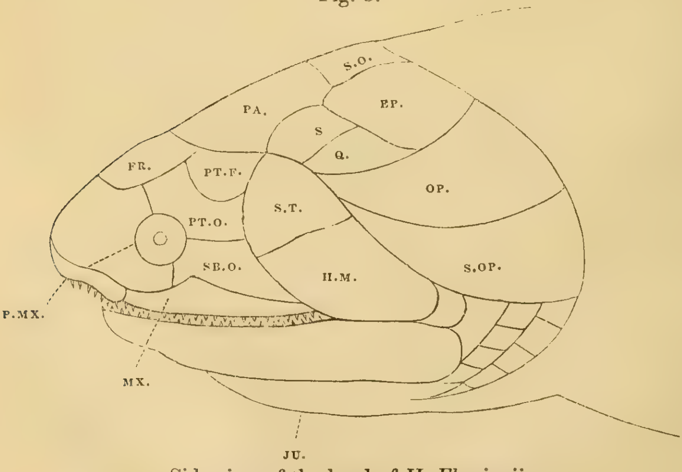


Fig. 1. Scale of *Glyptolepis*, from the side; natural size.
Fig. 2. Scale of *Holoptychius Flemingii*, from the ventral surface, about two inches behind the jugular plates; natural size.

when compared with specimens of undoubted *Glyptolepis* (for which I am indebted to the kindness of Mr. Powrie), and then with the figures and description of the scales of that genus in Prof. Huxley's essay, 'Decade X.,' the resemblance is at once apparent and unmistakeable. In some cases the resemblance is even closer to the figure from Pander, given in the above decade, than to that of the figures by Huxley, which were drawn (as he says) from a scale of *Glyptolepis* from Wick. To Prof. Pander is due the credit of having first discovered the true sculpture of the scales of *Glyptolepis*, which he wrought out of a Lethan-Bur nodule; while Prof. Huxley has still further elucidated and confirmed the matter, which he says he did by "scraping away the inner layers of the scales of undoubted examples of this genus in the Museum of Practical Geology," &c. He further states, "The clear recognition of the fact that this elegant structure really characterizes *Glyptolepis* is of great importance, for it enables one to discriminate between *Holoptychius* (whose scales have no semilunar area of backwardly-directed points) and *Glyptolepis*." As we have just seen, the scales of *H. Flemingii*, Agass., have the identical structure of the scales of undoubted specimens of *Glyptolepis*, so far, at least, as the crescent of points is concerned, which seems to be the only tangible difference between them generically (*Holoptychius* and *Glyptolepis*). Such being the case, we are warranted in pronouncing *H. Flemingii* to be a true *Glyptolepis*.

The head of *H.* (*G.*) *Flemingii* is in length to that of the body as 1 to 4 or 5, and is of a depressed roundish form, gradually tapering towards the snout, which is blunt and round. The head is covered with granulated plates of no great thickness; on the sides of the head they join each other by squamous sutures, extending inward and upward. In this way these bones slightly overlap at the margins, without projecting externally. When their granulated surfaces happen to be uninjured, it is not always easy to determine where one bone ends and another begins. The occipital region is covered over by a median and two lateral bones; the median, or supra-occipital (s.o.), is truncated in front and rounded behind, where it partly overlaps the

Fig. 3.

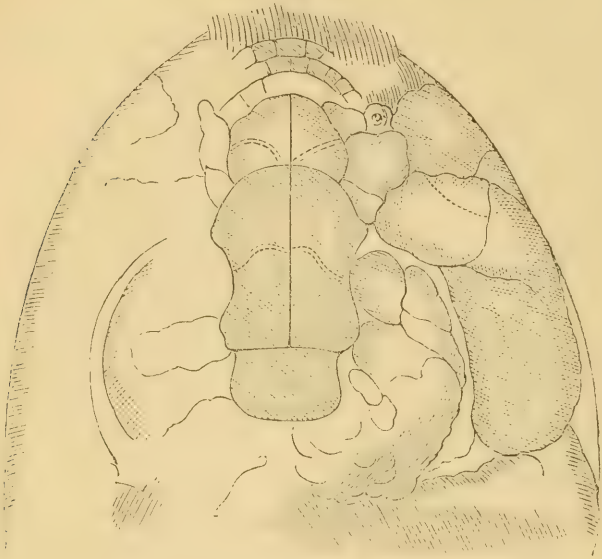


Side view of the head of *H. Flemingii*.

scales of the nape. The lateral or epiotic (EP.) extend backwards and downwards till they meet the operculum, their upper anterior edges projecting forward a little beyond the commencement of the parietals. The parietals (PA.) are rather large bones, and, like the frontals, join each other on the middle of the cranium by a suture of square edges; their posterior ends are truncated where they meet the supra-occipital, the anterior somewhat regularly rounded, the round terminating on the antero-lateral edges in points, which are rendered more apparent by their lateral margins being concave. Into these concave margins the upper edge of one of two bones, which may represent the squamosal (SQ.), is attached; they meet the epiotic posteriorly, and fill in the spaces between the parietals and operculum. The operculum (OP.) and sub-operculum (S.OP.) are distinct bones, co-adapted, and look somewhat like a single rudely crescent-shaped plate, with the concave edge turned upward, rounded behind, and slightly so in front. The opercular and squamosal bones are succeeded in front by two bones, the upper of which may represent the supra-temporal (S.T.), and meets the lower margin of the parietal; the lower bone, which may be the hyomandibular (H.M.?), fills in the space between the supra-temporal and the maxilla. Both these bones have their exposed surfaces ornamented by radiating striæ; on the upper bone the striæ proceed from a raised horizontal centre, on the lower bone from a raised nearly vertical centre. The frontals (FR.) are about half the length of the parietals, and not much more than half their breadth; the posterior margins, by which they meet the parietals, are concave, the anterior somewhat convex. There is a small bone on each side of the head, probably the post-frontal (PT.F.), which fits in between the frontals and the supra-temporals. The next bone in front is perhaps the post-orbital (PT.O.), which forms the posterior boundary of the orbit; its margins unite with the frontal, post-frontal, and supra-temporal; the lower edges unite behind the middle of the orbit with the sub-orbital bone (SB.O.), which thus forms the lower boundary of the orbit behind and fills in the space between the post-orbital and the maxilla. The bones in front of the orbits are not distinctly defineable on any specimen that I have seen; but it appears as if the lower edge of the pre-frontal passed back between the orbit and the maxilla till it met the sub-orbital. Neither are the bones before the frontals clearly legible; the space seems to be occupied by a number of small four- and five-sided plates, which may represent the ethmoid, &c. The maxillæ (MX.) do not appear to have been very strong; externally they were ornamented like the bones of the head, and had a row of small (as far as I have seen) equal-sized teeth on their lower edges. There appears to me to be a pretty distinct pre-maxilla (P.MX.), which joins the maxilla under the anterior margin of the orbit, and there is a row of small slightly hooked teeth extending round its lower border.

The lower jaws appear to be strong, and are somewhat powerful-looking bones: there are two distinct rows of plates on each side between the rami and the two central jugular plates; the

Fig. 4.



Crushed head of *H. Flemingii.*

outermost row is the largest; their exterior margins seem to have been overlapped a little by the inferior edge of the rami, while they in turn overlapped the margins of the next; these plates are longer than broad, and meet each other by oblique sutures passing inwards. The inner row of plates is about half the breadth of the outer, and they join together by more transverse sutures. These plates or bones are continued back, and turned up, on the sides of the head, behind the articulation of the inferior maxilla, till they terminate below the inferior margin of the sub-operculum.

So far as I can perceive, the cranium above described does not appear to differ in any respect from that of *H. Andersoni*: the head of the latter species is not, in general, so well preserved; but so far as the bones are exposed, they seem to me to be the same in number, arrangement, and shape. Neither does it differ materially from the bones of the head of *Glyptopomus*, as figured by Prof. Huxley; in fact, the resemblance in this case is very close, which is not altogether what we might expect: we should rather have expected to find the head of that genus agreeing in this respect with *Glyptolæmus* and *Osteolepis.*

There are some other specimens of *Glyptolepis* from Dura Den in the museum, which now appear to me deserving of a more particular notice than I at first thought. These fishes have appeared to me for a considerable time to be only a variety of *H. Flemingii*; but a more careful examination of some of these specimens has now convinced me that they are specifically distinct: at least, the differences between these two forms are as great as that which exists between many of our present species. Upon comparing specimens of both forms, about the same size, I find the following differences:—The fishes in question have the head rather shorter in proportion to the whole length; the first dorsal and the ventral fins are placed an inch (in some cases more) nearer the head; the dorsal and anal fins are larger than the same fins in any specimen of *H. Flemingii* that I have ever seen; and the scales, which will be more particularly noticed hereafter, have their external sculpture much finer.

The specimen figured in Plate II. measures $10\frac{1}{2}$ inches in length; to this we may perhaps add another inch to complete the caudal extremity. The head is to the whole length as 1 to 5 or $5\frac{1}{2}$. The greatest depth of the body is halfway between the termination of the head and the commencement of the first dorsal fin, where it attains to 3 inches, from which it gradually tapers to the beginning of the caudal fin, where it is $1\frac{1}{2}$ inch deep. The pectoral fins are not preserved on any specimen. The first dorsal fin commences six inches behind the snout; its longest rays are $1\frac{1}{2}$ inch in length; the second dorsal fin is inserted about an inch behind the termination of the first: this appears to have been a large fin, with a round free margin; the longest rays measure $1\frac{3}{4}$ inch in length. The ventral fins are placed a little further forward than the first dorsal; but they are not in a sufficient state of preservation, on this or any other specimen, to show their exact form. The anal fin is situated under the second dorsal, and terminates in a somewhat pointed extremity; its longest rays are $1\frac{1}{2}$ inch in length. The tail appears to be heterocercal: the lower lobe is well developed, but rather abruptly truncated at its posterior margin; its first rays originate about $\frac{1}{4}$ inch behind the anal fin, where they are $1\frac{3}{4}$ inch in length; from this point they become gradually shorter as they near the distal end: the upper lobe consists of a number of short rays, which form a kind of marginal fringe on the upper side of the notochord. The scales are rounded, and appear to be rather thin; but they have the crescentic area of tubercles on their anterior half very clearly exhibited (fig. 2). The exposed surfaces of the scales have fine thread-like sculptured lines extending from the tubercles to the free margin; these lines seldom anastomose.

Whether the preceding is a new species of *Glyptolepis*, or not, would at present be rather premature to say. However this may be, it has never been noticed before as occurring among the Dura-Den fishes.

There is another specimen in the museum which shows the *Glyptolepis* crescentic structure of scale on some parts; it appears to have been a fish of some size, perhaps 2 feet or more in length, and is altogether different from *H. Flemingii* or the fish last noticed. The specimen is laid nearly on the back; the head and a considerable portion of the anterior of the body are wanting. The scales on the ventral surface and one of the sides for about two or three inches above the lateral line are well exposed, although not in a very good state of preservation. The scales are about an inch, some of them rather more, in diameter, and their external sculpture is more like the scales of *H. giganteus*, Agass., than any other scales that I know: those on the belly do not show the crescentic area of points; whether the points have never been there, or have been destroyed in lifting the specimen, is not easy to determine; but, on the flank and above the lateral line, some of the scales exhibit the area of points in front of the exposed sculpture very distinctly. From what I recollect of the large fish found in Dura Den, last year, by Dr. Anderson, I think it not unlikely that it and the large specimen above noticed will yet be found to belong to the same species.

If I am not greatly mistaken, Dr. Anderson's specimen of last year has the same form of tail as the *Glyptolepis* figured by Miller in pl. 5 of the 'Old Red Sandstone.' The finding of the crescent of points on the large specimen has made me look still more closely to the scales of *H. Andersoni*; besides, it has often appeared to me very probable that to whatever genus *H. Flemingii* might be assigned, *H. Andersoni*, from its close resemblance, must also be assigned: in accordance with this view, I have carefully looked over every specimen and fragment in the museum (and, thanks to the labours of Dr. Heddle, they are not few); but as yet I have entirely failed in finding the characteristic crescent of points on the scales of any undoubted specimen of *H. Andersoni*. But the further consideration of this and some other matters connected with these Dura-Den fossil fishes must be left for another paper, wherein I will also direct attention to some specimens of fishes either new to Dura Den or at least not well known.

XI.—*On Indian Species of Land-Shells belonging to the Genera* Helix, *Linn., and* Nanina, *Gray.* By W. T. Blanford, A.R.S.M., F.G.S.

In the course of the last few years, much has been published concerning the distribution of Indian and Burmese land-shells, and a large number of novel forms have been described, chiefly by Mr. W. H. Benson. The greater portion of this information, however, has necessarily been derived from an examination of the shells alone, and has left untouched the important question of the forms of the soft parts in the species described. In the case of forms referred to the genus *Helix* especially, the determination of the presence or absence of a mucous pore at or near the posterior termination of the foot is essential for the natural classification of the different species. I have had opportunities, during the last few years, of collecting several Indian and Burmese snails in various parts of the country; and, although my notes on the forms of the animals occupying them are very imperfect, they may suffice to correct some of the errors which prevail, in conchological works, in attributing various species to the different subgenera of *Helix* and *Nanina**.

I hope to communicate longer notices of the species enumerated below at some future time; for the present I have not the data at hand, and I therefore confine myself to a list of the species actually observed, with the localities from which I have obtained them; and I have added in italics the names of other species so closely allied to those observed that no doubt can exist as to their subgeneric affinity. With one or two exceptions, which are noted, the observations were made by myself on the living animals. The subgenera in which I have classed the species noted are those of Albers and Pfeiffer, somewhat modified, with a few necessary additions.

The genus *Nanina* is naturally divided into two groups of subgenera by the structure of the mucous pore itself; and this subdivision is fully borne out by the characters of the shells belonging to the two groups, although, as is the case more or less throughout the *Helicidæ*, there are some indications of a passage from one group to the other. In the first of these sections the foot is narrow, and more or less abruptly truncated posteriorly; the mucous pore is situated *at* the vertical or subvertical posterior termination, and has above it a projecting

* Thus, by Albers, *H. Huttoni*, Pfr., *H. capitium*, Bens., and *H. Guerini*, Pfr., are incorrectly classed under *Nanina*; while *Nanina Tranquebarica*, Fabr., and *N. ampulla*, Bens., are arranged under *Helix*. Adams and, I think, Pfeiffer, fall into similar errors, which, indeed, can only be guarded against by an examination of the animals.

horn-shaped lobe, of very variable length, and possessing a certain amount of contractility. Of this group, which is probably allied to *Stenopus** (if, indeed, that name ought not to be adopted for it), some of the principal Indian types are *N. vitrinoides*, Desh., *N. infula*, Bens., *N. pylaica*, Bens., and *N. ampulla*, Bens. In the other group the foot is broader, flatter, and rounded posteriorly, as in most of the true *Helices*. The mucous pore, generally of larger comparative size than in the first specified section, is situated in a groove in the centre of the upper surface of the foot, close to the posterior extremity, with no lobe whatever above or in front of it. Amongst the principal types are *N. lævipes*, Müll., *N. bistrialis*, Beck, *N. Tranquebarica*, Fabr., *N. indica*, Pfr., and *N. Thyræus*, Bens.

Before any complete list of Indian Naninas can be made, several additional observations are necessary. Amongst the species of which notices are especially desirable are the following:—

Nanina? Basileus, *Bens.* Anamullay Hills, S. India.
N.? Cycloplax, *Bens.* Darjiling, in the Sikkim Himalaya.
N.? Oxytes, *Bens.* Cherra, in the Khasi Hills.
N.? Orobia, *Bens.* Darjiling.
N.? serrula†, *Bens.* Khasi Hills.
N.? climacterica, *Bens.* Khasi Hills and Arakan.
N.? anceps, *Gould.* Tenasserim.
N.? infrendens, *Gould.* Molmain.
N.? Bombax, *Bens.* Molmain.
H.? radicicola, *Bens.* Landour and Darjiling.
H.? bifoveata, *Bens.* Tenasserim.
H.? monticola, *Hutt.* Western Himalaya.
The three species of *Sophina*‡ described by Mr. Benson, from Molmain, besides several of the species from Ceylon.

In the following list, all species of which I have neither seen the animals myself, nor authentic drawings of them, are marked by italics, as are also all localities not verified by myself, by my brother, Mr. H. F. Blanford, or by Mr. W. Theobald,

* The name *Nanina* has been so generally employed by conchologists for the great genus of shell-bearing Helicidæ characterized by the presence of a mucous pore, that, although objectionable both on account of its signification and of other terms having unquestionable priority, no good purpose could now be served by attempting to change it.

† *H. Bensoni*, v. d. Busch, is the same shell as *N.? serrula*, Bens., if the specimen of the first-named in Mr. Cuming's cabinet is authentic, which I believe it is.

‡ I am inclined to anticipate that these may very possibly prove to be Naninas.

Jun., to whom I am indebted for several of the shells mentioned*.

Genus NANINA, Gray.

Section A. *Mucous pore at the truncated posterior extremity of the foot, and with a lobe above.* (? Stenopus, *Guilding.*)

Subgenus MACROCHLAMYS, Bens.

Syn. *Orobia*, Albers; *Xesta*, Pfr.

N. vitrinoides, *Desh.* Bengal.
N. semifusca, *Desh.* S. Arcot; Trichinopoly; var. from the Kolamullay Hills.
N. Perrottetii, *Pfr.* Nilgiri Hills, S. India.
N. Todarum, *W. & H. Blanf.* Nilgiri Hills, S. India.
N. pansa, *Bens.* Thayet Myo, Pegu; Ava.
N. molecula, *Bens.* Rangoon; Ava.
N. textrina, *Bens.* Arakan and Pegu.
N. ligulata, *Fér.* Bengal; Madras.
N. subjecta, Bens. *Rajmahal Hills*, Bengal; Orissa.
N. lecythis, Bens. *Rajmahal Hills*, Bengal; Orissa.
N. lubrica, Bens. Darjiling.
N. decussata, Bens. Khasi Hills (Theobald); E. Bengal.
N. sequax, Bens. Darjiling.
N. rorida, Bens. Darjiling.
N. Hodgsoni, Bens. Darjiling.
N. Patane, Bens. Darjiling.
N. Petasus, Bens. Tenasserim (Theobald).
N. splendens, Hutt. *Western Himalaya*; Parasnath Hill, in Bengal?
N. acerra, Bens. Molmain (Theobald).
N. pauxillula, Bens. Thayet Myo, Pegu.

I am unacquainted with *N. resplendens*, Philippi, from Mergui, in the Tenasserim provinces. Specimens which I have seen so marked from Bengal were *N. vitrinoides*, Desh.

The animal of *N. ligulata* differs in colour and somewhat in shape from the other species above enumerated. I am indebted to my brother, Mr. H. F. Blanford, for a drawing of it. It shows a passage into the other section of *Nanina*.

Subgenus KALIELLA, n. subg.

Syn. *Trochomorpha*, Albers, part.

N. fastigiata, *Hutt.* *Western Himalayas*; Nilgiri Hills.
N. Barrakporensis, Pfr. Base of Sikkim Himalayas; Kalryenmullay Hills, near Salem, in S. India (Foote).
N. aspirans, *W. & H. Blanf.* Nilgiri Hills.

* Absence from any collections and from almost all books of reference, at the time of writing, will render these lists less full than I could have wished them to be. I trust to be able to supply omissions hereafter.

Subgenus Trochomorpha, Albers (restricted).

N. attegia, *Bens.* Irawaddy Valley, near Prome; Ava.
N. infula, *Bens.* Lower Bengal; Orissa.
N. cacuminifera, *Bens.* Nilgiri Hills.
N. arx, Bens. Therabuin Hill, Tenasserim (Theobald).

Subgenus Durgella, n. subg.

N. levicula, *Bens.* Tenasserim (Theobald); Prome, in Pegu.
N. mucosa, *W. & H. Blanf.* Nilgiri Hills.
N. seposita, Bens. Darjiling.

Subgenus Helicarion?, Fér.

N. ampulla*, *Bens.* Western slope of Nilgiris (Elliott); Malabar (Jerdon).

Subgenus Sesara†, Albers.

Syn. *Tridopsis,* Pfr., part.

N. pylaica, *Bens.* Molmain.
N. impendens, Gould. Molmain.
N. capessens, Bens. Molmain (Theobald).

Helix Tickelli, Theobald, is a variety of either of the two last-named shells, with two of the teeth in the peristome blended together.

Section B. *Mucous pore above the flattened posterior extremity of the foot, and without a lobe above it.* (Ariophanta, *Desmoulins.*)

Subgenus Hemiplecta ‡?, Albers.

N. Tranquebarica, *Fabr.* E. coast of Southern India.
N. Bombayana?, *Grat.* E. base of Nilgiri Hills.
N. Belangeri, Desh. *Bombay?*
N. Maderaspatana, *Gray.* Nilgiri and other hill-groups of Southern India.
N. solata, *Bens.* Nilgiri Hills.
N. bistrialis, Beck. Madras and Trichinopoly.

N. semirugata, Beck, I have little doubt, is only a variety of *Tranquebarica.* *N. vitellina,* Pfr., is almost equally questionable.

* I am indebted to Mr. Walter Elliott for a drawing of the animal of *Nanina ampulla,* Bens., which I have not myself met with. It would seem to be distinguished from *Helicarion* by the absence of the long mantle-lobes reversed over the shell; but I hesitate to separate it without further information. *Vitrina irradians,* Pfr., observed by my brother, I believe to be a true *Helicarion,* as are probably several of the other Indian Vitrinas, *e. g. V. gigas,* Bens.

† Classed by Albers as a subgenus of *Helix.*

‡ The type of Albers's subgenus *Hemiplecta* is *H. Humphreysiana,* Lea, which is a very different shell from any of those here attributed to the section. Perhaps also *N. Tranquebarica* and its allies should be separated from the remainder.

Subgenus ROTULA, Pfr. (? Albers).

N. indica, *Pfr.* Nilgiri Hills.
N. Shiplayi, *Pfr.* Nilgiri Hills.

Subgenus ARIOPHANTA, Desmoulins.

N. interrupta, *Bens.* Bengal.
N. Laidlayana, Bens. Orissa.
N. Nicobarica, Chemn. Cuddapah (King).
N. lævipes, *Müll.* Bombay.
N. retrorsa, Gould. Molmain (Theobald).
N. Bajadera, Pfr. *Nagpur,* small typical var.; Bombay, large var. (Theobald).

From an inspection of the type-specimens of both shells, I have ascertained that *N. ammonia,* Val., is founded on the type-variety of *N. Bajadera,* Pfr. I have but little doubt that *N. Himalayana,* Lea, is *N. interrupta,* Bens., the Himalayan locality being probably an error. *N. retrorsa,* Gould, appears, on the other hand, to be a good species.

Subgenus OXYTES, Pfr.

N. Thyræus, *Bens.* Nilgiri Hills.
N. Cysis, *Bens.* Nilgiri Hills.
N. Cycloplax, Bens. Darjiling.
N. Oxytes, Bens. Khasi Hills (Theobald).

Genus HELIX, Linn.

Subgenus TACHIA, Albers.

H. fallaciosa, *Fér.* East coast of Southern India; Ceylon.
H. Nilagarica, *Pfr.* Nilgiri Hills.
H. asperella, Pfr. *Central India.*
H. Helferi, Bens. Andaman Islands (Haughton).
H. vittata, *Fér.* East coast of Southern India; Ceylon.
H. proxima, Fér. Caroor, in Coimbatoor district (King).
H. delibrata, Bens. Base of Himalayas, in Sikkim; Khasi Hills (Theobald); Arakan; Pegu.
H. gabata, Gould. Molmain (Theobald).
H. Merguiensis, Pfr. Molmain.

The last three should perhaps be separated as a distinct subgenus. *H. ruginosa,* Fér., appears to be merely a variety of *H. fallaciosa,* into which it passes by insensible gradations. *H. crassicostata,* Bens., is more distinct; but if it prove to be, as Pfeiffer considers it, a variety of *H. ruginosa,* it must also fall under *fallaciosa.* The animal of *H. vittata* shows no essential distinction from that of *fallaciosa*; and I can see no cause for its separation as a distinct subgenus, as suggested by Albers.

Subgenus Dorcasia?, Gray.

H. similaris, *Fér.* Thayet Myo, in Pegu; *Dacca.*
H. bolus, *Bens.* Thayet Myo.
H. Peguensis, Bens. *Pegu.*
H. Huttoni, *Pfr.* *Western Himalaya*; Sikkim; Nilgiri Hills; Puppa Hill, Ava.
H. tapeina, *Bens.* Khasi Hills (Theobald); Pegu.
?H. rotatoria, *v. d. Busch.* Pegu.
H. Akoutongensis, *Theobald.* Akoutoung, on the Irawaddy, Pegu; Thayet Myo.
H. Oldhami, *Bens.* Arakan Hills; Ava.

I doubt much the distinctness of *H. sculpturita,* Bens., from *H. similaris,* Fér., of which the first-named appears to be a large solid variety.

Subgenus Sivella, n. subg.

H. castra, *Bens.* Darjiling; Balasore in Orissa; Ceylon; Arakan Hills.
H. lychnia, Bens. *Singapore*; Nilgiri Hills (H. F. Blanford).

Subgenus Thysonota*, Albers.

H. Guerini, *Pfr.* Nilgiri Hills.
H. crinigera, Bens. Nilgiri Hills.

Subgenus Ganesella, n. subg.

H. capitium, Bens. *Rajmahal Hills, Bengal*; Orissa (Theobald); Ava.
H. variola, *Bens.* Thayet Myo; Pegu.

The distinctness of these two species appears very dubious.

Subgenus Plectopylis, Bens.

H. achatina, Gray. Molmain.
H. anguina, Gould. *Mergui.*
H. leiophis, *Bens.* Akoutoung, near Prome, Pegu; Thayet Myo.
H. refuga, Gould. Tenasserim Valley (dextral var., Theobald); *Tavoy* (sinistral var.).
H. plectostoma, *Bens.* Darjiling; Khasi Hills (Theobald); Arakan Hills; Bassein, Pegu.
H. pinacis, Bens. Darjiling.
H. retifera, Pfr. Nilgiri Hills.

Type-specimens of *Helix anguina,* Gould, in Mr. Cuming's collection, show that the species is quite distinct from *H. achatina,* Gray, with which, however, *H. repercussa,* Gould, is identical.

* Classed by Albers under *Nanina.*

XII.—*Characters of new Land-Shells of the Genera* Helix, Clausilia, *and* Spiraxis, *from the Andamans, Moulmein, Northern India, and Ceylon.* By W. H. Benson, Esq.

1. *Helix Haughtoni,* B., n. sp.

H. testa perforata, subumbilicata, solidula, subtrochiformi, irregulariter oblique obsolete plicatula, confertissime et minutissime spiraliter striata, epidermide rubenti-olivacea; spira depresse conoidea, apice valde obtuso, sutura impressa; anfractibus $4\frac{1}{2}$–5, convexis, ultimo antice breviter vix descendente, ad peripheriam angulato, subtus convexo, circa umbilicum intus callo arctatum compressiusculo; apertura obliqua, subrotundato-lunata, subquadrangulari, intus albida, peristomate recto, marginibus callo tenuissimo junctis, dextro intus subincrassato, columellari superne breviter reflexiusculo, subtus incrassato, intus dente calloso interdum munito.

Diam. major 31, minor 27, axis 19 mill.
Habitat in insulis Andamanicis.
Detexit Major J. C. Haughton.

This is the largest *Helix,* and the most peculiar in form and in the formation of the aperture, yet received from these islands, the columellar callus in one specimen recalling the appearance observable in some Mauritian *Helices.* In a second specimen, this protuberance is more slightly developed. I am indebted for it to Major Haughton, late Superintendent of the Andaman Colony, now Chief Commissioner in Assam, whose search for the land-shells of the locality has added largely to our knowledge of the island forms.

2. *Helix Gordoniæ,* B., n. sp.

H. testa perforata, orbiculata, depressa, tenui, superne oblique plicatula et minutissime striata, infra læviore, subpolita, confertissime radiatim striatula, striis nonnullis distantibus decussata, albida, epidermide pallide cornea induta; spira planulata, apice vix elevato, obtuso, suturis impressis, late marginatis; anfractibus 7, lente accrescentibus, vix convexiusculis, ultimo ad peripheriam superne compresse carinato, antice non descendente; apertura subobliqua, lata, angulato-lunata, peristomate vix reflexiusculo, intus breviter incrassato, albo, margine superiore brevi, basali late regulariter arcuato, prope umbilicum undulato.

Diam. major 33, minor 30, axis 11 mill.
Habitat in regione Birmanica prope Moulmein.

Two specimens of this beautiful and delicate species, one of which was imperfect, were kindly sent to me from Moulmein by Mrs. Gordon, wife of Major-General Gordon, of the Madras Army, with other shells previously found in that neighbourhood.

3. *Helix Cyclotrema*, B., n. sp.

H. testa sinistrorsa, obtecte umbilicata, conoideo-subglobosa, oblique striatula, granulata, sub epidermide cornea, albida; spira conoidea, apice obtuso, subfoveato, suturis impressis; anfractibus $4\frac{1}{2}$, convexis, gradatim crescentibus, ultimo ad peripheriam obtuse angulato, unifasciato, antice lato, longe descendente, subtus convexo; apertura valde obliqua, rotundata, peristomate dilatato, reflexiusculo, marginibus conniventibus, approximatis, callo brevi junctis, columellari late auriculato umbilicum celante.

Diam. major 22, minor 18, axis 11 mill.

Habitat in montibus "Soomeysur" dictis, prope regionem Nipalensem. Detexit W. Theobald jun.

This interesting shell is the first of the sinistrorse group allied to *H. trifasciata*, Chemn., which has been hitherto proved to inhabit the Himalayan region. A sinistrorse shell, alleged to have been collected by Dr. Burroughs in the Himalaya, was named *H. Himalana* by Dr. Lea, in a paper read before the Phil. Soc. of Philadelphia, in Feb. 1832 (date of the dedication of the printed volume, July 1834). In August 1834, the Southern Chinese *H. cicatricosa* (*H. Senegalensis*) was considered to be the shell indicated by Dr. Lea, in the opinion of the late Mr. G. B. Sowerby, and was described by me, in the Zoological Journal of that year, under Lea's name, together with *H. interrupta*, m., which occurs abundantly in the Rajmahal range, south of the Ganges, and in the Botanic Gardens near Calcutta. There is now little reason to doubt that *H. interrupta* is the same as Lea's original shell; and, even assuming that the latter had the advantage of priority of publication, the locality wrongly assigned by the name to the species should cause the abandonment of the designation on the same ground as that of the Chinese species originally attributed by mistake to Senegal.

A single dead and imperfect specimen of *H. interrupta* was sent to me from the station of Darjiling, where it was picked up by Mr. Theobald near a European dwelling-house. It was probably thrown away by the late Dr. Pearson, who resided at that station for some months, and who had also collected the shell, which I discovered in 1831, in the outliers of the Rajmahal range. It is highly improbable that the numerous conchological collectors who have lately explored Darjiling and other parts of the Himalayan Mountains should have missed a shell so conspicuous and abundant where found; and when a 'Times' editorial notice could, in 1860, announce a spur of the Himalaya as being visible from Calcutta, it is not a subject for wonder that an American traveller should have mistaken a group of hills south of the Ganges for an offset of the magnificent mountains which form the northern boundary of Hindostan.

4. *Helix hyptiocyclos*, B., n. sp.

H. testa latissime umbilicata, orbiculato-planata, planorbiformi, depressa, fragili, oblique striatula, translucente, polita, olivaceo-cornea; spira concaviuscula, apice foveolato, suturis profundis; anfractibus $4\frac{1}{2}$, gradatim increscentibus, utrinque convexis, ultimo convexiusculo, peripheria subcarinata; apertura valde obliqua, elliptico-lunata; peristomate tenui, acuto, marginibus conniventibus, callo tenui junctis.

Diam. major 6, minor 5, alt. $1\frac{1}{2}$ mill.

Habitat sub stercore bovillo ad latera collium prope Fort M'Donald, teste F. Layard.

This little shell resembles a *Planorbis* more closely than any known species of *Helix*. The specimens were taken in a living state, and it is a matter for regret that the tentacula and eyes were not examined and recorded at the time of capture. Mr. Layard, however, states that, when placed under a glass, the animals crept briskly on the interior surface, a fact which invalidates the idea of the shell being possibly a *Planorbis*. It occurred on a flat space on the side of the hills where a clearing had been made for cultivation, and where no water lay. The habits of the little Rohilkund *Planorbis rotula*, m., the temporary inhabitant of a precarious pool, may be compared with those of *Helix hyptiocyclos*, by referring to the 'Annals of Natural History' for May 1850.

The Himalayan *Helix Huttoni*, Pfr., which was detected by the Messrs. Blanford on the northern face of the Nilgiri range, in Southern India, reappears in the central mountain-group of Ceylon, where Mr. F. Layard took it near Fort M'Donald.

5. *Clausilia Ceylanica*, B., n. sp.

C. testa vix rimata, fusiformi, oblique confertissime costulata, costulis nonnullis undulatis, fuscescenti-olivacea; spira gradatim attenuata, lateribus convexiusculis, apice obtusiusculo, sutura impressa; anfractibus 8, convexiusculis, ultimo ad basin rotundato; apertura subobliqua, pyriformi, lamellis contiguis, inferiore valde exserta, torta, plicis palatalibus 2, subæqualibus, elongatis, columellari immersa; peristomate continuo, superne soluto, undique subexpanso, reflexiusculo.

Long. 12, diam. $2\frac{1}{2}$ mill.; apert. long. 3, lat. 2 mill.

Habitat prope Fort M'Donald.

Found by Mr. F. Layard at an altitude of 4500 feet on the central mountain mass of the Island of Ceylon. Its nearest Indian ally in form is the Darjiling *C. Ios*, from which it may at once be distinguished by its sculpture, teeth, and internal plicæ. This is the first species of the genus which has been found in Ceylon. No representative has yet occurred in Southern or Central India.

6. *Spiraxis Haughtoni*, B., n. sp.

S. testa imperforata, oblongo-conica, subturrita, solida, striata, versus suturam et apicem costulato-striata, albida, epidermide olivacea minutissime corrugata induta; spira elongato-conica, versus apicem obtusiusculum subito attenuata, sutura impressa; anfractibus 7, vix convexiusculis, subplanulatis, ultimo ad peripheriam subangulato; apertura vix obliqua, ovato-elliptica, intus cæruleo-albida, margine dextro tenui, acuto, columellari calloso, planato, expansiusculo, versus basin leviter emarginato, marginibus callo tenui expanso junctis.

Long. 20–30, diam. 10–11 mill.; apert. long. 11, lat. 5 mill.

Var. *oxynter* testa elongato-turrita, graciliore.

Long. 30, diam. 8 mill.

Habitat ad Portum Blair insularum Andamanicarum.

This species was, I believe, first discovered by Dr. Walker, Superintendent of the Settlement; but the most perfect specimens, with the epidermis in fine condition, were received from his successor, Major Haughton.

There is a tendency in the stouter form to verge towards the variety which I have called *oxynter*, although the extreme specimens might be considered as separate species. A single specimen of this variety was sent by Major Haughton.

7. *Spiraxis Walkeri*, B., n. sp.

S. testa imperforata, cylindraceo-turrita, arcuato-striatissima, sub epidermide albida; spira gracili, apice obtuso, sutura profundiuscula; anfractibus 9, convexiusculis; apertura obliqua, elliptica; margine dextro tenui, acuto, superne arcuato, columellari calloso, subito revoluto.

Long. 14, diam. $3\frac{1}{2}$ mill.

Habitat ad Portum Blair.

None of the specimens sent by Major Haughton possess a perfect epidermis, and all are more or less injured at the aperture.

8. *Spiraxis Layardi*, B., n. sp.

S. testa imperforata, elongato-turrita, tenui, arcuato-striatula, albida, epidermide tenui polita cornea induta; spira elongata, apice obtuso, sutura profundiuscula, nonnunquam eroso-denticulata; anfractibus $7\frac{1}{2}$, convexis, ultimo pone columellam impresso; apertura obliqua, elongato-ovata, superne angustata; peristomate tenui, acuto; labro arcuato, margine columellari incrassato, modice torto.

Long. $12\frac{1}{2}$, diam. 4 mill.; apert. long. 4, diam. vix 2 mill.

Habitat ad Moopana, Bootelle, &c., insulæ Ceylon.

This shell, the first of the genus noted from Ceylon, was collected by Mr. Frederick Layard. Specimens with the polished epidermis were very scarce.

Cheltenham, Jan. 5, 1863.

Addendum.

9. *Spiraxis Cingalensis*, B., n. sp.

S. testa subrimata, subulato-turrita, gracili, solida, polita, striatula, striis minutis confertissimis undulatis spiralibus decussata; spira elongata, superne sensim attenuata, apice —— ? sutura vix impressa, irregulari; anfractibus superstitibus 11 (apicalibus deficientibus), planulatis, ultimo ad basin rotundato; apertura subobliqua, emarginato-elliptica; peristomate recto, intus ad angulum superiorem calloso; margine dextro superne arcuato, basali incrassato, columellari calloso, expansiusculo, subreflexo, superne plica obliqua spirali solida munito.

Long. 14, diam. 3 mill.; apert. long. 3, diam. $1\frac{1}{2}$ mill.
Habitat ad Weelgamoowe, Matelle, Ceylon.

A single specimen of this peculiar form is in Mr. F. Layard's collection. It is a dead shell, and is deficient in the superior whorls. I had not seen it before the previous part of this paper was in type.

January 8.

XIII.—*On the Nomenclature of the* Foraminifera.

By W. K. Parker, M. Micr. Soc., and T. R. Jones, F.G.S.

Part VIII.—*Textularia.*

As the typical *Buliminæ* have a strong resemblance externally to a *Bulimus*, so the large *Textularia trochus*, D'Orb., insensibly losing itself in *T. turris*, D'Orb., brings to mind the shape of the *Trochus* among *Mollusca*. The mimetic *T. trochus*, however, can scarcely be considered as the type of this very variable species; for the circularity of the transverse section or of the base of the cone is rather to be regarded as an extreme condition,—the conical forms of *Textularia* being homomorphous with the short forms of *Bulimina variabilis* and the broadly conical polystomous *Valvulina*.

Textularia agglutinans, D'Orb., oval in its transverse section, and with more or less irregular gibbosity of its chambers, gives, in its ordinary and moderately developed condition, a fuller idea of the species than any other variety. The *T. sagittula* of Defrance was the first to receive the generic name. It is smaller than the foregoing, and more compressed, and leads down to the most delicate variety, *T. pygmæa*, D'Orb. It does not present the mean of the specific characters, however, and thus does not supply a fair type of the species.

Among the very minute organisms to be seen in marine deposits, recent and fossil (such as chalk-dust and the mud of the Clam-beds of the East Indies), are tiny, delicate, translucent

Foraminifers, consisting of symmetrically arranged globose cells, alternately placed along the axis of the shell, and rapidly increasing in size. These may be grouped in two sorts,—one biserial (*Textularia; T. globulosa*, Ehrenberg), and the other triserial (*Verneuilina; V. pygmæa*, Egger, sp.): the former prevails in the Chalk; and both kinds are abundant in deep seas (Red Sea, &c.). These present conditions very analogous to what obtains in other allied forms, and, like the small and delicate varieties of *Bulimina, Uvigerina, Globigerina,* and *Rotalia* (especially *R. Beccarii* in shallow water), appear to owe their origin to one or other of the following conditions:—an excessive abundance of individuals, local brackishness of shallow water, or extreme and abyssal depth. Such very simply constructed forms, arrested at an early stage of growth, require great care in the observer who would arrange them specifically; and unless the little, almost transparent shell under the microscope be turned in all directions, and compared with its homomorphs in other groups, no certainty can be attained to: seen in Canada-balsam or other liquids, or in transparent sections of rock-specimens, its nature can only be guessed at.

Referring to Dr. Carpenter's 'Introduction to the Study of Foraminifera' (Ray Society), 1862, p. 190, &c., for an account of the structure and relations of *Textularia*, we may state that it is one of the most polymorphic and protean species of Foraminifera. Its morphology is more complex than that of *Nodosarina*. The first four or five chambers are often arranged in a flat Nautiloid spire (like that of *Rotalia* or *Operculina*); but this direction of the coil is soon changed, and the long and more or less compressed spire, with its biserial alternating chambers, is formed. With an almost tendril-like freedom of growth, the spire varies widely in its proportions in different varieties. The nautiloid coil occurs in the flattened "Bigenerine" condition of *Textularia*; but here further licence is taken, the shell finishing with a *single* series of chambers, and thus presenting a *Trigenerine* state. This trimorphism has been observed in certain individuals allied to *T. prælonga*, from the Gault; for in some Gault-clays, probably of deep-sea origin, this variety commences with a flat spiral coil, then becomes biserial with an alternation of chambers (Textularian), and ends uniserially. This Trigenerine variety occurs fossil also in the Oolite-clays. As a useful varietal form, it deserves a distinguishing name, and may be termed *Textularia annectens* (fig. 1).

Fig. 1.

Textularia annectens, *P. & J.*

Textularia prælonga, Reuss, has very often a coiled commencement (it is figured thus in Eley's 'Geology in the Garden,' pl. 3.

fig. 15, and pl. 9. fig. 15 *c*, p. 196); and Bigenerine *Textulariæ* with a coiled commencement occur in Baffin's Bay. So also *T. carinata*, D'Orb., is often coiled in its early stage, especially the specimens found in the London Clay; and the coiled condition of *Grammostomum capreolus*, D'Orb., is well and boldly illustrated by Soldani in his 'Testaceograph.' vol. i. part 2, pl. 108. *G. capreolus* and its subvarieties may be either coiled and biserial, or coiled, biserial, and uniserial (offering a form equivalent to *Textularia annectens*), or bi- and uniserial without the coil. It is often sandy, and of a large relative size; it occurs in the West Indies, and abounds in the Adriatic.

Some of the shells arranged as *Gaudryina* (for instance, *G. siphonella*, Reuss) have their triple series of chambers so twisted on the axis as to have a Buliminoid aspect. We possess a very beautiful specimen of this kind from the Tertiary beds of San Domingo. A slight approach to this condition occurs in the *Verneuilina polystropha* (*Bulimina polystropha*, Reuss), which we have found to be very common in the living state in Davis's Straits (Baffin's Bay), St. George's Bay (Beyrout), Syra (Greek Archipelago), Abrolhos Bank, &c.

A large proportion of the *Textulariæ* may be clear-shelled and tubuliferous, as the smaller individuals of *Textularia* proper, *Grammostomum*, and *Verneuilina*. Others are opake-shelled, because arenaceous. The calcareous cement of the shell-matter in many (*Verneuilina polystropha* and *Bigenerina digitata*) is of a ferruginous colour in the recent state, the substance of the shell having the rusty-red colour of the recent *Lituola*—a colour which, with other tints, occurs in both opake and clear-shelled Foraminifers*.

All the larger varieties of *Textularia* are arenaceous; but there is a host of small forms (many of which have been honoured by authors with specific appellations) entirely free from foreign matter, the shell being composed of finely perforated clear substance. These are at first sight often undistinguishable from D'Orbigny's *Bolivinæ* (which may be said to be Textulariform *Buliminæ*). The larger forms, *T. trochus*, *T. turris*, *T. agglutinans*, and *T. gibbosa* (essentially hyaline in their shell-structure), strengthen themselves not only with sand-grains, but

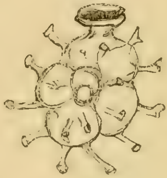
* The same species of Foraminifera may be very variable in tint when taken from different habitats. *Orbitolites* may be either rust-coloured, livid, or pink (usually the last). In *Miliola* the aperture is sometimes rusty; and sandy specimens are sometimes altogether rust-coloured, especially *Quinqueloculina agglutinans*. *Peneroplis* is pink when alive. *Alveolina* is sometimes pink, sometimes rusty. *Globigerina* has a beautiful pink colour. *Planorbulina farcta* is livid or purplish in the Mediterranean, *P. vulgaris* of Australia is livid; in the Indian Sea it is rosy pink; and often it is destitute of colour.

(as is also the habit of *Valvulina*) acquire some degree of rude ornament from the accretion of smaller Foraminifers, sponge-spicules, and prismatic fragments of molluscan shells. The clear and porous shell, in small and medium-sized specimens, occasionally has the pores projected as short tubes; this is well shown in a little Bigenerine *Textularia* in the Eocene deposits of Grignon, which is closely related to *T. pectinata*, Reuss (Denkschr. k. Akad. Wiss. Wien, 1850, i. pl. 49. f. 2, 3), from the Vienna Basin, but is characterized by its relatively few pseudopodian passages being elongated as short tubes all over the surface (fig. 2). *Planorbulina farcta* has very small deep-sea varieties with similar structure—for instance, *Rotalia reticulata*, Czjzek, Haid. Nat. Abhandl. ii. 1848, pl. 13. f. 7–9 (= *Siphonia fimbriata*, Reuss, Denks. k. Akad. Wiss. Wien, i. 1850, pl. 47. f. 6) (fig. 3): these tubuliferous *Planorbulinæ* are not uncommon in the Red Sea and elsewhere, and both recent and fossil in the Mediterranean area.

Fig. 2.

Textularia (Bigenerina) tubulifera, *P. & J.*

Fig. 3.



Planorbulina farcta, var. reticulata, *Czjzek.*

Like some of the small varieties of *Bulimina*, the little, particularly clear *Textulariæ* frequently develope a crest with prickles, as is well seen in the *T. carinata*, D'Orb., so common in the London and other Tertiary clays.

The large *Textularia trochus* of the Miocene Sands of San Domingo adopts the habit of *Lituola* in subdividing its chambers; so that each lobule of sarcode must itself have been most minutely lobulated. This labyrinthic condition is seen in a less degree in the large *T. agglutinans** of the Suffolk Crag.

As in *Bulimina*, so in *Textularia* proper, the aperture is the diagnostic mark. It is merely a low transverse arch having for its base the middle of the septal plane of the penultimate chamber: generally the aperture has not a thickened margin; but sometimes it is slightly lipped. In many of the Textularian varieties the aperture gets more and more in the substance of the septal plane, passing upwards towards the apex of the con-

* For many splendid specimens of this shell, and also of *T. turris* and *T. gibbosa*, from the same deposit, we are indebted to Searles Wood, Esq., F.G.S.

vexity of the septum, and thus becoming terminal. In this way it takes the form of a vertical slit-like aperture (generally without a margin) in *Grammostomum* (a compressed *Textularia*) both in the monomorphous and dimorphous forms, and especially in the large individuals.

Ehrenberg's *Proroporus* (as illustrated by Reuss, Sitzungsb. Akad. Wiss. Wien, vol. xl. p. 231, pl. 12. fig. 5) is an elongate *Textularia* with its aperture terminal or nearly so.

In *Gaudryina* and the sandy *Sagrina* the aperture is generally more or less margined and terminal. In *Verneuilina* the later cells have the aperture more and more axial; the terminal chamber in large specimens having a central aperture, generally unlipped: these form Reuss's genus *Tritaxia**. In the bi- uniserial varieties, also, of *Textularia* the mouth becomes central and pouting.

A most complete confluence of all these Textularian forms, whether varying in the mode of growth, the size and shape of chambers, or position of aperture, is proved by the countless intermediate modifications yielded by most sea-bottoms, fossil and recent.

The chief forms of Textularian growth may be thus enumerated:—

Textularia proper. Biserial, with transverse aperture at the base of the chamber.

Bigenerina. Biserial, becoming uniserial (bi- uniserial); with a terminal, round, pouting aperture.

Grammostomum. Usually biserial, extremely compressed; with simple slit-like aperture at the end of the chamber: occasionally bimorphous or even trimorphous.

Sagrina (in part: *S. rugosa*†, D'Orb., sandy). Biserial and sometimes tri- biserial; and then uniserial as far as one chamber; with a pouting, round terminal aperture.

Gaudryina begins triserially (Verneuiline), and generally ends biserially, the last aperture being Textularian; but it runs insensibly into the foregoing. Some *Gaudryinæ* are twisted and Buliminoid.

Verneuilina. Triserial. *V. dubia* (Reuss) = *Uvigerina tricarinata*, D'Orb., takes in its last chamber a central aperture (*Tritaxia*, Reuss): another single chamber makes it Clavuline. In *V. dubia* the aperture may be seen, in a series of specimens, to creep up from the base of the cell to the top.

Clavulina (part). Those *Verneuilinæ* taking on a uniserial

* Sitzungsberichte Akad. Wiss. Wien, 1860, vol. xl. p. 83.

† The other *Sagrina* (*S. pulchella*, D'Orb. For. Cuba, pl. 1. figs. 23, 24) (biserial, ribbed, and not sandy) is a *Uvigerina*.

chamber, with a round, pouting, central aperture, and no valve *.

Textulariæ are widely distributed: one and the same deposit usually yields many varieties; indeed, it is a world-wide species, and it seems to thrive equally well off the North Cape and in the East Indian Seas. The largest specimens are *T. gibbosa*, *T. agglutinans*, and the conical *T. trochus* and *T. turris*. Shelly sands and shelly clays yield the largest *Textulariæ* at from 30 to 100 fathoms, 60 to 70 fathoms being the best depth (coast of Sicily; English Channel; off Vigo and Ushant; and Southern Australia).

Textularia sagittula generally occurs in company with the large-sized *Textulariæ*, and is very common in all seas at a moderate depth. Remarkably large specimens of *T. carinata* (which usually occurs of small size) are found in the rich Nodosarian clay of the Vienna Basin; also recent in the line of soundings off South Arabia, between Socotra and Kurachee.

The London Clay yields three varieties of *Textularia*—a globose-chambered form, a compressed carinate form, often with a flat spiral commencement (*T. carinata*, D'Orb.), and the tri-uniserial form (*Clavulina communis*†).

The Chalk and Chalk-marl are very rich in Textularian forms, especially *T. trochus*, *T. turris*, *T. prælonga*, and other true *Textulariæ*, as well as *Verneuilina triquetra*, *V. dubia*, &c. The Gault of Biggleswade, Bedfordshire, appears to have been deposited in a deeper sea than the Gault of Kent was, if we judge by the varieties of *Textularia* and other genera, compared with recent conditions. It yields *Textulariæ* not only having the coiled commencement, but becoming uniserial (*T. annectens*).

Textularia occurs in the Silurian greensand of St. Petersburg; in the Carboniferous and Permian limestones; plentifully (usually small, but large when Verneuiline) in some of the clays of the Oolites; abundantly in the Cretaceous rocks; and plentifully and varied in the Tertiary deposits.

A List of some of the Textulariæ *proper.*

1826. Textularia gibbosa, *D'Orb.* Modèles, No. 28; Ann. Sc. Nat. vii. p. 262. No. 6.

1826. Textularia pygmæa, *D'Orb.* Modèles, No. 7; Ann. Sc. Nat. vii. p. 263. No. 13.

1828. Textularia sagittula, *Defrance*, Dict. Sc. Nat. vol. xxiii. p. 344, pl. 13. f. 5.

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* *Clavulina Parisiensis*, D'Orb., Modèles, No. 66, is certainly a tri-uniserial *Valvulina* with the loss of the little lip—an accident common to the brittle Grignon fossils. *Clavulina nodosaria*, D'Orb., is a Bigenerine *Textularia*.

† *Nodosaria rustica*, Jones, Morris, Catal. Brit. Foss. 1854, p. 38.

1839. Textularia agglutinans, *D'Orb.* For. Cuba, pl. 1. f. 32–34. [The type.]
1839. Textularia globulosa, *Ehrenberg*, Abhandl. Akad. Berlin (1838), 1839, pl. 4 (several figs.).
1840. Textularia trochus, *D'Orb.* M. S. G. Fr. iv. p. 45, pl. 4. f. 25, 26.
1840. Textularia turris, *D'Orb.* M. S. G. Fr. iv. p. 46, pl. 4. f. 27, 28.
1845. Textularia prælonga, *Reuss*, Böhm. Kreid. i. p. 39, pl. 12. f. 14.
1846. Textularia carinata, *D'Orb.* For. Foss. Vien. p. 247, pl. 14. f. 32–34.

A List of several of the best-known Varieties, Passage-forms, or Polymorphs of Textularia, *with Remarks on their Synonymy.*

1826. Vulvulina* capreolus, *D'Orb.* Modèles, No. 59; Ann. Sc. Nat. vii. p. 264. No. 1, pl. 11. f. 5–7.
,, Vulvulina elegans, *D'Orb.* Ann. Sc. Nat. vii. p. 264. No. 3.
,, Bigenerina nodosaria, *D'Orb.* Modèles, No. 57; Ann. Sc. Nat. vii. p. 261. No. 1, pl. 11. f. 9–12.
,, Bigenerina digitata, *D'Orb.* Modèles, No. 58. [*Gemmulina digitata*, D'Orb. Ann. Sc. Nat. vii. p. 262. No. 4.]
1838. Textularia triquetra, *Münster*, N. Jahrb. 1838, pl. 3. f. 19. [Verneuilina.]
,, Bigenerina pusilla, *Roemer*, N. Jahrb. 1838, pl. 3. f. 20. [B. nodosaria, *D'Orb.*]
1839. Vulvulina gramen, *D'Orb.* For. Cuba, pl. 1. f. 30, 31.
,, Candeina nitida, *D'Orb.* For. Cuba, pl. 2. f. 19, 20. [A small *Verneuilina*, showing a few pseudopodial passages near the junctures of the cells.]
,, Clavulina nodosaria, *D'Orb.* For. Cuba, pl. 2. f. 19, 20. [Bigenerina nodosaria, *D'Orb.*]
1840. Verneuilina tricarinata, *D'Orb.* Mém. Soc. Géol. France, iv. p. 39, pl. 4. f. 3, 4. [V. triquetra, *Münster.*]
,, Uvigerina tricarinata, *D'Orb.* M. S. G. Fr. iv. p. 42, pl. 4. f. 16, 17. [Verneuilina (Tritaxia) dubia, *Reuss.*]
,, Gaudryina rugosa, *D'Orb.* M. S. G. Fr. iv. p. 44, pl. 4. f. 20, 21.
,, Gaudryina pupoides, *D'Orb.* M. S. G. Fr. iv. p. 44, pl. 4. f. 22, 24.
,, Sagrina rugosa, *D'Orb.* M. S. G. Fr. iv. p. 47, pl. 4. f. 31, 32.
1845–1846. Textularia triquetra, *Münst.*, Reuss, Böhm. Kreid. pl. 13. f. 77. [Verneuilina.]
,, Bulimina polystropha, *Reuss*, Böhm. Kreid. ii. p. 109, pl. 24, f. 53. [Verneuilina; sandy, swollen, twisted.]
,, Textularia tricarinata, *Reuss*, Böhm. Kreid. pl. 8. f. 60. [Verneuilina triquetra, *Münst.*]
,, Verneuilina Bronni, *Reuss*, Böhm. Kreid. pl. 12. f. 5. [V. triquetra, *Münster.*]
1846. Clavulina communis, *D'Orb.* For. Foss. Vien. pl. 12. f. 1. [Verneuilina, tri- uniserial; or Clavuline Verneuilina.]
,, Bigenerina agglutinans, *D'Orb.* For. Foss. Vien. pl. 14. f. 8–10. [B. nodosaria, *D'Orb.*, elongate.]
,, Verneuilina tricarinata, *D'Orb.* For. Foss. Vien. pl. 21. f. 26, 27. [V. triquetra, *Münster.*]
,, Gaudryina pupoides, *D'Orb.* For. Foss. Vien. pl. 21. f. 34, 35 [not 36].
,, Vulvulina gramen, *D'Orb.* For. Foss. Vien. pl. 21. f. 46, 47.
1850. Verneuilina spinulosa, *Reuss*, Denkschr. Wien, i. pl. 47. f. 12.
,, Gaudryina Badensis, *Reuss*, Denkschr. Wien, i. pl. 47. f. 14.

* This term, disused by D'Orbigny, is well replaced by *Grammostomum*, Ehrenberg.

1851. Verneuilina Bronni, *Reuss.* Nat. Abhandl. iv. pl. 5. f. 2. [V. triquetra, *Münst.*]
,, Verneuilina dubia, *Reuss,* Nat. Abhandl. iv. pl. 5. f. 3. [Tritaxia, *Reuss.*]
,, Gaudryina Ruthenica, *Reuss,* Nat. Abhandl. iv. pl. 5. f. 4. [Sagrina, *D'Orb.*]
,, Gaudryina siphonella, *Reuss,* Zeitsch. Deutsch. Geol. Ges. iii. pl. 5. f. 40–42. [Sagrina, *D'Orb.*]
,, Grammostomum dilatatum, *Reuss,* Zeitsch. Deutsch. Geol. Ges. iii. pl. 8. f. 8. [G. capreolus, *D'Orb.*]
1854. Nodosaria rustica, *Jones,* Morris's Cat. Brit. Foss. 2nd. edit. p. 38. [Clavulina communis, *D'Orb.*; a Clavuline Verneuilina.]
,, Verneuilina Muensteri, *Reuss,* Denks. Wien, vii. pl. 26. f. 5. [V. triquetra, *Münst.*]
,, Polymorphina silicea, *Schultze,* Org. Polyth. pl. 6. f. 10, 11. [Verneuilina polystropha, *Reuss.*]
1857. Bulimina arenacea, *Williamson,* Brit. Foram. pl. 5. f. 136, 137. [Verneuilina polystropha, *Reuss.*]
,, Bulimina tuberculata, *Egger,* N. Jahrb. 1857, p. 284, pl. 12. f. 4–7. [Verneuilina polystropha, *Reuss.*]
,, Bulimina pygmæa, *Egger,* N. Jahrb. 1857, p. 284, pl. 12. f. 10, 11. [Verneuilina; smooth, inflated, twisted.]
1860. Tritaxia tricarinata, *Reuss,* Sitz. Akad. Wien, 1860, vol. xl. p. 83, pl. 12. f. 1, 2. [Verneuilina, with central aperture.]

XIV.—*On the Genera and Species of Recent Brachiopods found in the Seas of Japan.* By Arthur Adams, F.L.S. &c.

The result of my investigations into the geographical distribution of the Terebratulidæ in Japanese waters shows that the North-European, the North-Asiatic, and the Indo-Pacific provinces require to be united as regards these Mollusks. Besides *Waldheimia Grayi, Terebratulina Japonica,* and *Terebratella Coreanica,* the North-Asiatic province yielded me *Waldheimia cranium, W. septigera,* and *Terebratulina caput-serpentis.* I likewise obtained *Waldheimia picta, Terebratulina Cumingii,* and *Ismenia sanguinea,* which were supposed to be confined to the Indo-Pacific province.

Fam. **Terebratulidæ.**

Subfam. Terebratulinæ.

Genus Terebratulina, D'Orb.

1. *Terebratulina Japonica,* Sow.

Hab. Gotto; 48 fathoms. Tsusaki; 55 fathoms.

2. *Terebratulina caput-serpentis,* Linn.

Hab. Tsusaki; 55 fathoms. Tsu-Sima; 26 fathoms. Mino-Sima; 63 fathoms.

3. *Terebratulina Cumingii*, Davids.

Hab. Tsu-Sima; 26 fathoms. Mino-Sima; 63 fathoms.

Genus Waldheimia, King.

1. *Waldheimia cranium*, Gmel.

Hab. Kuro-Sima; 35 fathoms.

2. *Waldheimia septigera*, Lovén.

Hab. Satanomosaki; 55 fathoms.

3. *Waldheimia picta*, Chem.

Hab. Satanomosaki; 55 fathoms.

4. *Waldheimia Grayi*, Davids.

Hab. Hakodadi; Mososeki; 7 fathoms.

Subfam. Magasinæ.

Genus Terebratella, D'Orb.

1. *Terebratella Coreanica*, Adams & Reeve.

Hab. Hakodadi; 7 fathoms. Straits of Korea; 48 fathoms.

This is *T. miniata*, Gould.

2. *Terebratella Mariæ*, A. Adams ('Annals,' 1860).

Hab. Uraga; 21 fathoms. Gotto; 48 fathoms. Satanomosaki; 55 fathoms.

The only species at all resembling this is *T. Spitzbergensis*, described by Davidson in the 'Annals' for 1852, and founded on a single specimen in the Cumingian collection.

Genus Ismenia, Gray.

1. *Ismenia sanguinea*, Chem.

Hab. Mino-Sima; 63 fathoms.

2. *Ismenia Reevei*, A. Adams.

I. testa suborbiculari, globoso-lenticulari, punctata, alba, lævi, nitida, ad umbones acuminata, marginibus regulariter arcuatis; valva ventrali ventricosa, dorsali planiuscula; foramine modico, integro, circulari.

Hab. Gotto; 48 fathoms.

A large pure-white species, conspicuously punctate. The loop is trebly attached, as in *Megerlia*; but the shell externally has the aspect of *Terebratella*.

Fam. **Rhynchonellidæ.**

Genus Rhynchonella, Fischer.

1. *Rhynchonella lucida*, Gould.

Hab. Satanomosaki; 55 fathoms. Gotto; 48 fathoms.

Dr. Gould observes that this species might be taken for a small *T. vitrea*, but is very thin and delicate, and further distinguished by the absence of punctures. His examples were dredged off the Japan coast, 30° 35′ N., 130° 40′ E., in 110 fathoms sand, by Capt. Stevens, of the 'Hancock.'

2. *Rhynchonella Woodwardii*, A. Adams.

R. testa subtrigonulari, tumida, nigricante, semiopaca; valvis subæqualibus, impunctatis, concentrice striolatis; umbone rostriformi, parvo, curvato, apice acuto; margine ventrali rotundato, in medio producto.

Hab. Rifunsiri; 35 fathoms. Gotto; 48 fathoms.

This species differs from *R. psittacea* in being concentrically striolate instead of radiately grooved; the beak, moreover, is smaller and less curved; the form is more broadly triangular, and the ventral margin is rounded and produced in the middle. The young possess the same characters seen in more adult specimens.

Fam. **Craniidæ.**

Genus Crania, Retzius.

Crania Japonica, A. Adams.

C. testa crassa, solida, suborbiculari; valva superiore convexa, rugosa, apice elato, subcentrali; margine irregulari; impressionibus muscularibus validis, rotundatis, apophysi interna bifurcata, prominente; impressione pallii multilobata.

Hab. Gotto Islands; 71 fathoms.

A very distinct and well-marked species, with the bifurcate process in the upper valve very prominent and conspicuous.

Fam. **Discinidæ.**

Genus Discina, Lamarck.

Discina stella, Gould.

Hab. Seto-Uchi (Akasi); 17 fathoms. Tsu-Sima; 17 fathoms. Tabu-Sima; 26 fathoms, on coral. Tsu-Sima; 25 fathoms.

Fam. **Lingulidæ.**

Genus Lingula, Brug.

1. *Lingula tumidula*, Reeve, Conch. Icon. sp. 2.

Hab. Tsaulian; 7 fathoms, mud.

2. *Lingula smaragdina*, A. Adams.

L. testa oblonga, lateribus rectiusculis, ad umbones attenuata, ad marginem ventralem subtruncata; carina dorsali valida, prominente; glabra, nitente, viridissima.

Hab. Yobuko; 10 fathoms, mud.

A bright green species, found also in the China Sea, and most nearly resembling *L. hirundo*, Reeve.

3. *Lingula jaspidea*, A. Adams.

L. testa oblongo-ovali, lateribus convexis, ad umbones subdilatata; margine ventrali arcuato; carina dorsali mediocri, subdepressa; glabra, nitente, subviridi-lutescente, antice pallidiore, rufo-fusco tincta.

Hab. Mososeki; 7 fathoms, mud.

4. *Lingula lepidula*, A. Adams.

L. testa oblongo-ovali, umbonibus acutis, productis, lateribus convexis, dilatatis, membranaceis; margine ventrali rotundato; carina dorsali depressa; glabra, nitente, luteo-cornea, in medio albida.

Hab. Seto-Uchi (Akasi); 10 fathoms, mud.

A species as small as *L. semen*, and shaped like *L. ovalis*.

XV.—*A Contribution to the Knowledge of the* Tæniæ. By Ludwig Stieda*.

Of the numerous Cestodea forming the group of the *Tænioidea*, scarcely any except the cystic *Tæniæ* have hitherto been particularly investigated in respect to the generative organs, the other *Tæniæ* having received little attention. The different forms, however, as has already been shown by Pagenstecher's description of the several organs of *Tænia microsoma*†, present very peculiar structures, differing in many parts from the arrangement of the sexual organs occurring in the cystic *Tæniæ*; and these are of more importance inasmuch as the different structure of the generative organs will enable us to found a more certain and natural classification of the innumerable *Tænioidea* than has hitherto been possible. For this reason I hope that the present short communication, in which I have endeavoured to describe the generative organs of certain *Tæniæ*, some of them unknown, others imperfectly known, will not be entirely destitute of interest.

In the small intestine of the Field-Mouse (*Hypudæus arvalis*)

* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1862, p. 200.

† Zeitschr. für wiss. Zool. ix. p. 523.

there is frequently a Tapeworm of considerable size, which, according to the character given by Dujardin* with especial reference to the habitat, I must regard as the *Tænia omphalodes*, Hermann.

This *Tænia* is 120–160 mill. in length; the head is quadrangular, measures 1·5–2·5 mill., and is distinctly separated from the body of the Tapeworm; it possesses neither a proboscis nor a circlet of hooks, but only four round sucking-disks, 0·35 mill. in diameter. The so-called neck, on which no joints are perceived, even by the microscope, is 1·5–2·5 mill. in length, and 1 mill. in breadth. The succeeding, distinctly recognizable joints increase rapidly in breadth, so that at a distance of 25–35 mill. from the head the joints are already 4–5 mill. broad. The joints do not, however, maintain this breadth, but diminish in the lowest part of the worm to 3 mill. The length of the joints increases very gradually, but constantly; the broadest joints are $\frac{1}{2}$–1 mill. in length, so that they are about five times as broad as long; the last joints are about 2 mill. in length. In consequence of this shortness of the joints, the Tapeworm, in its upper parts, has a very finely striated appearance, whilst it is only in the lower parts that, as the joints become longer, the notched form more or less peculiar to the Tapeworms in general manifests itself. The sexual orifices do not occur always upon the same side, but, in irregular sections, sometimes on one and sometimes on the other side. The number of joints forming the Tapeworm may be ascertained to be 250–300 by direct counting, which must be effected, on the parts nearest to the head, by means of the microscope. A perfectly developed uterus, with distinctly recognizable ova, is exhibited by the first joints of the third hundred; fully developed embryos occur about twenty-five joints further on.

In the 40–50 joints lying nearest to the head no development of sexual organs can be recognized, but in the part of each joint in which the sexual organs are to be produced there is a greater accumulation of cells. This becomes gradually differentiated in this way:—a rounded mass, from which the female germ-preparing organs are developed, becomes marked off in the middle line of the joint, on the one side from a mass situated on the lateral margin of the joint, and destined to produce the testes, and on the other from a small elongated mass of cells deposited on the opposite margin of the joint, and which serves for the development of the germiducal organs.

In the following joints (40–80), which increase chiefly in breadth, the testes are first of all developed. From the mass which is situated on the side opposite to the genital pore a large

* Hist. Nat. des Helminthes, p. 578.

group of small roundish corpuscles, measuring 0·035–0·056 mill., is formed; these, gradually increasing in size and number, soon occupy one-half of the joint. These corpuscles appear at first finely granular, afterwards pale and transparent, and represent the well-known testicular vesicles or testicular tubes of the *Tæniæ*. Transverse sections show that these testicular vesicles are enclosed by a fine structureless membrane, and still contain in the interior a cellular mass, whilst the fine, delicate, very long seminal filaments already occur rolled up at the margin. Sometimes a fine efferent duct may be detected on these corpuscles. At the same time, on the side of the joint opposite to the testis, an elongated vesicle is formed from the aggregation of cells there occurring; this is 0·210 mill. in length, and 0·070 mill. in breadth at its widest part. This is the cirrus-pouch, which is somewhat pointed at the extremity turned towards the median line of the joint, and applies itself with the other (rounded) end to the genital pore. It contains the penis or lemniscus, which is 0·056 mill. in length, and 0·014 mill. in breadth. This is continued into the vas deferens, which disappears behind the cirrus-pouch, without forming any loops. In favourable transverse sections, however, it may be traced beyond the median line of the joint. I have never seen any connexion between it and the above-described fine efferent ducts of the testes.

In the following joints (80–100), whilst the testicular vesicles and cirrus-pouch still further increase in size, the female organs also make their appearance. While previously there was only an indistinctly limited organ of undefined appearance between the testes and cirrus-pouch, we may now distinguish two organs distinctly separated from each other in form and contents. At the lower margin of each joint there is an elliptical body, with its longest axis placed in the transverse diameter of the joint; this is the germ-stock, which measures 0·0280–0·0350 mill. in length, and 0·210 mill. in breadth, and appears to be filled with finely granular contents. Below, the germ-stock is pretty sharply defined; but above, its limits are not so distinctly marked, because the yelk-stocks are situated upon it. The latter occupy the space between the germ-stock and the upper margin of the joint, spreading out right and left; they appear as if composed of a number of larger and smaller cæca, which seem to unite at the median line of the joint. Their contents (as may be seen by tearing them to pieces, and still more distinctly in transverse sections) are coarsely granular, consisting of a quantity of very small, homogeneous, strongly refractive corpuscles. At the lower margin of the cirrus-pouch there is a more or less distinctly projecting canal, which is somewhat dilated at its orifice in the genital pore. This canal, which is 0·021 mill. in diameter at its orifice, but subsequently only 0·007–0·014 mill., represents the vagina. Close behind the end of the cirrus-pouch which is turned towards the median line of the joint, this canal becomes suddenly dilated to the considerable size of 0·070 mill.: the limits of this dilatation escape detection in the vicinity of the germ-stock and yelk-stock; so that it would appear as if the dilatation pushed itself in between those organs. I have not been able to discover any connexion between the dilatation of the vaginal canal and the germ-producing organs. The contents of this dilatation consist, as may easily be ascertained, of seminal filaments; so that we have to do, according to this, only with a remarkably extended seminal pouch of the vagina, or a *receptaculum seminis*.

Whilst now the *receptaculum seminis* becomes more and more filled by increased reception of semen, and the germ-stock and yelk-stocks become more and more extended, the testes undergo a retrograde metamorphosis, and gradually disappear.

At about the 150th joint the first indication of the uterus makes its appearance. Both at the upper margin and at the two lateral margins the uterus appears as a cavity in the parenchyma of the body, furnished with diverticula and filled with a mass resembling the contents of the yelk-stocks. The following joints present the different degrees of development of the uterus, whilst the other organs gradually disappear. Towards the end of the second hundred segments, in which the uterus is shown in its full development, of the other organs only the cirrus-pouch and vaginal canal, with the *receptaculum seminis*, are retained; the latter organs are completely pressed down to the lower margin of the joint, and have considerably diminished in extent. The form of the uterus is characteristic, in that its principal stem, corresponding with the short but broad form of the proglottides, runs transversely, whilst the lateral branches or the individual diverticula are arranged in the direction of the length of the joint.

As the development of the ova was not sufficiently observed by me, I only add a few words upon the mature ova found in the last proglottides. These appear smooth and perfectly round; they are 0·035–0·042 mill. in diameter, and possess two envelopes, of which the outer one, 0·0035 mill. in thickness, presents a stratified appearance, whilst the other, which is closely applied to the embryo, on which the embryonal hooks are scarcely visible, appears to be very fine and structureless.

In the small intestines of the Field-Mouse there was sometimes, although but rarely, another *Tænia*, to which I here refer because it perfectly agrees, in regard to the genital apparatus, with the *T. omphalodes*. I am not in a position to make very accurate statements as to the length and size of this *Tænia*, as the examples of it which I have seen were never quite perfect, and, especially, never possessed maturely developed proglottides. I mention only that this Tapeworm exactly resembles the *T. omphalodes* in regard to its head and upper part, although it is of rather smaller dimensions; in the lower part, however, it differs in that the joints, as they grow narrower, become considerably elongated, so that the last joints are three times as long as broad, and appear somewhat compressed laterally. I regard this Tapeworm as identical with the *Tænia pusilla*, Goeze, which, indeed, has hitherto only been mentioned as occurring in the common mice and rats, but the description of which suits very well with the present Tapeworm.

In the small intestine of the Shrew (*Sorex araneus*) I have met with two Tapeworms distinctly differing from each other both in size and in the form of the hooks, which, however, do not agree with the characters given by Dujardin* of some *Tæniæ* found by him in the Shrews. I regard them, therefore, as hitherto unknown forms.

One of these two *Tæniæ*, which occurs very frequently, numbering from ten to twenty in each Shrew, and which I will denominate *T. uncinata*, is 10–15 mill. in length. The head is 0·280 mill. in breadth, has four sucking-disks 0·056 mill. in diameter, and a short proboscis, which has a simple circlet consisting of fourteen to eighteen hooks. The head passes immediately into the neck, which is but little narrower, and exhibits no segmentation. The number of recognizable joints is about 120. The joints immediately following the neck are 0·182 mill. in breadth; and as they advance they increase both in length and breadth, so that the last joints are about 0·560 mill. broad and 0·210 mill. long. The sexual orifices all occur upon one side of the worm, each in the middle of the joint. The hooks have a very characteristic form; they are very strongly curved, and have a rather fine point. The extreme point of the hook is distant from the extremity of the root-process 0·0175 mill., and from that of the dental process only 0·0035 mill.; the two processes are 0·0140 mill. apart.

The various stages of development of the sexual organs as presented in the different joints are not so easy to observe in this Tapeworm as in *T. omphalodes*. It appears only that in this case also the development commences especially at three points in each joint. One of these points is at the upper margin of each joint, where the cirrus-pouch and vagina are formed, whilst the germ-preparing organs are produced from two aggregations of cells situated in the middle of the joint.

* Hist. Nat. des Helminthes, p. 562.

In a sexually mature segment the most striking organ is one situated in the middle, which may be compared, as to its form, with a retort. The neck of this, which is turned towards the margin of the joint, opens into the genital pore, whilst the body of the retort almost touches the lower margin of the joint, and is surrounded here by two other organs. The diameter of the tube at its external orifice is 0·0070 mill., and enlarges to 0·0105 mill.; the diameter of the body is 0·035–0·052 mill. Its contents consist, as may easily be ascertained, of seminal filaments. Below or above the tube, and often completely concealed by it, there is a small vesicle, 0·042 mill. in length and 0·0105 mill. in breadth, pointed at both ends, which issues above the orifice of the tube in the genital pore. This is the cirrus-pouch, which contains the small, rarely protruded penis: posteriorly the penis passes into the *vas deferens*, which here also exhibits no loops, but disappears under the retort-like organ. This retort-like organ occurs also, although not constantly, of the same extent and form in other Tapeworms, and was not unknown to previous observers, but has usually received an erroneous signification. By Dujardin, as appears from his descriptions and figures of the Tapeworms of the Shrews observed by him (*Tænia pistillum, T. tiara, T. scalaris*, and *T. murina**), it was regarded as the testis opening into the cirrus-pouch—an opinion which has also been expressed very recently by Weinland† with regard to the same organ in *Tænia flavopunctata*. On the other hand, Professor Leuckart, as I learn from his own communication, long since recognized the corresponding organ in *Tænia nana* as the vaginal canal, with a very greatly dilated *receptaculum seminis*. From the description above given, no further discussion is necessary as to whether here in *Tænia uncinata* we are to recognize in this organ the vagina and the seminal receptacle formed out of it which particularly distinguish this group from that of the cystic *Tæniæ*. On the portion of the receptacle approximated to the lower margin of the segment lies the elliptical germ-stock, filled with finely granular contents, and measuring 0·025 mill. in length and 0·014 mill. in breadth, and on each side the apparently coarsely granular yelk-stocks. I could find no connexion between the germ-stock, yelk-stocks, and *receptaculum seminis*. The remainder of the joint is occupied by from three to five pale transparent testicular vesicles, which are of a round form and 0·035 mill. in diameter. In the segments presenting the next grades of development all the organs, except the cirrus-pouch and the *receptaculum seminis*, which has a distinct canaliform process to the lower margin of

* Helminthes, pp. 562 *et seq.*

† Beschreibung zweier neuer Tänioïden des Menschen: Jena, 1861, p. 9.

the joint, have disappeared; on the other hand, the uterus, with its ova, immediately makes its appearance. In this case, however, it does not present, as in other *Tæniæ*, the characteristic form, already often compared to a stem and branches, but only forms a sac densely filled with ova, and occupying the whole joint. Each joint contains about 100–150 eggs. The fully developed ova are elliptical, 0·0560 mill. in length and 0·0455 mill. broad; they present three envelopes, of which the outermost is smooth and transparent, the intermediate one very thin and slightly folded, and the innermost one, which is closely applied to the embryo, 0·0035 mill. in thickness. The diameter of the six-hooked embryo is 0·0315 mill.; the distinctly perceptible embryonal hooks are 0·0105 mill. in length.

The second *Tænia* met with in the Shrew, which I will call *T. furcata*, on account of the forked form of its hooks, is very rare. Its length is 8–10 mill.; the round head, distinctly separated from the neck, is 0·151 mill. in breadth, and possesses four sucking-disks and a short proboscis, which is furnished with a circlet of from twenty-two to twenty-eight hooks. The neck is 0·210 mill. in breadth. The width of the segments increases gradually with the length, so that the broadest segments are 0·56 mill. in breadth and 0·21 mill. in length: the last joints, from which the ova are already removed, exhibit smaller dimensions; they are 0·280 mill. broad, and 0·105 mill. long. The number of distinctly recognizable segments is 100. The genital orifices are all on one side.

The hooks are distinguished by a long and thin root-process, which is clearly separated from the true hook-process. The distance from the root-process to the apex of the hook is 0·024 mill.; the apex of the hook is distant 0·005 mill. from the distal process, and the two processes are 0·0210 mill. apart.

With regard to the sexual organs and the ova, I have nothing to add, as all that has been said of *T. uncinata* applies also to this *Tænia*.

XVI.—*Remarks on some Coal-measure Crustacea belonging to the Genus* Belinurus, *König; with Description of two new Species from Queen's County, Ireland.* By William Hellier Baily, F.G.S.*

[Plate V.]

The generic term *Belinurus* was applied by König, in 1820, to a peculiar Crustacean from the Coal-measures, figured and named

* An abstract of this paper was read at the Meeting of the British Association in 1858.

by him *Belinurus bellulus**; previous to this, Martin† gave a figure and short description of this species, which he called *Entomolithus monoculites*? (*lunatus*), including it with *Trilobites* under the same generic term of *Entomolithus*, a name which would therefore, according to the rules of nomenclature, be inadmissible. Parkinson‡ figures a similar fossil from ironstone found in the Coal-measures of Dudley, which he includes with the *Trilobites*, stating at the same time that it appeared to be identical with that described by Martin. The same species is figured and noticed by Dr. Buckland under the name of *Limulus trilobitoides*§, and afterwards by Mr. Prestwich, in his paper on the Geology of Coalbrook Dale, who adopts the same name, giving a figure of this and other species belonging to the genus, from the Ironstone found in the Coal-measures of Coalbrook Dale‖. Lastly, General Portlock figures a specimen, said to be from Carboniferous shale (most probably, however, Coal-measures), Maghera, co. Derry, which he doubtfully refers to the same species¶.

Prof. Morris, in his Catalogue of British Fossils, ed. 2, 1854, cites all the above authorities, except Parkinson, referring the same species to *Limulus trilobitoides*, Buckland.

In a paper read by me before the Geological Society of Dublin** a description was given of a specimen (the only one then obtained) from Bilboa Colliery, Queen's County, discovered by Mr. G. H. Kinahan, of the Geological Survey of Ireland, in *débris* derived from the three-foot bed of shale immediately over the Coal No. III. of the section, Castlecomer district. The accompanying fossils in the same bed of shale were a few scattered plant-remains and numerous small bivalve *Unio*-like shells (probably *Myacites*), and others of a Mytiloid form, which may be referred to *Myalina*. In this paper some remarks were offered on the allied species from Coalbrook Dale, which had been included with it in the genus *Limulus*; and it was proposed, from the characteristic differences they presented, and their greater affinity with the *Trilobites*, to remove all these Coal-measure Crustacea from that genus, and group them into a new one, under the name of *Steropis*. Since then, more complete specimens have been obtained from Bilboa Colliery, which have

* Icones Fossilium sectiles, by Charles König, 1820, pl. 18. fig. 230.
† Petrificata Derbiensia, 1809, pl. 45. fig. 4.
‡ Organic Remains, 1811, vol. iii. p. 274, pl. 17. fig. 18.
§ Bridgewater Treatise, 1836, p. 396, vol. i., & vol. ii. p. 77, t. 46″. fig. 3.
‖ Trans. of Geol. Soc. of London, ser. 2. 1840, vol. v. pl. 41. fig. 8.
¶ Report on the Geology of Londonderry and Tyrone, 1843, p. 316, pl. 24. fig. 11.
** Journal of the Geological Society of Dublin, 1858, vol. viii. p. 89.

still further confirmed my views with regard to the advisability of separating them from *Limulus*; and, on reconsideration, I preferred adopting the appropriate name of *Belinurus*, which was applied by König to one of the most common species, in preference to that under which I had formerly proposed to group them.

In the Explanation of Sheet 137 of the Maps of the Geological Survey of Ireland*, I have given a short account of the fossils from the Coal-measures of this district, which includes a notice of these remarkable Crustacea from Bilboa, after visiting the locality, when I was fortunate enough to obtain the very perfect specimen named by me *Belinurus Reginæ*, and represented at Pl. V. fig. 1 A.†

On another visit, a still more perfect specimen (fig. 1 B) was obtained by the gentleman who accompanied me on that occasion, Mr. John Edge, to whom I am indebted for that and the loan of other specimens which have materially assisted me in drawing up these descriptions‡.

CRUSTACEA. *ENTOMOSTRACA.*

Legion **PŒCILOPODA.** Order **Xiphosura.**

Genus Belinurus, König.

Etym. Βέλος, a dart; *οὐρὰ*, the tail.

Gen. Char.—General form suborbicular. Head or cephalic shield semicircular, slightly arched; the central portion (*glabella*?) prominent and declining towards the circumference, surrounded with a flattened margin, and terminating at its posterior angles in long spines. Body composed of five segments, which terminate in spines and diminish gradually towards the

* Explanation of Sheet 137, Geol. Survey of Ireland, Palæontological Notes, pp. 12–14.

† Since writing this paper for the British Association, I found that Pictet, in his 'Traité de Paléontologie,' ed. 2, 1854, had anticipated me by removing these Crustacea (as I had proposed to do) from the genus *Limulus*, restoring them to that of *Belinurus*, with the following remarks:—

"Les *Belinurus*, König, diffèrent des deux genres précédents par l'articulation de la queue, et surtout parce que le bouclier abdominal présente deux sillons longitudinaux qui lui donnent une ressemblance avec le corps des *Trilobites*." The following is from his classification of Crustacea:—

Order XIPHOSURA.

Genus 1. Limulus.	Genus 3. Belinurus.
Genus 2. Halycine.	Genus 4. Pterygotus.

‡ I also take the opportunity to acknowledge the kind assistance I have received from Benj. B. Edge, Esq., J. P., of Clonbrock House, Crettyard, near Carlow, who has aided me, on the several occasions of my visits, with valuable information and the loan of specimens.

posterior extremity, Tail or caudal portion small, with a few slight radiating divisions, to which is articulated an elongated spine (*telson*).

Belinurus Reginæ, n. sp. Pl. V. fig. 1 A–D.

Diagnosis.—*B.* latus, limbo scuti cephalici orbiculari, angulis longispinosis; corpore decurtato; thorace quinque articulis longispinosis munito; pleuris sulco longitudinali, usque ad finem spinæ producto; tripartita cauda, cui spina prælonga coaptatur.

Description.—General form broadly ovate, acuminate posteriorly; axis convex. Cephalic shield three and a half times as broad as long, bow-shaped anteriorly, and surrounded by a narrow and flattened margin; the posterior angles produced into long spines, which are directed outwards; central portion, or glabella, smooth and moderately convex, of the same breadth as the axis of the thorax at its junction, but decreasing gradually towards the anterior margin, having an arched division on each side extending towards the anterior margin. Eyes central, lunate, attached to these divisions. Thoracic rings (*somites*) five, the lobes of the first twice as broad as the axis, those of the last rather less in breadth than the axis, the lateral lobes extending in a straight line, each being furrowed and terminating in a spine, the length of which diminishes in regular gradation towards the tail; each of the rings of the axis bears a moderate-sized tubercle. Tail or caudal portion very small, having about three slightly marked divisions on each side, to which is appended or articulated (?) an extremely long spine (*telson*), being three times the length of the other portion of the animal, broad at the base, and tapering gradually to a point.

Remarks.—The little Crustacean to which I have given the above specific name (Pl. V. fig. 1 A) was found by me in the *débris* of the same coal-pit which yielded the next species; it is in a very perfect condition, and exhibits in a remarkable manner the extravagant development of its various segments into long spines spreading out on each side of the body, and gradually decreasing as they approach the tail, from which proceeds an enormous spine. These characters sufficiently distinguish it from any other species. The head and body in the specimen figured appear to have been a little squeezed together. Another specimen of what I believe to be the same species (fig. 1 B), obtained by Mr. John Edge, is still more perfect, with the exception of the tail-spine, a portion of which has been broken away: this specimen is enlarged at fig. 1 C, D, and shows a slight wrinkling or furrowing of the expanded margin of the cephalic shield, as well as the sulcated pleuræ and single tubercle upon each ring of the axis terminating in a larger and more obtuse prominence on the tail.

The spine or telson which is attached to this portion exhibits a central longitudinal ridge, having a membranous expansion on each side similar to that noticed by Parkinson as occurring in the species described by Martin, and which I have referred to *B. bellulus*, König.

The following are the measurements of fig. 1 A :—

[The line is considered as being the twelfth of an inch.]

Total length from anterior margin of cephalic shield to point of telson..	1 inch 1 line,	or 27 mill.
Breadth at widest part of spines ..	7 lines	or 15 ,,
,, of cephalic shield	5 ,,	or 10 ,,
Length of telson	10 ,,	or 20 ,,

Measurements of fig. 1 B :—

Length of, from anterior margin of cephalic shield to end of tail	5 lines	or 10 mill.
Length from anterior to posterior margin of cephalic shield	$2\frac{1}{2}$,,	5 ,,
Breadth of cephalic shield	$6\frac{1}{2}$,,	13 ,,
Length of body and tail	$2\frac{1}{2}$,,	5 ,,
Breadth of body at cephalic shield ..	4 ,,	8 ,,

Locality. From Coal-shale, Bilboa Colliery, Queen's County.

Belinurus arcuatus, n. sp. Pl. V. fig. 2 A–C.

Diagnosis.—*B.* latus; limbo scuti cephalici orbiculari, angulis longispinosis; glabella spinis duabus brevioribus munita; thorace quinque articulis brevispinosis; pleuris usque ad terminos sulcatis; tripartita cauda, cui spina longa coaptatur.

Description.—General form broadly ovate, acuminate posteriorly; axis convex. Cephalic shield semicircular, slightly elevated, declining towards the circumference, and surrounded by a narrow flattened margin; the central portion or glabella having three ridges extending to about two-thirds the breadth of the shield, rounded at their anterior extremity, and forming a double arch, the central portion being broadest at its posterior extremity, the two outermost ridges curving at about half their length towards the very slightly raised semicircular eyes, and continuing beyond the posterior extremity of the shield in two sharp straight spines, which project over the body about one-tenth of an inch; the posterior angles of the cephalic shield are produced into long spines, as in the preceding species, three-tenths of an inch in length, slightly curved, and spreading out on either side from the body. Thoracic rings five, which, as in the preceding species, decrease in breadth towards the posterior extremity; the lateral lobes, extending in a straight line, terminate in a short spine, and have an angular furrow, which proceeds to the end, curving at the same angle to the point of each spine.

Caudal extremity small, with two or three radiating divisions, to which is appended a spine about equal in length to the head and body.

Remarks.—This Crustacean differs from the preceding one in having much shorter spiny terminations to the pleuræ, and a much shorter tail-spine. The detached head or cephalic shield (Pl. V. fig. 2 A, B) is more orbicular, and the arched ridges proceeding from the middle portion of the head (*glabella*) terminate on each side in short spines—a character not observed in any of the specimens of *B. Reginæ.* I have not succeeded in obtaining good specimens of this species with the body and tail entire: an imperfect one (fig. 2 C) forms the centre of a concretion in the shale, and exhibits a portion of the body with the tail-spine uncompressed, showing distinctly the division of each thoracic ring, with its grooved lateral angles as in the *Trilobites.* In another specimen, which was accidentally relieved from the shale, exposing both sides, the body was found to be doubled back upon the head, like an *Ampyx* or *Trinucleus.* This species is allied to *Belinurus bellulus,* König, but differs from it in the more orbicular form of the head, the spiny terminations of the pleuræ, and the greater proportion of the body to the cephalic shield.

Total length	1 inch, or	25	mill.
„ breadth	11 lines, or	22	„
Length of body	7 „	15	„
Breadth of cephalic shield	8 „	17	„
Length of cephalic shield	4 „	8	„
„ telson, about	½ inch	12	„

Locality.—Found with the previous species at Bilboa Colliery, Queen's County.

A third species, closely allied, if not identical, with *Belinurus* (*Limulus*) *rotundus*, Prestwich, sp., was also obtained at the same locality; but as it is scarcely perfect enough for description, I have preferred referring it, with a doubt, to that species. A figure, of the natural size and enlarged, is given on Plate V. fig. 3 A, B.

The following is a list of the species of *Belinurus,* with their synonyms and localities:—

1. *Belinurus bellulus,* König, Icon. Foss. Sect. pl. 18. fig. 230. Coal-measures, Coalbrook Dale, Shropshire.

Syn. *Entomolithus* (*monoculus*) *lunatus,* Martin, Pet. Derb. pl. 45. fig. 4. Near Mansfield, Nottingham.
—— ——, Parkinson, Org. Rem. vol. iii. pl. 17. fig. 18. Dudley, Shropshire.
Limulus trilobitoides, Buckland, Bridg. Treat. pl. 46″. fig. 3.
—— ——, Prestwich, Geol. Trans. ser. 2. vol. v. pl. 41. fig. 8.
—— ——? Portlock, Geol. Report, pl. 24. fig. 11.

2. *Belinurus arcuatus*, n. sp., Baily. Bilboa Colliery, Queen's County, Ireland.
3. —— *Reginæ*, n. sp., Baily. Bilboa Colliery, Queen's County, Ireland.
4. —— *anthrax*, Prestwich, Geol. Trans. vol. v. pl. 41. figs. 1–4. Coalbrook Dale.
5. —— *rotundus*, Prestwich, *ibid.* Coalbrook Dale and ?Bilboa Colliery, Queen's County.

The discovery of these peculiar Coal-measure Crustacea in Ireland, with associated shells and plants corresponding so remarkably with those found in similar deposits at Coalbrook Dale in Shropshire and other parts of the Midland counties in England, is a point of great palæontological interest, showing their distribution over a wide area, and indicating the prevalence of the same conditions in both countries, although at localities so widely distant. The great differences observable in some parts of their structure to that of the more recent and living forms of *Limulus* may be accounted for by the wide interval which separates the Coal-measure strata in which their remains are found from the Upper Jurassic formation, where those of true *Limuli* first occur. There are, however, certain points in their structure analogous to that of *Limulus*, which they somewhat resemble in their general form and in being provided with a tail-spine that was most probably (although the articulation is not clearly shown), like that of *Limulus*, capable of mobility; on the other hand, as we recede in time, we find intermediate forms, such as *Pterygotus* and *Himantopterus*, connecting them with the *Trilobites*, to which they are also allied by the moveable nature of their body-segments, and in other particulars. We have, therefore, in these Coal-measure Crustacea such a modification of structure as may be considered sufficient to constitute them a distinct genus, and show them to be a link in the chain leading from the important group of *Trilobites*, so characteristic of the Palæozoic rocks, to the Oolitic *Limuli*, in which the whole body is covered by a double shield, the segments of the abdominal portion being merely rudimentary and immoveable, like those of the existing species.

As to the question of the freshwater or marine habitat of these Crustacea and their associated fossils, I am inclined to the opinion that the deposits in which they occur were of freshwater or estuary origin, from the abundance of small shells like *Unio*, and others very similar to the freshwater *Mytilus* (*Dreissena*) *polymorpha*, accompanied by the remains of succulent or marshy plants. This opinion corresponds with the observations of Martin and Prestwich. Other theories have been advanced attributing a general marine origin to the Coal-beds, in support of which great stress has been laid upon the fact of the occurrence of minute spiral bodies found attached to some of the plant-remains, and formerly referred to *Spirorbis*, a marine genus of Annelida common upon our shores at the present day, where it is generally attached to sea-weeds, and is well known as *Spirorbis nautiloides*. These little spiral bodies of the Coal-measure plants have, however, been described by Göppert as a Fungus, under the name of *Gyromyces Ammonis*, and are figured by Geinitz in his fine work on the Coal-plants of Saxony*. We have here, therefore, an instance of the great caution required in drawing general conclusions from insufficient data, and would rather concur with the remarks offered on the subject at page 54 of this Journal, believing that the Coal-measures afford evidence of having been deposited under both freshwater and marine conditions.

EXPLANATION OF PLATE V.

Fig. 1 A–D. *Belinurus Reginæ*, n. sp.: A, B, natural size; C, D, enlarged 3 diameters. (The dotted lines represent the part restored.)

Fig. 2 A, C. *Belinurus arcuatus*, n. sp.: A, detached cephalic shield, natural size; B, the same, enlarged 2 diameters; C, a small uncompressed specimen from a concretion.

Fig. 3 A, B. *Belinurus rotundus*?, Prestwich: A, natural size; B, enlarged 3 diameters. (The dotted lines represent parts restored.)

XVII.—*On new Species of Fishes from Victoria, South Australia.* By Dr. Albert Günther.

A collection of fishes from Victoria, sent to the International Exhibition, and procured for the British Museum, was distinguished by the unusually large size of the specimens. They are all stuffed, and unfortunately not accompanied by smaller examples preserved in spirits, so that we are obliged to leave the descriptions of the new species incomplete in some points. We hope, however, soon to make up for this deficiency, as we may expect further supplies from that colony.

Lates colonorum.

B. 6. D. 8 | $\frac{1}{10}$. A. $\frac{2}{8}$. L. lat. 55. L. transv. 8/21.

The specimen is 17 inches long, apparently a female, and rather extended by stuffing; the length of the head, however, appears to be a little less than one-third of the total (without

* Die Versteinerungen der Steinkohlenformation in Sachsen, pl. 34. figs. 1–3. Dr. Geinitz first called my attention to this little fossil on a Calamite-stem from a neighbouring colliery, in Mr. B. Edge's collection.

the caudal). Teeth minute, villiform; the bands on the palate are half as broad as those in the upper jaw; the vomerine band short, crescent-shaped, separate from the palatine bands. Maxillary broad, triangular. The præopercular limb is naked, finely serrated behind, and with coarse spinous teeth below, directed forwards; no large spine at the angle. Operculum terminating in a larger spine, with several smaller ones above; præorbital, sub-, and interoperculum finely serrated.

The dorsal fins are continuous at the base; the spines are strong; the fourth is the longest, its length being contained twice and a third in that of the head. Caudal fin slightly emarginate. The third anal spine is rather longer than the second, and as long as the sixth dorsal spine.

Uniform greenish-olive above, silvery on the sides and on the belly.

"Perch" of the colonists.

Melambaphes.

Similar in general habit to *Glyphidodon.* Body covered with small ciliated scales; cheeks, opercles, and the soft parts of the vertical fins with very small scales. Of all the bones of the head, only the præoperculum is slightly crenulated. Each jaw with a series of trenchant tricuspid teeth, and with a broad band of villiform teeth behind; no teeth on the palate. Fourteen or thirteen spines in the dorsal fin, and three in the anal fin.

Having only one stuffed specimen for examination, we are unable to say whether this fish belongs to the Acanthopterygians proper or to the Pharyngognaths. If to the former, it is to be referred to the group *Cantharina,* and to the *Pomacentridæ* if it should prove to have the lower pharyngeals united. In either case it appears to be the type of a distinct genus, which we have so characterized that it may be readily distinguished from all the other Sparoid and Labroid genera.

Melambaphes nigroris.

Glyphisodon nigroris, Cuv. & Val. v. p. 485.

D. $\frac{14}{12}$. A. $\frac{3}{11}$. L. lat. 100.

We have but little doubt that the "Black Perch" of the colonists is the *Glyphisodon nigroris* of Cuvier and Valenciennes, although their description is extremely short, giving as the formula of the fins, D. $\frac{13}{14}$. A. $\frac{3}{12}$.

Glyphidodon Victoriæ.

D. $\frac{13}{17}$. A. $\frac{2}{15}$. L. lat. 30. L. transv. 4/10.

The height of the body is somewhat less than one-half of the total length (without the caudal). Teeth narrow, not emarginate, twenty-one on each side of the upper jaw. Infraorbital scaly; the width of the præorbital is two-thirds of that of the orbit. Five or six series of small scales on the cheek. Vertical fins scaly nearly to their margins. The third to the seventh dorsal spines are nearly of equal height, one-half of the length of the head. Caudal forked. Reddish-violet (in a dried state); fins blackish.

Nine inches long.

The "Rock-Perch" of the colonists.

Labrichthys ephippium.

? *Labrus ephippium*, Cuv. & Val. xiii. p. 96.

D. $\frac{9}{11}$. A. $\frac{3}{10}$. L. lat. 27. L. transv. 3/10.

A posterior canine tooth. Cheek with three series of very small scales. Base of the dorsal fin not scaly. Each tube of the scales of the lateral line with numerous branches.

Coloration in a dried specimen:—Back violet-olive to the end of the spinous dorsal; head, belly, and tail reddish, the latter with a broad violet-olive band between the posterior halves of the soft dorsal and anal. A blackish spot behind the opercle; the pectoral, ventral, caudal, and spinous dorsal reddish or yellowish, the first with a black spot superiorly in the axil. The soft dorsal and the anal blackish-violet.

Seventeen inches long.

The "Parrot-fish" of the colonists.

Pseudophycis barbatus.

B. 7. D. 8 | 51. A. 58. V. 5. L. lat. ca. 140.

The ventral fin does not extend to the vent. Sixteen or eighteen series of scales between the anterior dorsal and the lateral line.

This fish is similar to its congener, *P. breviusculus*, Richards., from New Zealand, but may be readily distinguished by the characters given. We have received a specimen 17 inches long. The species is called "Rock-Cod" by the colonists. With regard to the characters of the genus *Pseudophycis*, we refer to 'Catal. Fish.' iv. p. 350.

Lotella callarias.

B. 7. D. 6 | 65. A. 57. P. 22. V. 7.

The two outer ventral rays produced into a filament. Uniform brown.

Similar to *L. fuliginosa*, Günth. (Catal. Fish. iv. p. 347), but with a shorter head, the length of which is one-fifth of the total (without the caudal). The ventrals, with the filament, are as long as the pectoral; the barbel is not quite half as long as the head. The typical specimen is 19 inches long.

The fish is called "Cod" by the colonists.

Rhombosolea flesoides.

B. 6. D. 62. A. 41.

Similar to *R. leporina* (Günth. Catal. Fish. iv. p. 460), but with the body more elevated. Its greatest depth is rather less than one-half of the total length (without the caudal), the length of the head two-sevenths. Eyes separated by a narrow, low, naked ridge, the lower being in advance of the upper. A cutaneous flap is suspended from the maxillary, overhanging the mouth. The gill-opening does not extend upwards beyond the base of the pectoral. The dorsal fin terminates at a distance from the caudal, which is one-fourth of the depth of the free portion of the tail; the first dorsal ray is inserted immediately behind the maxillary appendage, and the four or five anterior rays are produced beyond the connecting membrane, but considerably shorter than those behind the middle of the fin, which are nearly half as long as the head. Caudal subtruncated, its length being rather more than one-sixth of the total. The length of the pectoral is somewhat more than one-half that of the head. Ventral fins as in *R. monopus* and *R. leporina*. Uniform brown.

Length of the typical specimen 14 inches.

Called "Flounder" by the colonists.

BIBLIOGRAPHICAL NOTICES.

The Flora of Essex. By G. S. Gibson, F.L.S. 12mo. London: Pamplin. 1862.

Mr. Watson justly remarks, in his valuable 'Cybele Britannica,' that his difficulties in discovering the geographical distribution of plants in Great Britain have been greatly increased by the small number of good county floras. The works produced by the last generation of botanists are of course useless for his purpose, owing to the want of exactness so prevalent at the time of their production. Their authors had no idea that it was necessary, or even desirable, to do more than compile a simple catalogue of the plants found in their districts, and to record the localities of the rarer species. Doubtless such records as these are valuable, if the compilers were sufficiently good botanists to render their determination of the species trustworthy. Unfortunately, this was often not the case; and frequently plants were marked as "common," not from any certain determination of their frequency, but from an impression that such was the case. It thus became necessary for Watson to discover by some other means the correctness of these entries; for it not unfrequently happened that the so-marked "common" plant was an unlikely species to be "common" in that particular district; and even, in a few cases, one or more of them has been found to be altogether wanting in it. There is also another class of local "Catalogues" which is of very little use to the scientific botanical geographer. We mean those which only profess to name the rarer species. These books are often useful to collectors, and therefore deserve local encouragement; but as works of science they rank very low. Even such books as Leighton's 'Shropshire' and Bromfield's 'Isle of Wight' do not come up to the point now required. In the former case the large county is not divided into districts, as has now become the habit; and therefore the distribution and more or less frequency of the plants is not easily discovered from it, even if discoverable at all. Dr. Bromfield's book relates to a very limited area, and therefore division into districts was hardly called for; but it is a posthumous work, not very well edited, and showing most manifest signs of wanting the last touches of its author. Indeed, the chief value (and it is great) of these two works is that they contain very many useful descriptions of plants and much elaborate critical discussion. The date of Leighton's work causes it to occupy a prominent position in the history of the present movement for placing the flora of Britain on a level with those of several of the Continental nations. It was one of the first books where an attempt was made to identify our plants with those of foreign botanists, and to submit the names used by us to the laws which regulate botanical nomenclature. Previous to that time we were not much in the habit of consulting the local floras of foreign countries; and Fries's writings concerning the Phanerogamic plants of Scandinavia had attracted very little attention in this country. We well remember the commotion which took place amongst the botanists attending the British Association Meeting at Bristol (A.D. 1836), when the lamented Edw. Forbes drew from his pocket Reichenbach's 'Flora Excursoria.' It was like opening a new world to those who had been previously satisfied with Smith's 'English Flora' and Hooker's 'British Flora' in its earlier form.

The discovery of Reichenbach was soon followed by that of Koch's 'Synopsis,' and English works began immediately to show the results of a study of Fries, Reichenbach, and Koch. We need not follow this movement any further. It was strongly opposed in some quarters, gained ground slowly but steadily, and is still, in spite even of faintly continued opposition, making its way amongst those who especially desiderate an accurate knowledge of their country's plants.

But it may be asked, What has this to do with Gibson's 'Flora of Essex'? We answer, much; for without the knowledge attained, and the exactness of observation acquired, by a study of the modern local floras of Europe, such a work could not have been produced.

Mr. Gibson divides the county of Essex into eight districts, and in effect gives a more or less complete flora of each of them. The same plan had previously been followed by Babington for the county of Cambridge, and, at a still earlier date, by Webb and Coleman for that of Essex. But possibly the very first attempt at recording the plants of a province in this way was made in Babington's 'Flora of the Channel Islands.' He there always records the presence of a plant, when known to him, in each of the four principal islands, and thus gives a tolerably complete flora, not only of the whole group, but also of the two larger islands, and less perfectly of two of the smaller ones. We believe that there are no other books in which this valuable mode of determining the frequency of each plant within the range of a local flora is employed.

Mr. Gibson has manifestly taken much pains to render his book as complete as possible. He records about 1120 plants as said to have been found in Essex, but marks a considerable number as either mistakes, naturalized, or otherwise more or less ambiguous as species or as natives of the county. This weeding of the list seems to have been done with care, and we very rarely see any reason for arriving at a different opinion from that announced by the author. We may, perhaps, instance as a few of these differences our doubt if *Nymphæa alba* can require the mark of doubtful nativity appended by Gibson; and the same may perhaps be said of *Rosa rubiginosa*. On the other hand, it seems nearly certain that *Saponaria officinalis* is a naturalized plant in the east of England, whatever claims it may show to be thought indigenous on the borders of Wales. But we will not occupy valuable space by following up a subject so open to controversy, and on which each careful observer must judge for himself.

We have said that the Essex flora contains an enumeration of about 1120 plants, thus exceeding that of the adjoining county of Cambridge by nearly 200 species. This is chiefly caused by the extensive sea-coast which bounds Essex, and the almost total absence of maritime plants from Cambridgeshire.

Very much addition is made to the value of this book by the exceedingly numerous, learned, and accurate remarks introduced into it by the Rev. W. W. Newbould, one of our best botanists and a gentleman especially conversant with contemporary foreign floras, and also with the writers of the ante-Linnæan period and their herbaria. His remarks are usually (although, we think, not always) pointed out by the letter N being appended to them. Mr. Gibson observes in the Preface:—"I cannot omit to refer more particularly to my valued friend W. W. Newbould, to whom I am indebted for the assistance which he has most kindly and freely rendered. In addition to the time bestowed on ancient authorities and herbaria, he has undertaken excursions into several districts, for the purpose of noting localities; and, besides offering various important suggestions, he has revised the manuscript, assisted in correcting the proof-sheets while they were passing through the press, and added many critical notes. The accuracy of the work has been much enhanced by W. W. Newbould's exertions." This acknowledgment we consider fully required; for we have personal knowledge of the great labour and care with which he treated the manuscript. Newbould makes an interesting remark upon *Carex ericetorum*, which has been recently recorded as a British plant, and supposed to have been first noticed by Messrs. Ball and Babington on the Gogmagog Hills, in Cambridgeshire. He states that the original drawing published in 'English Botany' as *C. præcox,* and made by the late James Sowerby, represented *C. ericetorum,* but that "Smith saw that the glumes were not those of *C. præcox,* and the details were in consequence altered." Thus the plant was found by some botanist at least as long since as the year 1802; but, unfortunately, the locality is not recorded. His researches have shown that, unfortunately, such alterations of the original drawings were not unfrequently made by Smith, and that thus many of the difficulties have arisen which we now meet with when endeavouring to identify plants with the otherwise valuable plates in 'English Botany.'

Some interesting papers appear in the Appendix. First, a table showing the dates of the earliest and latest notice of many plants in Essex. Some few of these are as early as the sixteenth, and a good many occur in the seventeenth century. Next we have a table of the comparative abundance of each plant. They are arranged as "common," "rather local," and "very local." No. 3 is a comparison of the floras of Essex, Cambridge, Hertford, and Kent. No. 4 relates to the arrangement of the plants of Great Britain according to their comparative frequency, as given in Watson's 'Cybele Britannica,' vol. iv. No. 5 gives a short list of plants not unlikely to be found in Essex. No. 6 includes biographical sketches of the celebrated John Ray, who commenced and ended his life in Essex; of Samuel Dale, Richard Warner, and the recently lost and justly lamented Edw. Forster.

It will be seen by what we have said, that this is a work quite up to the requirements of the present time, highly creditable to its author, and well deserving of the attention of English botanists; and it is probably unnecessary to add that it does not contain descriptions of the plants, but that the general floras of Britain are referred to for information of that kind, as is now the usual and laudable custom of writers on local botany.

A Manual of European Butterflies. By W. F. Kirby. Williams & Norgate. 1862.

A descriptive Manual of the Butterflies of Europe has long been a desideratum with those of our travellers who, not caring to make a close study of entomology, still take some interest in the more conspicuous objects of natural history. Of these objects none are more striking or beautiful than the numerous butterflies which, in our Continental rambles, at once attract notice, whether they rise from the rushes on the steep mountain-side, or on the sultry plain flit lazily from flower to flower, a "joy for ever" to all whose hearts sympathize with nature.

Mr. Kirby offers us descriptions of 321 species of *Rhopalocera*: these descriptions are partly original, partly compiled or condensed from the best foreign authorities. We may here be permitted to protest against the singular use which our author has made of the signs * and †, to indicate that specimens have been examined by himself. Mr. Kirby is a young author, and we are sure that he will forgive our pointing out that these signs are very perplexing to the eye, and, besides, have been used for quite different purposes in other scientific works. How much easier to have appended the usual "B. M." or the marks "!!" or "*vidi spec.*" In the same way, when the descriptions are quoted or abridged, how much more satisfactory if these had been noted by inverted commas or an abbreviated name.

At the head of each genus, we find an analysis of the species comprised in it. Here we cannot but regret that Mr. Kirby has not adopted the Lamarckian or dichotomous method. The use, also, of *italics* for the more distinctive characters in the specific descriptions would have been a great boon to the traveller, whose time is so valuable.

We think that the authority should have followed the specific names in the body of the book, as well as in the synonymic list given in the Appendix. We say it with reluctance; but the carelessness of entomologists is in this respect quite proverbial.

We could have wished that the best figure of each insect had been quoted throughout; and certainly some indication of the range might have followed the specific descriptions. By using five capital letters for "North, Middle, South, East, and West" Europe, much information might have been condensed in a very short space. The alpine or mountain insects might have been distinguished in a similar manner, and the "kind of station" would have been another welcome addition.

Having relieved our mind by these free remarks, we have no hesitation in recommending Mr. Kirby's handy-book to the notice of our summer tourists. Travellers are in these days very apt to run into zoological eccentricities. It is not at all uncommon to see blue or green gauze nets waving on the Rhigi or from a passing carriage, in many parts of the Continent. The 'Manual of European Butterflies' is a work of good promise, and a proof of no small diligence on the part of its author.

But why should entomologists have a monopoly? With the exception of Lord Clermont's little book on the Mammals and Reptiles of Europe, we know of no portable Manual for the English traveller of zoological tastes, when he is starting for a six-weeks' ramble on the Continent. Have we not other naturalists who might give us the digested results of their long study of different branches of the European Fauna? Might we suggest to Mr. Alfred Newton how useful would be a manual of the European birds? And will not Dr. Günther take pity on the poor fishes, all neglected since the illustrious Agassiz left Europe for his Transatlantic home?

A very useful feature of Mr. Kirby's book is the table of geographical distribution, inserted as an Appendix. This table is admirably constructed; for Mr. Kirby has succeeded in showing not only the country in which each insect has been found, but also the name of the authority in every case. We commend this Appendix as quite a model of how much information may be conveyed in a few pages.

A second Appendix supplies a complete and partly synonymic catalogue of all the European Butterflies, amounting, as we said before, to 321 species. In his estimate of the number of species Mr. Kirby has wisely contented himself with following a good recent authority—Staudinger.

We must now leave the Butterflies of Europe in the hands of Mr. Kirby and his fellow entomologists. We trust that enough has been said to stimulate travellers to the contemplation, if not the capture, of *some* of the 321 species.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Nov. 20, 1862.—Major-General Sabine, President, in the Chair.

"On the Fossil Remains of a long-tailed Bird (*Archeopteryx macrurus*, Ow.) from the Lithographic Slate of Solenhofen." By Prof. Richard Owen, F.R.S.

The author details the circumstances connected with the discovery of the fossil remains, with the impressions of feathers, in the Lithographic slates of Solenhofen, of the Oxfordian or Corallian stage of the Oolitic period, and of the acquisition for the British Museum of the specimen which forms the subject of his paper.

The exposed parts of the skeleton are,—the lower portion of the furculum; part of the left os innominatum; nineteen caudal vertebræ in a consecutive series; several ribs, or portions of ribs; the two scapulæ, humeri, and antibrachial bones; parts of the carpus and metacarpus, with two unguiculate phalanges, probably belonging to the right wing; both femora and tibiæ, and the bones of the right foot; impressions of the quill-feathers radiating fan-wise from each carpus, and diverging in pairs from each side of the long and slender tail. The above parts indicate the size of the winged and feathered creature to have been about that of a rook. The several bones, with their impressions and those of the feathers, are described, and the bones are compared with their homologues in different Birds and in Pterodactyles. Whence it appears that, with the exception of the caudal region of the vertebral column, and apparently of a biunguiculate manus, with less confluent condition of the metacarpus, the preserved parts of the skeleton of the feathered animal accord with the ornithic modifications of the vertebrate skeleton. The main departure therefrom is in a part of that skeleton most subject to variety. Twenty caudal vertebræ extend from the sacrum in a consecutive and naturally articulated series, resembling in structure and proportions those of a squirrel. The tail-feathers are in pairs corresponding in number with the vertebræ, diverging therefrom at an angle of 45° backward, becoming more acute near the end, and the last pair extending nearly parallel with and $3\frac{1}{2}$ inches beyond the last caudal vertebra. This feathered tail is 11 inches long and $3\frac{1}{2}$ inches broad, with an obtusely rounded end. This novel and unexpected character of the tail is owing to the constancy with which all known existing and tertiary birds have presented the short bony tail with the terminal modification in most of them of the ploughshare bone.

Professor Owen next gives the results of investigations into the osteogeny of embryo birds, showing the number of vertebræ corresponding to the anterior caudals in *Archeopteryx* which coalesce with the pelvis in the course of growth, and the degree to which the posterior caudals retain a resemblance to those of *Archeopteryx* in the Birds with rudimental wings. From eighteen to twenty caudal vertebræ may be counted in the young Ostrich. In *Archeopteryx* the embryonal separation persists, with such continued growth of the individual caudal vertebræ as is commonly seen in long-tailed Vertebrates, whether Reptilian or Mammalian. The author remarks that the modification and specialization of the terminal bones of the spinal column in modern birds is closely analogous to that which converts the long, slender, many-jointed tail of the modern embryo fish into that short and deep symmetrical shape, with coalescence of terminal vertebræ into a compressed lamelliform bone, like the 'os en charrue' of birds, to which the term 'homocercal' applies—such extreme development and transformation usually passing through the heterocercal stage, at which, in palæozoic and many mesozoic fishes, it was arrested. Thus he discerns in the main differential character of the mesozoic bird a retention of structure which is embryonal and transitory in the modern representatives of the class, and consequently a closer adhesion to the general vertebrate type.

The least equivocal parts of the present fossil declare it to be a Bird, with rare peculiarities indicative of a distinct order in that class. Although the head is absent, the author predicts, by the law of correlation, a beak-shaped mouth for the preening of the plumage; and he also infers a broad and keeled sternum in correlation with the remains of feathered organs of flight.

The paper is accompanied by drawings of the fossil and its parts, and of homologous parts in Birds and Pterodactyles. The author assigns to the fossil animal the name of *Archeopteryx macrurus*.

Dec. 18, 1862.—Major-General Sabine, President, in the Chair.

"Description of a new Specimen of *Glyptodon*, recently acquired by the Royal College of Surgeons of England." By Thomas Henry Huxley, F.R.S., Hunterian Professor of Comparative Anatomy at the College.

In the present brief preliminary notice I propose to give an account of the more remarkable features of the skeleton of a specimen of the extinct genus *Glyptodon*, recently added to the Museum of the Royal College of Surgeons.

The specimen was obtained in 1860, by Signor Maximo Terrero, on the banks of the River Salado, and was presented to the College by that gentleman, through the instrumentality of the late President of the College, J. F. South, Esq.

It arrived in England in an extremely broken and mutilated condition; but, by the exercise of great care and patience, Mr. Waterhouse Hawkins, to whom the President and Council of the Royal College of Surgeons entrusted the task of adjusting the scattered fragments, has succeeded in restoring to their natural condition the greater part of the vertebral column, the limbs, and much of the head. In the execution of this laborious undertaking Mr. Hawkins has had, from time to time, all the anatomical aid that Mr. Flower, the Conservator of the College Museum, and I could afford him; and the authorities of the College have finally entrusted me, as one of the Professors of the College, with the duty of describing the specimen.

This duty I propose to discharge by preparing a full description of the skeleton in a memoir to be presented (accompanied by a draught of the requisite illustrations) to the Royal Society. But as the preparation of such a memoir will require some time, I wish, at present, to lay before the Royal Society a preliminary account of those particulars in the structure of this animal which must interest anatomists in general as much as the special student of the fossil Edentata, in the hope that the notice may appear in the 'Proceedings' of the Society.

The mass of bony fragments which arrived from South America has afforded material for the reconstruction of the carapace, and of the following parts of the skeleton:—the anterior moiety of the skull with the entire palate; the mandible; some of the cervical, and the greater part of the dorsal, lumbar, sacral and coccygeal vertebræ, with vertebral and sternal ribs; the pelvis and the hind limbs; part of the scapula, and an entire fore limb. And there can be no doubt that all these remains belong to one and the same animal, as no duplicate bones have been discovered, nor any which there is the least reason to believe belong to a different individual. This circumstance gives a particular value to the present specimen, apart from the fact that, notwithstanding the researches of Professor Owen, of D'Alton, of Lund, and of Nodot, our knowledge of the structure of the anterior part of the skull, of the vertebral column and pelvis, and of the fore limb of *Glyptodon* and its immediate allies, is either nil or extremely imperfect. I now proceed to note the more important and the novel anatomical peculiarities which it reveals.

Of the *skull* the new specimen exhibits the anterior moiety, from the anterior boundary of the cranial cavity to the anterior end of the nasal bones, together with the almost entire bones of the face and the lower jaw; it thus furnishes a nearly complete supplement to the fragmentary cranium, consisting of the brain-case and the nasal bones, with the zygomatic processes, formerly described by Professor Owen as a part of *Glyptodon clavipes*, and now set up in the College Museum, together with a carapace, a tail, and a hind foot, as the typical example of that species*. In the form of the frontal bone, of the

* The parts thus combined together were not found so associated, and the

orbits, of the nasal bones, and of the zygomatic process, the skull of the new specimen agrees very closely with that of *Glyptodon clavipes.* From the slighter rugosity of the supraorbital region, the less development of the temporal ridges, and the fact that the nasal suture persists in the new specimen, I conceive it to have been a younger animal.

The anterior nasal aperture is trapezoidal, and narrower below than above. The vomer is very thick and strong, and the turbinal bones are well developed. The premaxillæ, though small slender bones, enter largely into the lateral boundary of the nasal aperture. Inferiorly they are separated in the middle line by a narrow fissure, which runs back into the crescentic anterior palatine foramen.

The maxillary bones are extremely elongated; while the palatine bones are small in proportion to them, and, like the premaxillæ, are separated by a very narrow median fissure. The extreme length of the roof of the palate, formed by these three pair of bones, is 10 inches; while its width (between the inner edges of the teeth), though rather greater in front than behind, nowhere exceeds $1\frac{3}{4}$ inch. From before backwards the palate has a double curvature, being concave downwards from the anterior end of the premaxilla to the level of the third tooth, and convex thence to the end of the palate-bones; so that the posterior part of the palate has a very marked inclination upwards and backwards.

There were eight teeth in each maxilla, all trilobed, the longitudinal grooves separating the lobes being less marked in the anterior teeth.

The mandible is represented by the two horizontal rami, with the symphysis, the greater part of the right coronoid process, and the entire right condyle, together with many of the sixteen teeth. It very closely resembles the mandibles of *Schistopleuron gemmatum*, described by Nodot, but is wholly unlike the restored jaw of *Glyptodon clavipes* given (on the authority of a drawing) by Professor Owen*.

The articular surface is situated almost wholly upon the anterior surface of the condyle of the mandible, looking but very slightly upwards; it is transversely elongated, slightly concave from side to side, and convex from above downwards. In all these respects it furnishes a counterpart to the glenoid articular surface of the temporal bone of *Glyptodon clavipes,* already described by Professor Owen.

The length of the head of the present specimen, when entire, was probably not less than 13 inches. The greatest depth of the cranium, from the centre of the frontal bone to the middle of the

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question may arise whether the skull, hind foot, and tail are really parts of the animal to which the carapace (on whose characters the species is founded) belonged. Provisionally I assume that they are. But so many difficulties are involved in the precise determination of the species of these extinct Armadillo-like Edentata, that for the present I leave the question open.

* The mandible of the Turin *Glyptodon,* mentioned at the end of this paper, is quite similar to that of the new specimen, and to that of M. Nodot's *Schistopleuron.*

palate, is about 6 inches; the length of the mandible can hardly have been less than 12 inches.

Of the vertebral column, the greater part of the sacral and dorsal region, and some fragments of the cervical region, are preserved. The latter show that the atlas was distinct, but that the axis was anchylosed with one or two succeeding vertebræ, as in the Armadillos. The fifth and sixth cervical vertebræ were probably free, but no traces of them have been found. The anterior part of what remains of the rest of the vertebral column consists of a very broad flat bone, composed of three vertebræ firmly anchylosed together, and having their spinous processes represented by a short but very stout osseous knob, which projects upwards and backwards. Anteriorly, these anchylosed vertebræ exhibit on each side of the neural canal an articular facet with a convex surface, resembling a segment of a horizontal cylinder; posteriorly, articular surfaces of a similar character, but concave, are situated in corresponding positions.

Each side of this 'trivertebral bone' presents two large and deep articular cavities for the heads of ribs, fragments of which are still preserved. The anterior rib, remarkable for its stout and massive proportions, was undoubtedly the first; and this circumstance I believe gives a clue to the precise character of the vertebræ which are anchylosed together to form the trivertebral bone; for in the Armadillos the head of the first rib is fitted into a deep fossa, formed partly by the last cervical, and partly by the first dorsal vertebra. Furthermore, the body and transverse processes of the last cervical vertebra in the Armadillos present articular facets of an essentially similar character to those observable on the anterior face of the bone under description*; and, finally, the last cervical vertebra is practically immoveable upon the first dorsal in many Armadillos, while the two vertebræ are completely anchylosed together in the priodont Armadillo. I conceive, then, that this remarkable bone of the *Glyptodon* is formed by the anchylosis of the last cervical and first and second dorsal vertebræ.

Of the remainder of the spinal column thirteen consecutive vertebræ are preserved; and all of these were immoveably united into one long continuous tunnel or arched tubular bridge of bone, a structure which is without a parallel among the Mammalian Vertebrata. Of these thirteen vertebræ, the four anterior are so completely anchylosed together, that the original lines of demarcation between them are hardly discernible. Persistent sutures separate the fourth from the fifth, and the latter from the sixth; but all trace of the primitive distinction of the sixth and seventh is lost. The other vertebræ are separated by sutures which become coarser and less close posteriorly. In all but the first, second, third, eleventh, and thirteenth vertebræ, the parts representing the vertebral centra are broken away; but where they persist, they are so similar that they were doubtless of similar form throughout. Each centrum is, in fact, a

* I may remark in passing, that all the cervical vertebræ of the Armadillos, from the third backwards, are articulated together by joints similar in principle of construction to those which connected together the trivertebral bone of *Glyptodon* with the vertebræ in front of and behind it.

comparatively thin bony plate, so curved as to form a segment of a hollow cylinder of much larger diameter in the front than in the hinder vertebræ, the sides of which pass superiorly into the arches of the vertebræ.

The foremost vertebra of the thirteen is as broad as the posterior part of the 'trivertebral bone,' and presents a couple of convex articular facets which articulate with the lateral articular concavities described above in that bone. The vertebræ rapidly narrow, however, until the fourth is not more than three-fifths as wide as the first, while it is proportionately deeper; and this increase of depth relatively to width goes on until in the thirteenth vertebra the spinal canal is deeper than it is wide.

The spinous processes of these vertebræ are all broken short off; but sufficient remains of their bases to make the following points clear.

The spinous process of the first is almost obsolete, being a mere ridge sloping back towards the second, with which it is continuous. This appears to have been necessary to afford the requisite play for the knob of the trivertebral bone in its movements of flexion and extension on the rest of the spinal column.

The spinous process of the second vertebra was long and thick, and probably somewhat high. It appears to have been completely distinct from the third, which was thinner, and was anchylosed with its successors (as far as that of the twelfth vertebra inclusive) into a long continuous crest. The apices of the spinous processes may, however, have been distinct. So much as is left of the base of this crest shows that it was thickest at the sixth and seventh vertebræ (of the thirteen), and that it became thinner both anteriorly and posteriorly.

The spinous process of the twelfth vertebra, forming the termination of the crest, appears to have ended in a free, thin, but rounded edge. What remains of the spinous process of the thirteenth vertebra, on the other hand, thins off anteriorly to a natural edge, which is inclined upwards and backwards. Posteriorly the spinous process becomes very thick and stout, and appears to have had a considerable height. It ends in a fractured hinder margin.

The broad wing-like plates which represent the coalesced transverse processes of the first, second, and third vertebræ of the thirteen, exhibit distinct articular surfaces for the capitula and tubercula of ribs. Further back, the natural edges of the apophysial ridges are broken away, up to the eighth vertebra. Here they are entire on the left side and broken on the right; but, curiously enough, the broken processes are higher than the entire ones, so that the transverse processes in this region of the body must have been asymmetrically developed. The thirteenth vertebra presents peculiarities which could only be made intelligible by a lengthened description, and by figures. The contours of the articular processes become first distinctly traceable at the posterior part of the eleventh vertebra. They are better marked at the posterior part of the twelfth, and at the anterior part of the thirteenth vertebra.

The nervous foramina are not intervertebral, but pierce the arches of the vertebræ throughout the series. In the thirteenth the outlet of the foramen is separated, by a longitudinal bar of bone, into an upper and a lower division.

The posterior part of the thirteenth vertebra is much injured, and does not adjust itself naturally to the anterior end of that part of the lumbar region of the vertebral column (consisting of two vertebræ) which remains continuously anchylosed with the sacrum. One or two vertebræ may possibly be wanting, or even three; but I conceive the last to be the extreme limit of the deficiency*.

The great Priodont Armadillo has twenty dorso-lumbar vertebræ. If the *Glyptodon* had the same number, there would be three missing; for there are two dorsal vertebræ in the trivertebral plate, thirteen follow it, and two lumbar are anchylosed with the sacral, making altogether seventeen.

The 'sacrum,' composed of anchylosed lumbar, proper sacral, and coccygeal vertebræ, contains at fewest twelve, and perhaps thirteen vertebræ. The centra of the two lumbar vertebræ and of the two proper sacral vertebræ which follow them are preserved. They are thin and broad plates, flat above and slightly concave below, exhibiting a most marked contrast with the half-cylinder of the hindermost of the thirteen dorsal vertebræ above described. It would seem to require the interposition of at least two, if not three, vertebræ to effect the transition of the one form of centrum into the other.

The last coccygeal is the only vertebra among all those preserved the centrum of which exhibits characters at all like those of an ordinary mammal, its terminal face being a very broad oval, slightly concave, disk. The centrum of the penultimate coccygeal is much flatter and narrower; and this flattening and narrowing predominates still more in the antepenultimate and that vertebra which lies before it, or the fourth from the end. From this point to the two anterior sacrals the floor of the vertebral canal is completely broken away, but there can be no doubt that the centra were represented by a thin bony plate.

The line of the centra of the coccygeal vertebræ forms a very marked arch behind the two sacral vertebræ, whose centra form a nearly horizontal floor; while the dorso-lumbar vertebræ (including the trivertebral bone) form a second arch, flatter than the first.

The spinous processes of all these lumbo-sacro-coccygeal vertebræ, up to the fourth from the end inclusively, are anchylosed together in a long and strong osseous crest, broad and extremely rugose above, eight inches high in front, but slowly diminishing as it follows the curve of the centra posteriorly to five inches.

The spinous process of the penultimate coccygeal vertebra is very thick, but is broken short off. It was probably not less than 4 inches high, and afforded a middle point of support for the carapace between the ischial protuberances. The sides of the median crest, and of the two vertebræ which appear to constitute the true sacrum, are anchy-

* Unless I greatly err in my interpretation of the photographs, these three missing vertebræ are preserved in the Turin *Glyptodon*.

losed firmly with nearly the whole of the inner edge of the vast ilium. Behind these the vertebræ seem to have been devoid of transverse processes, as far as the fourth from the end. But the antepenultimate had a long and slender transverse process on each side; the penultimate has an equally long but much stouter process, while the last coccygeal vertebra has transverse processes of no less length, and extremely stout.

The expanded distal ends of these processes unite with one another, and with the inner surfaces of the greatly expanded ischia.

The ilia are immense quadrate bones, slightly concave anteriorly and posteriorly, with their planes so directed as to form rather less than a right angle forwards with the vertebral column. The crest of each iliac bone is thick, expanded, and rugose, and so arched as evidently to have afforded attachment and support to the carapace; which therefore rested directly, partly on the three transversely disposed pillars afforded by the coccygeal vertebræ and the two ischia, partly on the longitudinally arched crests of the sacrum and of the thirteen dorsal or dorso-lumbar vertebræ, and partly on the second great transverse support yielded by the arched crests of the ilia. Apart from their anchylosis, the whole of the parts named must have been practically fixtures in consequence of this arrangement of the carapace; and the only moveable parts of the vertebral column must have been the tail (of which unfortunately no portion has been found in the present specimen), posteriorly moveable on the last coccygeal vertebra,—the trivertebral bone with its two pair of ribs, capable of an up-and-down motion on the foremost of the thirteen vertebræ,—and then the cervicals, more or less moveable upon the anterior part of the trivertebral bone and upon one another.

I am not aware of the existence of any mammal in which the vertebral column presents characters of a similar singularity.

The mobility of the rib-bearing trivertebral bone, by a hinge-joint upon the rest of the vertebral column, is peculiarly anomalous. However, if, as appears to have been the case, the heads of the ribs attached to this bone were incapable of movement, and the first rib was furthermore directly anchylosed with the sternum, respiration must have been carried on entirely by the diaphragm, if the anterior dorsal vertebræ had been immoveable on the posterior ones. The hinge-like movement of the trivertebral bone, on the other hand, by permitting the ribs and sternum to describe a longitudinal arc alternately downwards and forwards, and upwards and backwards, would allow of a most efficient bellows-action of the thorax, similar in principle to that effected by the ordinary movements of the ribs.

The trivertebral bone is about	6	inches long.
The thirteen vertebræ along their convexity ..	$29\frac{1}{2}$	,,
The sacrum	$35\frac{1}{2}$	,,
If three lumbar vertebræ are wanting allow ..	9	,,
	80	

Judging by the analogy of the Armadillos with which the *Glyp-*

todon presents such close resemblance, and from the shortness of such cervical vertebræ of *Glyptodon* as can be reconstructed, the neck did not exceed in length $\frac{1}{10}$th of the length of the vertebral column from the first dorsal to the last coccygeal. That would give 8 inches for the neck, and would give a grand total for the spinal column, exclusive of the tail, of 88 inches, or 7 feet 4 inches. The length of the carapace of *Glyptodon clavipes* in the Museum of the Royal College of Surgeons is 5 feet 7 inches.

The carpus of *Glyptodon* is in some respects very like that of *Dasypus sexcinctus*, but it consists of eight bones instead of seven, the trapezium and trapezoid being perfectly distinct, instead of forming a single bone as in *Dasypus*. The scaphoid articulates with the os magnum, and the cuneiform with a metacarpal, as in *Dasypus*. But it is not a little remarkable that, whereas in *Dasypus* it is the fifth metacarpal whose proximal end partially articulates with the cuneiform, in *Glyptodon* the corresponding bone articulated wholly with the cuneiform, and not with any of the distal row of carpal bones. The metacarpal articular end of that bone is, in fact, divided into two facets—an inner, larger, which articulates with part of the proximal end of the fourth metacarpal, and an outer, smaller, which is appropriated by the proximal end of the fifth metacarpal.

That the cuneiform should articulate with two metacarpal bones, and that the unciform should not articulate with the fifth metacarpal at all, are very remarkable peculiarities of the wrist of *Glyptodon*.

The pisiform is a large curved bone, the proximal end of which articulates by a large facet with the ulna, and by a small one with a facet on the palmar aspect of the cuneiform. It closely resembles the same bone in Armadillos.

The trapezium and trapezoid, taken together, have a form closely resembling that of the single trapezio-trapezoid of *Dasypus*. The trapezium possesses only a very small double articular facet on its palmar face. If this gives support to a metacarpal, it must have been very small; and as at present neither it nor any of the hallucal phalanges have been discovered, it is possible the pollex may have been altogether rudimentary. In any case the pollex must have been so much smaller and more slender in proportion than that of *Dasypus*, that the animal must have had a practically tetradactyle fore foot.

The second metacarpal is the longest of all which have been discovered, but is not quite so thick as the third. Its proximal end articulates with the trapezium, trapezoid, and magnum.

The third metacarpal, an almost cuboidal bone, but broader than long, articulates with the magnum, the cuneiform, and the adjacent metacarpals.

The fourth metacarpal, still shorter and broader in proportion, articulates with the unciform and cuneiform, and with the adjacent metacarpals.

The fifth metacarpal has not been found. The two proximal or first and second phalanges are very short, broad, discoidal bones in the second and in the third digits; and the second, which alone exists, in the fourth digit has the same character. The proximal phalanges of the fifth digit have not been found.

The distal or third phalanx is a broad bone, squarely truncated at the extremity, and longer than the rest of the digit, in the second, third, and fourth, and presumably in the fifth digit. Each of these phalanges is thicker on one side than on the other, so that the upper surface, which is convex from side to side, and also from before backwards, slopes from the thick towards the thin edge.

The distal phalanx of the second digit has its thick edge on its ulnar side, but all the others have their thick edges radial. The distal phalanx of the fifth digit is more pointed, smaller, and thicker in proportion than the others.

The hind foot is quite normal in structure, possessing five toes and the regular number and disposition of tarsal, metatarsal, and phalangeal bones. The third or middle digit is the longest, and its distal phalanx is the longest of all. It is nearly square, and its outer and inner edges are almost equally thick. The distal phalanges of the other toes are all thicker on the side turned towards the middle toe. That of the second toe is almost as square as that of the third; but the distal angles of that of the third and fourth are bevelled off on the fibular side, while the terminal phalanx of the hallux is similarly bevelled off upon the tibial side. The metatarsal bones have the same thick prismatic form, and the proximal phalanges the same discoidal character as in the fore foot.

The calcaneal process is directed outwards at an angle of 45° from the axis of the foot, and must have been much raised in the natural position.

While the work of restoration, whose results have just been briefly detailed, was going on, we learned from Dr. Falconer that a nearly entire specimen of a *Glyptodon* was exhibited in the Museum at Turin. An application was at once made to the authorities of the Museum for information, and, if possible, for photographs of this skeleton, and was responded to with the most obliging readiness.

These photographs of a skeleton in some respects more, in others less perfect than that of the College, have confirmed the conclusions already arrived at in the most satisfactory manner; and I trust before long to be in possession of descriptive details of parts of this specimen which are wanting in our own, and which will enable me to complete the anatomy of the skeleton of the gigantic extinct Armadillo.

ZOOLOGICAL SOCIETY.

June 10, 1862.—Professor Busk, F.R.S., in the Chair.

List of Mammalia from the Camaroon Mountains, collected by Capt. Burton, H.M. Consul, Fernando Po. By Dr. J. E. Gray, F.R.S.

Crocidura morio, sp. nov.

Uniform rather brownish black, rather paler and browner beneath.

Teeth white. Feet very slender, weak. Tail nearly as long as the body and head, very slender, annulated, covered with very short closely adpressed hair.

Length of body and head, dry, $2\frac{3}{4}$ inches; tail, dry, 2 inches.

"*Mole* from Camaroon Mountains, 7000 feet above the level of the sea, January 1862."

Sciurus Isabella, sp. nov.

Yellowish brown, minutely grizzled, with four broad dorsal streaks —the two central from the crown of the head to the base of the tail, the side ones from the shoulder only; the underside whitish grey. Tail slightly annulated.

Length of body and head 7 inches; tail 5 inches.

"*Squirrel* from the Camaroon Mountains, 7000 feet above the level of the sea, January 1862."

I have great pleasure in naming this beautiful new species after Mrs. Isabel Burton,—her husband, the discoverer of it, having requested that any novelty that might be in the list should be so named.

Anomalurus Beecroftii, Fraser.

"A *Flying Squirrel*, shot in the Camaroon Mountains, 7000 feet above the level of the sea. Colour of the eyes dark grey. January 18, 1862."

Mus maura, sp. nov.

Fur very soft and silky; above black, slightly marked with brown from the minute brown tips of the hairs; beneath whitish—the hair of the underside black, white-tipped. Teeth very narrow, orange. Ears rounded, moderate. Sides of the nose and edge of the orbits black. Eyes covered with very short close-pressed hairs. Tail very long, slender, closely annulated with very slender, very short adpressed hair.

Length of body and head $4\frac{1}{2}$ inches; tail 5 inches; hind foot very nearly 1 inch.

"Camaroon Mountains, 7000 feet above the level of the sea."

Euryotis irrorata, sp. nov.

"*Rat* from the Camaroon Mountains, 7000 feet above the level of the sea. January 1862."

I am not certain about this species until I can compare the skull with those of the other species of the genus from Africa, as they are all very similar externally.

With these animals was sent the skin of a Chimpanzee without its skull, but with the bones of the hand and feet enclosed in the skin. This skin differs from all the other specimens of this species which I have seen, in being covered with much more abundant and softer fur, and in the fur of the back being of a brown colour, from the large brown tips to the blackish hair. It would seem to indicate a distinct variety or species, which may be designated, until we receive better specimens and more particulars, *Troglodytes vellerosus*.

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

Descriptions of Three New Species of Pitta from the Moluccas. By Alfred Russel Wallace.

These birds are brought before the Society, detached from the collections of which they form a part, because a Monograph of the *Pittidæ*, by Mr. Elliot, is now in course of publication, and it is desirable that they should be described in England before appearing in a foreign work.

They are interesting as showing the permanent modifications in form of these semiterrestrial birds, in islands within sight of each other. I may mention as a curious fact, that the great island of Ceram appears to contain no *Pitta*, although one or two species occur in almost all the other islands of the Moluccan group. I have myself collected for several months in various parts of Ceram and Amboyna, without seeing or hearing of the genus; and the natives were positive no such bird was to be found in their country. The naturalists collecting for the Leyden Museum were not more successful; and recently a German ornithologist, M. Rosenberg, has resided some years in the island, and up to the time of my departure had seen no *Pitta*. This is the more remarkable, as in the little island of Banda, within sight of Ceram, a species exists which, with two others, I now proceed to describe.

Pitta rubrinucha.

Head reddish brown, darker behind, where there is a subquadrangular spot of bright red, and above it an obscure blue vertical stripe; back dull olive-green, shading into slaty blue on the wings and tail; quills blackish, with a white spot on the third and fourth; a small white spot on the shoulder; underside with the slaty-blue breast and crimson belly, exactly as in *P. celebensis*, but the black line separating the two colours is narrower. Bill blackish horn-colour; feet light dull blue; iris pale olive-brown.

Total length 7 inches; wing $3\frac{3}{4}$ inches; bill, from the gape, 1 inch.

Hab. Island of Bouru (Moluccas).

Remark.—This species is at once distinguished from its near ally, *P. celebensis*, by the red nuchal spot, and by having much less blue on the wing- and tail-coverts. It is also considerably smaller.

Pitta Vigorsi.

Pitta Vigorsi, Gould, Birds of Australia, vol. iv. pl. 2.

I had proposed a name for this species, supposing it to be new, and misled by Bonaparte's 'Conspectus,' which gives "*gula nigra*" as a character of *Vigorsi*. Having since, at Mr. Gould's suggestion, compared my bird with the type in the Museum of the Linnean Society, I find it to be the same. My specimen is a fine adult male, and differs from Gould's figure and description in having the bill entirely black, and in the red of the under parts being much mixed with black on the breast.

Total length 7 inches; wing $4\frac{3}{5}$ inches; bill, from gape, $1\frac{1}{8}$ inch.
Hab. Banda Island (Moluccas).
Remark.—The habitat "Australia" is probably a mistake, as the birds of this genus are very local, and no well-authenticated specimen has ever been received from that country.

Pitta crassirostris.

Similar in colour to *P. Vigorsi*; but the superciliary stripes are altogether pale rufous, the colour beneath is lighter (agreeing with *P. concinna*), and the chin is black, which colour extends in a triangle on to the throat, without being produced into a stripe, as in *P. concinna*. Bill black, with the base of the lower mandible horny; feet very pale flesh-colour; iris black.
Total length $7\frac{1}{4}$ inches; wing $4\frac{5}{8}$ inches; bill, from gape, $1\frac{1}{8}$ inch.
Hab. Sula Island (Xulla of the English maps), E. of Celebes.
Remark.—This species differs from its nearest allies by its very strong bill, as well as by the peculiarities of colouring above described. It is very like Temminck's figure of *P. irena* from Timor; but that species appears to have much more blue on the back, and the bill entirely black, and not so strong. It is also highly improbable that the same bird should be found in such distant localities, when so many of the neighbouring islands have each their peculiar species.

Descriptions of New Species of Reptiles and Fishes in the Collection of the British Museum. By Albert Günther, M.A., M.D., Ph.D., F.Z.S.

Chloroscartes.

(Fam. Agamidæ.)

Head short, body and base of tail compressed, tail exceedingly long. Head covered with numerous smooth, small shields; all the scales keeled, small, those of the belly and tail being the larger; scales on the throat conical. Femoral pores very prominent, in a longish series; præanal pores none. A low crest of triangular scales on the neck; a series of enlarged, sharp scales along the median line of the back and tail. Fingers five, and toes five, all elongate, and armed with sharp claws; the middle toe fringed along the basal joints. Throat with a small pouch and cross fold. No prominent scales at the ear.

Chloroscartes fasciatus.

Grass-green, with three very broad dark-green cross bands.
Feejee Islands.
Description.—Head rather elevated and obtuse; pouch below the throat and transverse fold in front of the shoulder well developed; body and basal portion of the tail compressed, the latter rounded in the middle and posteriorly, tapering, three or four times as long as the body. The fore limbs extend backwards to the loin; the third and fourth fingers are equal in length. The hind limbs are as long

as the trunk; the third toe has a series of enlarged triangular scales along its inner margin, forming a serrated edge.

Shields on the upper and lateral parts of the head very numerous and smooth. Nostril in a single somewhat elevated shield, situated above the second and third upper labials. Rostral shield much broader than high, subtriangular; nine upper labials, the posterior being considerably lower than the anterior; there are three or four series of small shields between the labials and the eyelid; eyelids entirely scaly. Seven lower labials; scales on the throat conically elevated. Scales of the upper parts of the body very small, of equal size, each with a short keel or conical protuberance. A low crest, formed by compressed triangular scales, runs from the occiput towards the middle of the tail, where it is gradually lost. Scales on the belly in transverse, slightly oblique series, small, but much larger than those on the sides, strongly keeled. Limbs with keeled scales of moderate size. The scales of the middle and posterior parts of the tail are much larger than those on its basal portion; all are keeled, the keels forming continuous longitudinal ridges. Each femur with a series of twelve to fourteen large pores filled with a greasy substance; præanal pores none.

Tympanum larger than the eye.

Each jaw with eighteen to twenty teeth on each side; teeth tricuspid, the lateral points being small; palatines with small teeth posteriorly.

Bright grass-green; head and nape of the neck, three broad cross bands on the trunk, and about fourteen broad rings round the tail dark green. Nasal shield white.

	inches.	lines.
Total length	27	0
Length of head (to tympanum)	1	2
,, trunk (from tympanum to vent)	4	5
,, tail	21	6
,, fore limb	2	11
,, third finger	0	9
,, hind limb	4	0
,, third toe	1	0
,, fourth toe	1	3

Phrynobatrachus.

(Fam. Ranidæ.)

Skin with large flat warts. Fingers quite free; toes half-webbed; head pointed; tongue elongate, deeply notched behind; vomerine teeth none; eustachian tubes small, tympanum entirely hidden.

Port Natal.

Phrynobatrachus natalensis.

A fold of the skin between the fore limbs; greyish olive, marbled with darker. Metatarsus with two tubercles, tarsus with a third on the middle of its inner edge.

Description.—Forehead flattish, without canthus rostralis; sides of the head subvertical; snout somewhat pointed and rather longer than the eye; eyes of moderate size, with round pupil, rather distant; a fold in front and behind the orbit. Inner nostrils and eustachian openings small; lower jaw without prominences; tongue longish, deeply nicked behind. Body and limbs rather stout; back and sides with numerous large, smooth glands; belly smooth; an indistinct cross fold between the fore legs. The fore leg, if laid backwards, does not extend to the vent; fingers and toes tapering; the first and third fingers are equal in length, and longer than the second and fourth. Hind legs much longer than the body; toes two-thirds webbed, the third a little longer than the fifth. Dark-greyish olive, marbled with darker; an indistinct light streak between the eyes. Lower parts dirty whitish; throat with some obscure dark spots.

	lines.
Length of the body	15
,, fore leg	8
,, hind leg	23
,, tarsus with fourth toe	$7\frac{1}{2}$

A single specimen was in a collection sent by Mr. T. Ayres from Port Natal.

CENTROPOGON MARMORATUS.

D. $\frac{16}{9}$. A. $\frac{3}{6}$. V. 1/5. L. lat. 68.

The third to sixth dorsal spines are the longest, half as long as the head; the second anal spine longer and stronger than the third. Yellowish, marbled with brown.

Moreton Bay.

Description.—This species is similar to *Centropogon australis*, from which it will be readily distinguished by the shorter third dorsal spine, which in *C. australis* is two-thirds as long as the head. The height of the body is contained thrice and a half in the total length; the length of the head thrice and a quarter. Head slightly compressed, with deep grooves along the interorbital space, which is concave and much narrower than the orbit; there is a slight groove behind the orbits, across the occiput. Snout shorter than the eye, the diameter of which is scarcely more than one-third of the length of the head. Cleft of the mouth slightly oblique, of moderate width, the maxillary extending beyond the front margin of the orbit; jaws equal in length anteriorly. Each turbinal bone with an obtuse spine superiorly; præorbital spine strong; præoperculum with five spines, the upper of which is the longest; operculum with two ridges; spines on the occiput small and obtuse. Head naked, without cutaneous appendages; vomerine teeth in a narrow angular band.

The dorsal fin commences immediately behind the occiput, its spines are of moderate length and strength; the third to the sixth are the longest, half as long as the head; the following decrease in length, the last, again, being a little longer than the penultimate; the soft dorsal rather more elevated than the spinous, short, the length of its base being contained thrice and a fifth in that of the spinous dorsal. Caudal fin scaleless, rounded, contained four times and two-thirds in the total length. The anal commences opposite the fourteenth dorsal spine; its second spine is the longest, contained twice and two-thirds in the length of the head. The pectoral has the rays branched, and extends nearly as far backwards as the ventral, which is composed of a strong spine and five soft rays; the region round the base of the pectoral and ventral fins is naked, covered with soft skin.

The gill-membranes are scarcely united below the throat. There is a distinct cleft behind the fourth gill*.

Length of the specimen, 3 inches.

CATOPRA SIAMENSIS.

D. $\frac{13}{15}$. A. $\frac{3}{9}$. L. lat. 27. L. transv. $\frac{5\frac{1}{2}}{13}$.

The height of the body is contained twice and a third in the total length. Cheek with six series of scales, the lower of which covers the præopercular limb. Body with eight dark cross bands; scales on the nape with some minute whitish dots; the outer edge of the ventral white.

Siam.

Description.—The height of the body is contained twice and a third in the total length, the length of the head thrice and a third; head as high as long. Snout rather shorter than the eye, the diameter of which is one-fourth of the length of the head, and equal to the width of the interorbital space. The lower jaw is scarcely longer than the upper, and the maxillary extends slightly beyond the anterior margin of the orbit. Two nostrils remote from each other, both very small. Præorbital and angle of the præoperculum slightly serrated; opercles, throat, and isthmus entirely scaly. The dorsal fin commences above the end of the operculum, and terminates close by the caudal; its spines are very strong, and can be received in a groove; the fifth, sixth, and seventh are the longest, not quite half as long as the head; the last spine is shorter than the penultimate; the soft dorsal is elevated and scaly at the base. The second anal spine is exceedingly strong, rather stronger and longer than the third, and not quite half as long as the head; the soft anal is similar to the soft dorsal. Caudal fin rounded, slightly produced, one-fourth of the total length; its basal half is scaly. Pectoral rather narrow, as long as the head without snout. The ventral is inserted immediately behind the base of the pectoral; it has a strong spine, and extends to the vent.

Scales minutely ciliated; the upper part of the lateral line terminates below the last dorsal rays, the lower commences above the third anal spine.

Gill-membranes united below the throat, not attached to the

* I have been induced by that circumstance to re-examine *C. australis*, and have found a very small opening behind the fourth gill; so that the presence of such a narrow cleft is to be introduced into the diagnosis of the genus *Centropogon* (Catal. Fish. ii. p. 128).

isthmus, scaly. Four gills, a slit behind the fourth; pseudobranchiæ none.

The jaws, vomer, palatines, and upper and lower pharyngeals are armed with bands of small villiform teeth. Very remarkable are two large, ovate, dentigerous plates, one at the roof, the other at the bottom of the mouth, in front of the pharyngeals; these plates are slightly concave in the middle, pavimentated with molar-like teeth, and have evidently the same function as the pharyngeal dentigerous plates of the true Pharyngognathi.

Total length 52 lines.

When I composed the generic characters of the genus *Catopra* from Bleeker's accounts, I had not seen a specimen of these fishes, and I described their peculiar dentition in very indistinct terms. The teeth ought to be described thus:—Villiform teeth in the jaws and on the vomer and palatine bones; a large patch of molar-like teeth on the præsphenoid and on the basihyal.

CATOPRA TETRACANTHUS.

D. $\frac{15-16}{11}$. A. $\frac{4}{8}$. L. lat. 26. L. transv. 3/9.

The height of the body is nearly one-third of the total length. Cheek with four series of scales, the lower præopercular limb being naked. Coloration uniform?

East Indies.

Description.—The height of the body is nearly one-third of the total length, the length of the head two-sevenths; head a little longer than high. The length of the snout equals the diameter of the eye, which is contained thrice and two-thirds in the length of the head. The width of the interorbital space is considerably less than that of the orbit. The lower jaw is scarcely longer than the upper, and the maxillary extends slightly beyond the anterior margin of the orbit. Two nostrils remote from each other, the anterior minute. Præorbital and angle of the præoperculum slightly serrated; opercles, throat, and isthmus entirely scaly. The dorsal fin commences above the root of the pectoral, and terminates at a short distance from the caudal; its spines are of moderate strength, those in the middle being the longest, a little more than one-third of the length of the head; the last spine is a little longer than the penultimate; the soft dorsal is somewhat elevated and not scaly. The three posterior anal spines are nearly of equal length and strength, two-fifths of the length of the head. Caudal rounded, scaly at the base, one-fourth of the total length.

Scales minutely ciliated.

The jaws, vomer, palatines, and upper and lower pharyngeals are armed with bands of small, villiform teeth, the jaws having a pair of small canine-like teeth anteriorly. The roof and the bottom of the cavity of the mouth have an elongate band of granular teeth, the lower not being confluent into one plate.

The coloration appears to have been uniform.

Two specimens, 54 lines long, were transferred from the collection of the East India Company to the British Museum.

Pseudochromis perspicillatus.

D. $\frac{3}{25}$. A. $\frac{3}{14}$. L. lat. 45.

Reddish-olive (in spirits), with a chestnut-brown band running from the extremity of the upper jaw through the middle of the eye to the middle of the base of the dorsal fin; the band is very dark and slender anteriorly, gradually becoming lighter and broader posteriorly.

China.

Description.—The height of the body equals the length of the head, and is contained thrice and a third in the total (without caudal). Head longer than high; cleft of the mouth oblique, with the jaws subequal anteriorly, and with the maxillary extending to behind the vertical from the front margin of the orbit. Snout a little longer than the orbit, the diameter of which is one-fourth of the length of the head. The width of the interorbital space, which is scaly, is less than that of the orbit. The lower jaw with two, the upper with three pairs of canine teeth. Scales on the cheek in six series. Caudal fin subtruncated, with an upper and lower ray produced into a filament.

Several specimens are in the collection of the British Museum; one of the largest is 42 lines long.

Amblyopus sagitta.

D. $\frac{6}{21}$. A. $\frac{1}{20}$.

The height of the body is one-twelfth of the total length; vertical fins united; caudal very long, arrow-shaped; teeth small, in a single series; eyes rudimentary.

California.

Description.—Body elongate, compressed, covered with small, imbricate, cycloid scales, which become larger posteriorly. Head elongate, subquadrangular, one-seventh of the total length (with the caudal), and two-thirds of the distance between the vent and the base of the ventral fin. Teeth very small, subhorizontal, in a single series. Cleft of the mouth oblique, rather wide, the maxillary extending to behind the eye; lower jaw prominent; eye very small. Ventral fins confluent; caudal arrow-shaped, nearly one-fifth of the total. Pectoral as long as the ventral, and half as long as the head. Upper parts grey, lateral and lower silvery; an ovate grey spot before each dorsal ray; caudal grey.

Four specimens of this fish have been procured for the British Museum. The largest of them is $9\frac{1}{2}$ inches long.

This is the most aberrant form of the genus *Amblyopus*; although closely allied to *A. Broussonetii*, it differs in its more feeble dentition and in its larger scales. *A. Broussonetii* has 11/16 vertebræ, *A. sagitta* 11/20. If the genus *Gobioides* of Lacépède be adopted, another must be created for *A. sagitta*, and the sections may be arranged as follows:—

AMBLYOPUS, Gthr.

A. Teeth in a band, with an outer series of stronger ones.
 * More than twenty-five soft dorsal rays : *Amblyopus*, C. & V. East Indies.
 ** Less than twenty soft dorsal rays : *Gobioides*, Lacép. Peru and Guayaquil.

B. Teeth in a single series : *Tyntlastes*. California.

DESCRIPTIONS OF SOME NEW CORALS FROM MADEIRA. BY JAMES YATE JOHNSON, COR. MEM. Z.S.

Fam. ACANTHOGORGIADÆ, J. E. Gray.

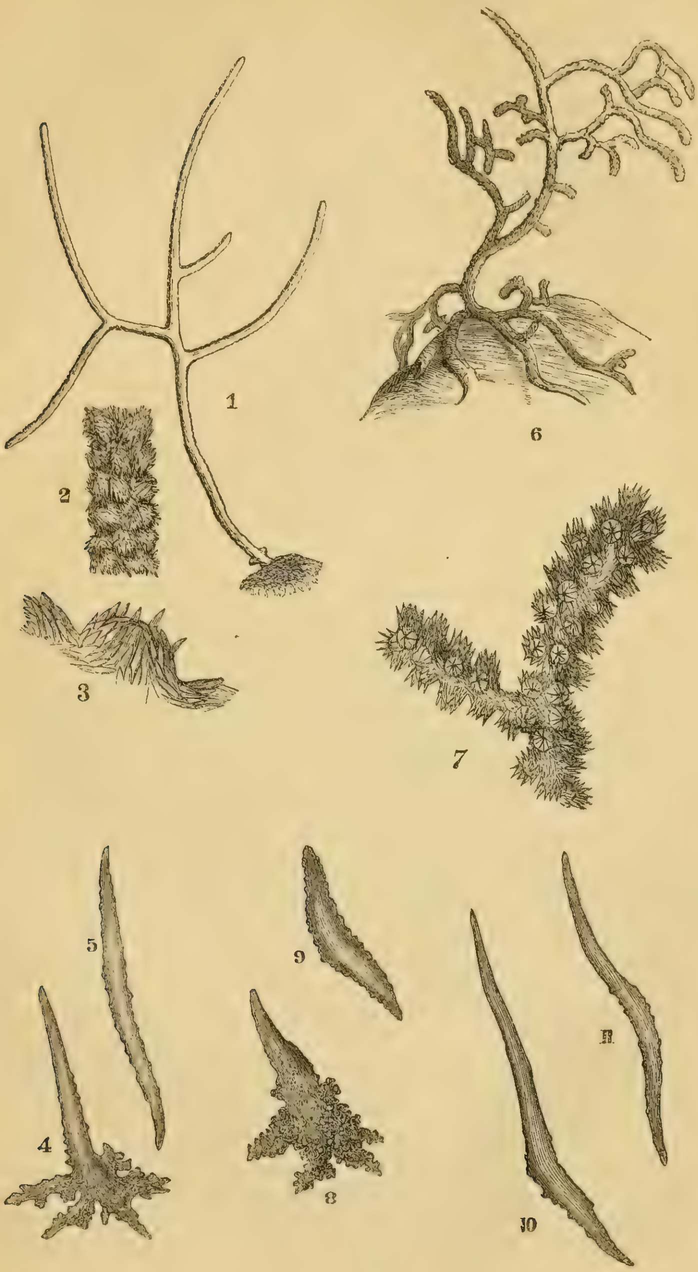
ACANTHOGORGIA ATLANTICA, sp. n.

Since the occurrence of a specimen of *Acanthogorgia Grayi*, of which I laid a description before the Society last year (Ann. Nat. Hist. 1862, ix. 75), another form of the genus has been discovered. This was brought up from deep water at Madeira, having become entangled in a fisherman's line. As there are obvious distinctions from the two other species of this genus, I shall venture to describe it as new.

It is of a dark-brown colour, and is very sparingly branched in one plane. The base spreads out in thin branching sheets amongst small shells and fragments of stone which adhere to it. The stem and branches, with their closely packed cells, are cylindrical, the former not much thicker than the latter. The branches are rounded at their extremities. The cells are short, cylindrical, sessile, and so crowded on all sides of the stem that they conceal it from view; whilst in the two other species of this genus the cells are widely separated, and the bark is seen between them. When the polypidom is dry, a brown, slender, horny axis, without spinulæ, stands distinct from the bark, as in the other species. This axis, when softened and submitted under pressure to the microscope, is seen to consist of fibres bearing a general similarity to those composing the axis of *Antipathes*. Round the orifice of each cell project large spicula, and smaller spicula strengthen the sides of the cells and the bark. The spicula are intermediate in character between those of *A. hirsuta* and *A. Grayi*, being less slender than those of the first species, and less stout than those of the second. The great spicula round the mouth of the cell have their exposed portions spinulose or tuberculated (not smooth as in *A. hirsuta*); their bases are branched (as in *A. Grayi*), and they are much less marked with the tubercles which roughen the bases of the last-named species so remarkably.

This species is distinguishable from the other two by the greater crowding of the cells, by the cells themselves being sessile and being therefore less prominent, by the paucity of the ramifications, and by the differences in the spicula already pointed out. In habit it is very distinct.

The specimen (which is now in the British Museum) has a height


1
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of 13 inches, and its branches have a spread of about 11 inches. The stem, with its cells, has a diameter of $3\frac{6}{10}$ of an inch, and the branches with their cells are only reduced to two-thirds of that diameter. Near the base are the stumps of two branches which have been broken off. Above, on one side, are two simple branches, and on the other a single forking branch. These three branches are placed not far apart near the middle of the main stem.

It ought to have been mentioned, with reference to the woodcuts of *A. Grayi* and *A. hirsuta* (Ann. Nat. Hist. 1862, ix. 75, 76), that the figures are considerably larger than the natural size.

DESCRIPTION OF THE WOODCUTS.

Acanthogorgia atlantica.

Fig. 1. Outline of the entire specimen, on a reduced scale.
Fig. 2. Portion of a branch, enlarged.
Fig. 3. A cell more highly enlarged.
Fig. 4. A spiculum from the edge of a cell.
Fig. 5. A spiculum from the side of a cell.

Acanthogorgia Grayi.

Fig. 6. Outline of a portion of the coral, on a reduced scale.
Fig. 7. A branch, enlarged, for comparison with fig. 2.
Figs. 8, 9. Spicula from the edge and side of a cell.

Acanthogorgia hirsuta.

Figs. 10, 11. Spicula from the edge and side of a cell.

Fam. Stylasteridæ.

Allopora maderensis, sp. n.

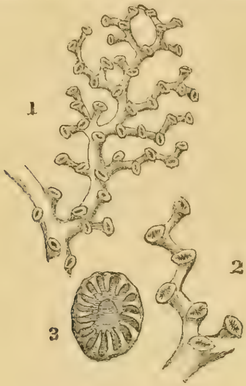
Opake white. Much and closely branching nearly in one plane, the branches becoming gradually of less diameter, and sometimes anastomosing. They zigzag from cell to cell; and the surface is finely reticulato-striate, but is without any tubercles. The cells are oblong, sessile, and always placed transversely to the branch, upon one face of the plane. The terminating cells, with their pedicels, are trumpet-shaped, but with oblong mouths, which are much wider than the stalk below. The margin of each cell is elegantly notched with from twelve to sixteen notches, with laminæ between.

The dimensions of the single specimen that has occurred (now in the British Museum) were $3\frac{1}{2}$ inches high and $2\frac{1}{4}$ inches across. The base had been broken away, and the thickest part of the remaining stem was $\frac{1}{5}$th of an inch in diameter. The longer axis of the terminal cells measured the twentieth of an inch.

The specimen was brought up by a long fishing-line on the coast of Madeira. Two examples of that curious patelliform shell the *Pedicularia sicula* were found seated on the branches. With respect to this circumstance, I may mention that Mr. S. P. Woodward has shown me a coral from the coast of Sicily, belonging to a totally distinct genus, with *Pediculariæ* upon it; and in the Coral Room at the British Museum there is another coral with the same shell still adhering to it.

The present form, though at the first glance t seems to have a general resemblance to *A. flabelliformis*, is quite distinct from that species, having the cells much larger and transversely oblong, not round. Moreover, the zigzag character of the branches is much more marked. It may, however, be worth inquiry whether it may not be the *A. infundibulifera* of Lamarck.

A. maderensis appears to show that the genera *Stylaster* and *Al-*



Allopora maderensis.

Fig. 1. A branch, with its ramuli, of the natural size.
Fig. 2. A ramulus magnified.
Fig. 3. A cell more highly magnified.

lopora ought to be united; for though there are no "petites pointes" or "tubercules vésiculaires" upon this coral (M. Milne-Edwards giving this as one of the characters of *Stylaster*), yet the gemmation is alternate and distichal—the same writer saying of *Allopora* that its gemmation is "tout-à-fait irrégulière."

Description of Two New Species of Corals belonging to the Genus Flabellum. By E. W. H. Holdsworth, F.L.S., etc.

1. Flabellum campanulatum.

Compressed, campanulate; borders straight or slightly convex; without spines. Base usually terminating in a small pedicel, sometimes irregularly compressed. Superior margin slightly arched. Cell deep and narrow. Border of lamellæ entire, sloping inwards from the apex for about one-third of their length, thence continuing straight to the bottom of the cell. Columella indistinct. Five principal lamellæ in half an inch. Height 14 lines; breadth 16 lines; proportion of axes 7 : 16.

Specimens in the British Museum are rather longer in proportion than those in my possession; but the variation is not very great.

Hab. Philippines.

This coral is very neat and symmetrical, and can hardly be confounded with any other species.

2. Flabellum nobile.

Much compressed throughout, elongated. Borders rather concave, with four or five root-like appendages more or less distant from the base, but closely united throughout their length to the lower half of the coral. These appendages spring from and are continuous with the transverse epithecal ridges which mark the successive periods of increase in the coral, and, although now intimately united to the main stem, are evidently of extraneous growth, corresponding in origin and nature with the ordinary form of spines, but taking a downward direction to increase the basal area. Upper margin of the coral slightly arched. Cell very deep and narrow. Margin of lamellæ entire, and gradually curving from apex to base, at which point opposite series of the larger plates almost unite. No columella perceptible. Four principal lamellæ in half an inch.

The two specimens which have furnished the above description are of different ages. The smaller and more perfect example is attached to the upper margin of the flat side of the larger one, and has grown in nearly the same vertical direction. It measures 2 inches 6 lines in height, and 1 inch 10 lines in greatest breadth. The older example is 2 inches 6 lines in the long diameter, and 1 inch 3 lines in the short. The base of this specimen is imperfect; so that the original length of the coral cannot be certainly ascertained.

This species is intermediate between the genera *Flabellum* and *Rhizotrochus*, having the usual compressed shape of the former, with a partial development of the radiciform appendages of the latter remarkable genus. The peculiar situation of the smaller specimen is perhaps worthy of notice, as being one in which the supplemental props are especially useful in aiding the attenuated base to support the long and heavy coral. A similar tendency to parasitic growth, or rather adhesion to another individual of its own species, may be observed in Milne-Edwards's figure of the type-specimen of *Rhizotrochus**. The species now under consideration should, I think, be placed in the genus *Flabellum*, although differing in some of its characters from most of the typical forms; and as it is the largest member of the genus, I propose to call it *nobile*.

The precise habitat of this coral is unknown. It was brought to this country by the late Sir Everard Home; and as that gentleman's collections were principally made in the neighbourhood of Australia and New Zealand, these corals were probably obtained from the same part of the world.

The specimens are now in the Museum of the Royal College of Surgeons of England.

* Milne-Edwards et J. Haime, Ann. des Sc. Nat. 3e sér. t. ix. p. 282, pl. 8. f. 16, 1848.

On the Occurrence of Caryophyllia clavus on the Coasts of Britain, with some Remarks on the Circumstances affecting the Distribution of Corals around the British Islands. By E. W. H. Holdsworth, F.L.S., F.Z.S., etc.

By the kindness of the Rev. Thomas Hincks of Leeds, I have recently been enabled to examine some specimens of coral which had been forwarded to him from Shetland, and from Loch Fyne on the east coast of Scotland. They prove to be new to Britain, and are identical with the *Caryophyllia clavus* of the Mediterranean, first described as a fossil by Scacchi in 1833, and figured and described from recent specimens under the name of *Cyathina turbinata* by Philippi in his 'Catalogue of Sicilian Mollusca,' published in 1836. Several examples of this coral have been obtained from deep water in the abovementioned localities; and an examination of characteristic specimens of different ages has enabled me also to identify with this species two small and much-worn corals which, in June 1857, were dredged from a depth of 60 fathoms, about forty miles west of Scilly, by Mr. S. P. Woodward of the British Museum, and kindly placed in my hands a short time ago by that gentleman.

This species of *Caryophyllia* may be readily distinguished from its near ally, our common *C. Smithii*, by its conical form and finely pointed base, as well as by the thinness of its walls and lamellæ. The general character of the polype, as described by Philippi*, agrees with that of *C. Smithii*; the integuments, however, are said to be excessively delicate and transparent, so that the borders of the lamellæ can be seen through them. The body is of an orange-colour, and the capitate tentacles whitish with metallic-green reflections. The coral is frequently attached to a tube of *Ditrupa*, or the shell of some deep-water univalve, or, in some cases, is entirely free. In the British Museum are several specimens of this coral which were brought from Sicily. These are all attached to a species of *Turritella*. The occurrence of this second species of *Caryophyllia* in three distinct localities on our coasts entitles it to a place among our British corals; and further investigation will probably show it to be generally distributed in the deep water along our western shores.

It may not be uninteresting to inquire here into the distribution of corals around the British Islands, and to trace, as far as possible, the cause of their frequenting only particular lines of coast.

The existence of the coral-polype in our seas is mainly dependent on the warmth and purity of the water. A tolerably high temperature is undoubtedly one of the most necessary conditions for the wellbeing of the delicate polypes whose calcareous lamellated skeletons constitute the true stony corals. Only within the Tropics do we meet with those vast reefs and extensive accumulations of coral-growth which form so characteristic a feature of the seas in those warm latitudes. The surface-water there becomes heated by the direct influ-

* Arch. für Naturgesch. t. i. p. 42, 1842.

ence of the sun, and, in those regions, few coral-polypes carry on their ceaseless work at a greater depth than 30 fathoms, thence building upward to the lowest tide-mark. As we come towards more temperate regions, the species diminish both in size and number; simple forms become proportionately more numerous, and their bathymetrical range is greatly increased.

The waters of north-western Europe might be expected generally to be too much within the influence of Polar temperature to be fitted for coral-life, even in its simplest form; yet in our own seas, and extending far into the Arctic Ocean, are found some few species vying with the productions of the Tropics in brilliancy of colouring and delicacy of structure. Here, however, we have a peculiar and extraneous source of warmth in the Gulf Stream, whose waters, now becoming widely diffused, but still retaining some portion of their original excessive temperature and motion, exercise a sensible influence on the coast-productions of the western side of the British islands. The course of the current in the neighbourhood of our shores is marked sparingly, but distinctly, by the presence of eight or ten species of living coral.

The long list of *habitats* recorded by Mr. Gosse in his valuable 'Actinologia Britannica' has been of great use to me in tracing the range of our native species; and although many parts of the coast have been but little worked, enough has been done to furnish a tolerably clear outline of the distribution of the coralligenous polypes. From the writings of Maury and others, it appears that the Gulf Stream is divided by the British Islands; one portion going southward to the Bay of Biscay, the other and main body of the current sweeping away to the north by the Orkneys and Shetland. The entrance of the English Channel and the Irish Sea would thus be under the most direct influence of the warm current; and it is in these waters we find corals most abundant. Devonshire and Cornwall are extremely rich in these productions; and, including Weymouth Bay (the only recognized locality for *Hoplangia durotrix*), the south-western promontory of England can boast of five out of the eight undoubted British species. They consist of two *Caryophylliæ*, one *Sphenotrochus*, *Balanophyllia*, and *Hoplangia*. Of these species, Guernsey produces two. *Caryophyllia Smithii*, the commonest species in the West of England, where it is found close to low-tide mark, ranges along the eastern and northern coasts of Ireland and the West of Scotland as far as Shetland, gradually increasing its depth of water as it proceeds north. It has also been met with on the western coast of Ireland; but very little has been done as yet in exploring the Atlantic sea-board of that island. Among the Hebrides and Orkneys, the fine branching coral *Oculina prolifera* has on rare occasions been met with, but only in deep water. Two species of *Caryophyllia* and the large scarlet *Ulocyathus arcticus* have been obtained in 80 or 90 fathoms near Shetland; the last-mentioned coral has also been taken by Sars at a depth of nearly 200 fathoms near the North Cape. Three other little corals have been dredged in the Moray Frith, and placed by Mr. Gosse in the genus *Paracyathus* of

Milne-Edwards. The specimens, however, are so young and imperfect that it is difficult to determine their specific characters.

If we now turn to the eastern side of Great Britain, and inquire whence come the waters of the German Ocean, we find them to be mainly of Polar origin, brought from the far north by the great surface-current which washes all the Norwegian and our own eastern coasts. To this must be added the comparatively fresh water which pours through the Sound, loaded with all the drainage of the Baltic. How does this cold and impure water affect the production of corals? Its influence is not less marked than that of the warmer western current. Through the entire length of the North Sea, from the north-eastern point of Scotland to near the Isle of Wight, I have been unable to ascertain that a single specimen of coral has ever been taken. That line of coast is also very deficient in *Actiniæ*; and of the few that are found there, most are of the commonest species. This cold water from the north, however, also skirts the western coast of Scotland and Ireland; but it is only as a narrow superficial current; and when corals are found in its neighbourhood, they are only in the deep water of the great Atlantic stream, which, still retaining some of its excess of saline matter, sinks deeper and deeper as it meets the fresher and lighter, although colder, water from the north. Thus, as has been observed, all the northern corals are found in deep water, even the same species which on the Devonshire coast is abundant at low-water mark. The late Edward Forbes, in his 'Natural History of the European Seas,' remarks that the characteristic fauna of the "Arctic province" is only to be observed in the littoral regions, and the animals from deep water are all of them southern forms.

What has been pointed out as to the causes of the particular distribution of the British corals, namely, the effect of warm and cold currents, equally applies to the formation of coral-reefs within the Tropics. A comparison of Maury's Chart of the "Sea-drift" with Darwin's Map of the Distribution of Coral-reefs would lead one to suppose they had been prepared by the same hand. I will mention two remarkable cases as illustrations. A well-known barrier-reef extends some hundreds of miles along the north-east coast of Australia; its southern limit is near Moreton Bay; and a reference to Maury's Chart shows this to be the precise point at which a cold current from the South Pole meets the warm equatorial current from the east. Again, it appears somewhat remarkable that along the whole western coast of North and South America no vestige of coral has been found. Mr. H. Cuming informs me that he has dredged in vain for specimens of these characteristic tropical productions in the Bay of Panama and at the Galapagos; but the chart shows that cold currents from the north and south sweep the whole western coasts of America, meeting at the Equator, and then turning away into the Pacific, where, under a vertical sun, the water soon becomes warm enough for the growth of the various coral-reefs scattered about in that ocean. Fresh water and sediment of any kind being present act as fatal barriers to the growth of coral; and to these causes may generally be traced gaps in reefs, and waste places of limited extent in those seas which especially abound in corals. Dana has recognized the effect of warm and cold currents in the general distribution of corals throughout the warmer seas; and the fact of the same influences being at work, and easily recognized, in the waters surrounding the British Islands appears sufficiently interesting to justify me in bringing the subject before this Society.

MISCELLANEOUS.

Pliocene Fossil Fauna of the Niobrara River, in Nebraska. By Joseph Leidy, M.D.

The researches of Dr. Leidy upon the Lower Miocene Fauna of the *Mauvaises Terres* are well known through his important memoir on the "Ancient Fauna of Nebraska," published in vol. vi. of the 'Smithsonian Contributions.' But the results of the geological survey, by Dr. F. V. Hayden, of the Pliocene deposits along the Valley of the Niobrara are less generally known. We have hitherto deferred noticing them, in the expectation that a detailed memoir, with illustrations, would have appeared on the subject by Dr. Leidy, as in the case of the Nebraska fauna above referred to; but as that has not yet taken place, a brief account of the results may be of interest.

The following is a list of the fossil Mammalia discovered in the Pliocene beds of the Nebraska, as determined by Dr. Leidy:—

Ruminantia.

Merycodus necatus, *Leid.*
Megalomeryx niobrahensis, *Leid.*
Procamelus occidentalis, *Leid.*
—— gracilis, *Leid.*
—— robustus, *Leid.*
Merychyus elegans, *Leid.*
—— medius, *Leid.*
—— major, *Leid.*
Cervus Warreni, *Leid.*

Multungula.

Rhinoceros crassus, *Leid.*
Mastodon (Tetraloph.) mirificus, *Leid.*
Elephas (Eueleph.) imperator, *Leid.*

Solidungula.

Hipparion (Hippotherium) occidentale, *Leid.*
Hipparion (Hippotherium) speciosum, *Leid.*
Merychippus insignis, *Leid.*
—— mirabilis, *Leid.*
Equus excelsus, *Leid.*
—— (Protohippus) perditus, *Leid.*

Rodentia.

Hystrix (Hystricops) venustus, *Leid.*
Castor (Eucastor) tostus, *Leid.*

Carnivora.

Leptarctus primus, *Leid.*
Felis (Pseudælurus) intrepidus, *Leid.*
Ælurodon ferox, *Leid.*
Canis sævus, *Leid.*
—— temerarius, *Leid.*
—— vafer, *Leid.*
—— epicyon, *Leid.*

The first point of general interest in the above list is the entire absence of Edentate forms in the Niobrara fauna. The same observation applies to the Miocene fauna of the "*Mauvaises Terres,*" while *Megatherium*, *Megalonyx*, and *Mylodon* occur extensively in the United States; and the leading characteristic of the fossil fauna of the Pampean deposits of South America is the abundance and variety of the Edentata.

The next most remarkable feature in the Niobrara fauna is its marvellous richness in *Solidungula,* both genera and species. Making allowance for *doubles emplois,* consequent upon the imperfection of the materials, there will still remain a very large number of Equine forms. The valley of the Missouri River, near the Rocky Mountains, appears to have been the head-quarters of the Horses, during the Pliocene period, very much after the manner in which India was the head-quarters of the Proboscidea during the Miocene period. According to Dr. Leidy's determinations, it supported not less than four generic or subgeneric types of *Equus,* namely, *Hipparion,* 2 sp.; *Merychippus,* 2 sp.; *Protohippus,* 1 sp.; *Equus,* 1 sp.; and it is further to be borne in mind that the subjacent Upper Miocene deposits of the same region have yielded two *Anchitheroid* forms,—*A.* (*Hypohippus*) *affinis* and *A.* (*Parahippus*) *cognatus*; while the Lower Miocenes of the "*Mauvaises Terres*" contain *Anchitherium Bairdi,* Leid. The post-Pliocene deposits of the littoral and central States S. E. of the Mississippi have, in addition, furnished fossil remnants which Dr. Leidy refers to *Hipparion venustum,* Leid., *Equus complicatus,* Leid., and *E. fraternus,* Leid., the last two representing the post-Pliocene fossil species of Europe. The whole make up a series of twelve North-American species, Anchitheroid Hippotherian, and Equine proper.

One statement is so unexpected that we quote it in the words of the author. Dr. Leidy observed that, "among all the Mammalian remains brought by Dr. Hayden from the Niobrara River, none were more remarkable than those which he now exhibited. They belong to an Equine animal which has the temporary teeth of *Anchitherium* and the permanent teeth of *Equus.* In both these genera the permanent and deciduous teeth are alike; but the new genus in early life is an *Anchitherium,* and later in life *a true Horse.*" The form in question appears to be *Merychippus mirabilis,* Leid.

The results yielded by the Niobrara fossil Pachydermata are equally unexpected. *Rhinoceros crassus,* Leid., is described as a species "which appears to have had almost the same size and formula of dentition as the recent Indian Rhinoceros." In *Mastodon mirificus,* belonging to the group *Tetralophodon,* "the form of the jaw is like that of the existing Elephant of India; a single tooth, the last molar, occupies each side of it, and resembles the corresponding one of *M. angustidens* of Europe or of *M. Sivalensis* of the Sivalik Hills of India." *Elephas imperator,* Leid., was a colossal species, characterized by molars nearly five inches broad, with unusually thick plates, there being only eight bands of wear within a space of seven inches,—a character which at once distinguishes this species from the Mammoth of the United States, *Elephas Americanus* of Leidy.

Dr. Leidy's determinations will probably undergo considerable modification before their final adoption by palæontologists; but the single fact of an American Rhinoceros, in Pliocene deposits, approaching the characters of the existing Indian species is of weighty import in the geographical distribution of Mammalia.

Dr. Leidy, in his general remarks upon the characteristics of the Niobrara fauna, observes that "One of the most remarkable circumstances, in relation with this extinct fauna, is that it is more nearly allied to the present recent one of the old world than to that of our own continent. From a comparison of our recent fauna and flora with that of the eastern continent, the deduction has been made, that the western continent is the older of the two, geologically speaking; whereas the Niobrara fauna would indicate just the reverse relationship of age. A number of similar instances show that totally different faunæ and floræ may be cotemporaneous, and do not necessarily indicate different periods of existence."

Dr. Leidy's enumeration and brief description of the genera and species (*op. cit.* pp. 20–29) is not in exact accordance with the tabular list given by Dr. Hayden, indicating their stratigraphical position (*op. cit.* p. 157). The Ruminant forms *Procamelus robustus* and *P. gracilis*, and the carnivorous *Leptarctus primus*, included by the latter, are omitted by the former. The list given above is founded on Dr. Hayden's enumeration, as being the later in date of publication, and probably embracing additional materials.—*Proc. Acad. Nat. Science of Philadelphia*, 1858.

On a remarkable Form of Rotation in the Pith-cells of Saururus cernuus. By George C. Schaeffer, M.D.

While examining the intimate structure of various plants, I discovered, in the year 1854, a peculiar motion in some of the pith-cells of *Saururus cernuus*, which was so different from anything before described that it seemed to be quite abnormal. Continued observation for eight years has shown however that, for this plant at least, the phenomenon is constant, while an equally long-continued examination of the writers on such subjects has proved that no record of this appearance has ever been made. As a mere microscopical curiosity the fact might be deemed worthy of notice; but the remarkable similarity to a motion which has been considered as invariably connected with a distinct and peculiar vegetable function seems to render its record needful for the true advancement of vegetable physiology.

The *Saururus cernuus*, like many other aquatic or marsh plants, has a pith the cells of which are not in complete juxtaposition, but separated in part by vertical air-passages which are as regularly built around by the cells as a chimney is by its bricks, with this difference, however, that the cells are arranged directly one above another, and do not "break joint" as the bricks would in any properly constructed chimney: no fault in Nature's workmanship, we should remark, since the pith is a mere filling in, surrounded by a much denser and more solidly built structure.

The cells in which the above-mentioned motion occurs are not those from which the party-walls of each air-passage diverge, but those forming the middle of the wall between any two contiguous channels; they seem to be smaller and *younger* cells than the others.

In all ordinary cases of *cyclosis* the motion is along the walls of the cell, coming and going in paths which are, for the time at least, permanent. But in the *Saururus* the granules lie in the centre of the cells above described, and their motion is of a quite different character. To those familiar with microscopic observations, we may best describe this motion as perfectly identical with that seen in the so-called vesicles in the ends of *Closterium*, which has been aptly styled "swarming" by the English and Germans. The granules are quite minute, rounded in form, and rather unequal in size. Sometimes a cell is seen in which all motion has ceased; in such cases the granules are always closely crowded together in the centre of the cell.

The time during which this motion continues is quite remarkable. Specimens of the plant kept for several days in water never fail to show it; while the proper pith-cells of all parts of the plant, even of the blanched portions of the stem growing beneath the mud, seem equally active. Indeed, no form of *cyclosis*, of which this is undoubtedly one, is so easily demonstrated.

The nature of the granules, however, is not so readily determined; for they do not show the starch-reaction with tincture of iodine, neither are they coloured as proteine-compounds (and such I had at first supposed them to be) would be under this reagent. There is, however, a remarkable difficulty, common also to many others, in applying chemical tests to sections of this plant; and this consists in the rapid discoloration of the specimens, owing to the presence of tannic acid, which acts upon the iron of the cutting instrument. It is quite certain, however, that the granules are neither starch nor proteine; whether they are the so-called aleurone I am unable to say.

To those familiar with the microscopic examination of freshwater algæ, this "swarming," apart from the best-known case of the *Closterium*, must be quite familiar; but such motions have always been considered as in some way connected with sexual reproduction. In the case in question, however, nothing of the kind can possibly occur; for the *Saururus* is, beyond a doubt, not only a phænogamous, but even a dicotyledonous plant, closely allied to the Pepper family. The cells in which this motion is seen are evidently smaller and younger than those in their immediate vicinity. Sometimes, indeed, two vertical rows of small cells show the same motion. The phenomenon in question would therefore merely indicate *active cell-multiplication*, and not *plant-reproduction*, to which similar appearances have always been referred. With a somewhat extensive experience I am able to say that nothing of the kind has before been observed in phænogamous plants; yet it must be admitted that one single instance among them is sufficient to invalidate the inferences formerly drawn from algæ, as to the true meaning of this peculiar kind of motion.

I am more earnestly disposed to insist upon this apparently exceptional case, because it confirms views long held and taught by myself as to the purely physico-chemical interpretation of most of the phenomena of vegetable life.—*Silliman's Journal* for Nov. 1862.

Washington, D. C., September, 1862.

Application of Magenta Dye in Microscopical Investigations.

At a recent meeting of the Microscopical Section of the Literary and Philosophical Society of Manchester, Dr. Roberts called attention to the aid that might be received in the examination of the structure of animal and vegetable tissue by the use of colouring materials. Magenta is peculiarly adapted for this purpose, in consequence of its solubility in simple water and its inert chemical character. The nuclear structures of animal cells are deeply tinted by magenta; and by its use the nuclei of the pale blood-corpuscles, of pus-globules, of the renal and hepatic cells, and of all epithelial structures are brought out in great beauty, tinted of a bright carbuncle-red. The *red* blood-disks are tinted of a faint rose-colour, and a darker red speck, not hitherto noticed, is to be observed on the periphery of the corpuscle; it undergoes some changes when treated with tannin and subsequently with caustic potash, but this point is still under investigation.

On a new Phyllodactylus *from Guayaquil.* By W. Peters.

Phyllodactylus Reissii, n. sp.

P. tuberculorum dorsalium seriebus quatuordecim, granulis occipitis minoribus quam sincipitis, scutello infralabiali primo mentali paulo minore; griseus, transversim nigro maculatus.

This species approaches very closely to *Phyllodactylus tuberculosus* of Wiegmann, from California, but differs from it in that, 1. the tubercles of the back, which are also triangular and keeled, stand in regular, not alternating, series; the interspace between these longitudinal series in the middle of the body is always greater than the tubercles themselves: 2. the occipital region does not, as in that species, exhibit roundish granules, larger than those upon the snout and between the eyes, but is covered by very small granules of uniform size: and, 3. the *mentale* lies almost entirely between the first dilated pair of *infralabialia*, whilst in both specimens of *P. tuberculosus* the first *infralabiale* is not broader than the following one, and two large, roundish, polygonal *submentalia* bound the posterior half of the *mentale*. In this new species, behind the *mentale* and between the first pair of *infralabialia*, there is a pair of small roundish scales, followed by a third small, median, round scale. In colour the two species appear to agree. The colour is grey, with irregular black spots, which, in a young specimen, form bowed transverse bands on the neck, and broad half-rings on the tail.

This species was discovered in the vicinity of Guayaquil, by the Prussian Consul, M. Carl Reiss, who has collected other remarkable reptiles in that locality. It is known by the Spanish name of "*Salamanquesa*."—*Monatsber. der Akad. der Wiss. zu Berlin*, November 1862.

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XVIII.—*Observations on the British Tunicata, with Descriptions of several new Species.* By Joshua Alder.

[Plate VII.]

Although much has been done towards the investigation of our marine zoology of late years, few British naturalists have paid any attention to the Tunicata. The unattractive appearance of many of the species, and the difficulty of finding characters to distinguish them, have probably deterred zoologists from undertaking the task. The first objection undoubtedly holds good with respect to most of the simple Ascidians; but many of the compound species are eminently beautiful and attractive, though the difficulty of discriminating these is even greater than in the more simple forms. Whatever be the cause, it is certain that the study of the British Ascidians has been very much neglected. The interesting account of this class given by Professor Edward Forbes in the 'History of British Mollusca' is, however, an exception to the general neglect; and had that distinguished naturalist lived to fulfil his intention of writing, in conjunction with Prof. Goodsir, a monograph of the British Tunicata, such a work would undoubtedly have left little further to desire. The lamented death of Prof. Forbes has, however, prevented this project being carried out.

For several years I have incidentally paid a little attention to this tribe, and, having lately had occasion to investigate the subject more closely, I purpose in the present communication to describe such new species as have come under my notice since the publication of the 'British Mollusca,' as well as to illustrate some obscure forms that have previously been imperfectly understood.

Ascidia pustulosa, n. sp.

Body ovate, rugose, horn-coloured, adhering towards the base. *Apertures* sessile, strongly tuberculated or echinated, reddish; the anal one terminal, the branchial nearly one-third down the side. *Test* rather thick, semitransparent, coriaceous, covered with irregular-sized warty or pustulose tubercles, principally on the upper or left side*; these generally bear smaller tubercles or echinations on their surface: the lower or recumbent side is nearly smooth. *Mantle* yellowish, blotched with red, especially towards the apertures, and sprinkled with opake white. *Tentacular filaments* few and stout. *Branchial sac* with rather small papillæ: ventral plait smooth. Length about 3 inches.

I dredged a single specimen of this new species in Fowey Harbour, Cornwall, in the summer of 1847; and two specimens, now in the Edinburgh Museum, were got in Lamlash Bay by Prof. Allman. It is readily distinguished from *A. mentula* by its pustulose tubercles, as well as by its more ovate form.

Ascidia obliqua, n. sp.

Body transversely ovate, light horn-coloured?, rather rugose when old, but not tuberculated, nearly smooth when young; attached diagonally at the base and partially at the side, leaning over towards the dorsal aspect. *Apertures* not far apart, conical, with longitudinal grooves corresponding to the angles of the lobes; the branchial aperture not quite terminal, the anal median: ocelli inconspicuous. *Test* rather thin, transparent, sometimes a good deal covered with zoophytes. *Tentacular filaments* slender. *Branchial sac* with large subclavate papillæ: ventral plait transversely ribbed. Length about two inches.

Three examples of this Ascidian in different stages of growth were dredged by my friend the Rev. A. M. Norman in 40 to 50 fathoms water, off the Outer Haaf, Shetland. The largest of these measured a little above two inches. A somewhat larger specimen was sent to me from Sweden by Prof. Lovén, with the name of *Ascidia mentula* attached. It has probably hitherto been overlooked as a variety of that species, but it is perfectly distinct: the form is more ovate, the transverse diameter being generally

* Some difference of opinion exists with regard to the positions of the organs in the Ascidians. I here follow the view adopted by Savigny, Huxley, and others, who consider the side on which the anal aperture is situated to be ventral, and the opposite side dorsal. The right side, on this view, is that on which the viscera are placed. In the *Ascidiæ* proper the animal always adheres more or less by the right side, thus affording protection to these organs. M. Milne-Edwards considers the vent to be placed on the dorsal aspect: the names of right and left side are consequently, in his nomenclature, reversed.

a little the broader; the test is very much thinner, and attached obliquely at the base; the apertures are more distinctly grooved and less distant; and the branchial sac has not the intermediate papillæ, nor is it reflected upwards as in *A. mentula.* It appears to be a northern species.

The longitudinal strands of the branchial meshes in this species are very tender, and are often found broken in spirit specimens, and contracted towards the papillæ, giving the latter the appearance of being tricuspidate.

Ascidia rudis, n. sp.

Body oblong or ovate, rather irregular, depressed, greenish, attached largely by the side. *Apertures* distant, the branchial terminal, the anal generally about halfway down: ocelli red, reniform. *Test* thick, coriaceous, coarse, wrinkled, and very slightly tuberculated, sometimes nearly smooth. *Mantle* bluish-green, with a yellowish tinge towards the upper part; the apertures distinctly tubular; the anal tube often much extended, and entering into a sheath in the substance of the test. *Tentacular filaments* few and slender. *Branchial sac* green, with stout papillæ at the intersections of the meshes, and frequently with intermediate ones on the longitudinal strands: ventral plait transversely ribbed. Length about 2½ inches.

Several specimens were obtained by Mr. Norman, at low-water mark, near the Whalsey Lighthouse, Outer Skerries, Shetland, in company with a large variety of *A. depressa,* to which externally it bears some resemblance; but it has a much closer affinity with *A. mentula,* and has probably hitherto been taken for a variety of that species. There are, however, sufficient grounds to consider it distinct. *A. rudis* never reaches the size of *A. mentula,* and is of a different colour; it is much more largely attached, and bears small, distant tubercles. The tubular form of the anal orifice in the mantle, too, is characteristic, though this is not conspicuous outside, the tube being imbedded in the thickening of the test, and the external aperture varying in position in proportion to its length. In a variety from Hastings, which I owe to the kindness of Mrs. Blackett, the tube is very much elongated within the test, and opens at a very short distance from the branchial aperture. Usually, however, it is situated about halfway down, pretty near to the position it occupies in the mantle.

Ascidia plebeia, n. sp.

Body oblong, slightly scabrous, attached for nearly its whole length, greenish. *Branchial aperture* terminal, produced, conical; *anal aperture* about two-thirds down, slightly raised: ocelli small, red. *Test* thin, transparent, roughish with small papillæ, and slightly covered with fragments of shell and sand, especially towards the attached part. *Mantle* yellowish green. *Tentacular filaments* numerous and stout. *Branchial sac* with papillæ at the intersections of the meshes, and occasional small intermediate ones on the longitudinal strands: ventral plait plicated. Length about two inches.

Examples of this species were dredged on the Outer Haaf, Shetland, by the Rev. A. M. Norman and J. Gwyn Jeffreys, Esq. I have also met with one or two *Ascidiæ* from the coasts of Northumberland and Durham, which I am inclined to refer to the same. It has affinities with *A. aculeata* and *A. depressa.* From the first it may be known by its more elongated form, its more prominent apertures, and by the papillæ of the test being smaller, fewer, and not echinated; from the latter by its thinner test and less area of attachment, as well as by the absence of the thickened margin or disk that divides the upper from the under surface in that species; from both it may be distinguished by the fragments of shells with which it is more or less covered.

Ascidia aculeata, n. sp.

Body ovate, depressed, greenish, more or less attached by the side to sea-weeds or zoophytes. *Apertures* nearly sessile, aculeated, the branchial terminal, the anal about one-third down the side. *Test* thin, transparent, greenish or nearly colourless, covered with aculeated tubercles most prominent on the upper or left side. *Mantle* greenish, transparent, showing the reticulations of the branchial sac and sigmoid intestine. *Tentacular filaments* small. *Branchial sac* with moderate-sized papillæ at the intersections; the stomata elliptical: ventral plait smooth. Length an inch to an inch and a half.

I first met with this species, many years ago, in Torbay. It has since been found at Bantry Bay and Guernsey, by Mr. Norman, and by Dr. W. B. Carpenter in Lamlash Bay, Arran. It is usually attached to sea-weeds, and appears to inhabit shallow water.

This species comes nearest to *A. depressa,* but is less depressed, less largely attached, and without the marginal disk dividing the upper from the under surface; the test is more uniformly thin, and has stronger and more sharply pointed tubercles. The apertures are also less distant. The tubercles are frequently compound, bearing several aculeations. This is probably the "*Ascidia mammillaris,* Delle Chiaje" of Thompson's 'Natural History of Ireland,' but, I think, not of Delle Chiaje, judging from his figure.

Ascidia pulchella, n. sp.

Body elongate, cylindrical, reddish, pale yellow or hyaline white, attached by a rounded base, and capable of great retraction. *Apertures* tubular, terminal; the *branchial* much the longer, nearly one-third the length of the body, and continuous in outline with it; the *anal aperture* about half as long as the branchial, and a little narrower, projecting diagonally; both orifices with bright crimson ocelli. A deeply impressed line runs from between the terminal tubes to nearly the base of the body. *Test* soft, smooth, hyaline, and transparent. *Mantle* yellowish, passing to red above, or sometimes colourless, with longitudinal muscular bands, narrower than in *A. intestinalis*. *Tentacular filaments* stout. *Branchial sac* with rather broad papillæ: ventral line with long filaments. Length an inch, or a little upwards.

Procured at Fowey Harbour by Mr. Peach, from whom I have drawings. The Rev. T. Hincks has also obtained it in Salcombe Estuary, and has favoured me with his manuscript notes and a pencil sketch. The description of the internal parts is taken from specimens dredged by the Rev. A. M. Norman in Guernsey.

This pretty *Ascidia* belongs to the section of the genus which Savigny has called "*Phallusiæ Cionæ*," and which constitute the genus *Ciona* of Fleming. They are distinguished by having the viscera extended below the branchial sac, and by the softness and flexibility of the test, the upper part of which can be withdrawn within the lower, concealing the orifices. This species comes very near to *A. intestinalis*, but may be distinguished from it by its smaller size and its much more elongated and unequal tubular orifices, as well as by the colour, which is never tinged with green as in that species, but is generally more or less marked with red, though it is occasionally colourless. The longitudinal bands of the mantle are much narrower than in *A. intestinalis*. The figure given in Blainville's 'Malacologie' under the latter name seems to be taken from an individual of this species.

Ascidia parallelogramma, Müller.

This lovely Ascidian is distinguished from all its congeners by several interesting characters which may perhaps be considered sufficient to raise it to the rank of a separate genus. It agrees with the genus *Ascidia*, as at present characterized, in having the apertures divided into the same number of segments (8 and 6), in having the test united to the mantle at the orifices only, and in having the branchial sac with papillæ and without folds. All the true *Ascidiæ* with which we are acquainted, however, are attached more or less by the right side, on which are placed the viscera; the smaller branchial meshes, moreover, are rectilinear. In the present species the animal is attached by the base, near which the viscera are placed, but on the left side. There is another peculiarity attending this species, namely, that the flexure of the intestine is in a contrary direction to what is usual in the genus. The intestine, after leaving the stomach, usually rises *upwards* on the right side of the branchial sac, and, afterwards bending downwards, forms a sigmoid curve, rising again towards the anal orifice. In this species the intestine, after leaving the stomach, bends immediately *downwards* on the left side, and, running along the base, rises towards the anal orifice*. It will be seen from these details that *A. parallelogramma* is a true sinistral species. But the chief peculiarity of this interesting Ascidian is in the meshes of the branchial sac, which are beautifully convoluted in a spiral direction on a flat surface (Pl. VII. figs. 1 & 2). From the centre of each spiral, smaller bands radiate to the circumference, which serve to hold the spiral vessels in their places. This delicate and complicated system of vessels is traversed by larger longitudinal vessels, which are on a different plane, and internal in position to the other portions of the sac, to which they are united by broad transverse vessels, that rise to them in a kind of loop, the apex of which forms the papilla. The spiral vessels are thus set in a square frame, the only part that is visible until a high magnifier is applied. This is perhaps the reason why this beautiful structure has hitherto escaped observation, as the species is pretty generally diffused, and from its beauty usually attracts attention. This species also differs from the other *Ascidiæ* in having the anal tube much the longer—a character only to be observed in the living animal. A variety of it is the *Ascidia virginea* of Forbes, but not of Müller.

The *Phallusia Turcica* of Savigny is a sinistral species, having a flexure of the intestine in the same direction as this; but the branchial sac, though peculiar, has the meshes rectilinear, and not convoluted.

Genus Molgula, Forbes.

The *Molgula* of Forbes was founded on external characters only, the principal one being the number of segments in the apertures—a character which has been taken by common consent for generic distinction in this tribe, and, though of little physiological importance, generally carries with it others of greater functional value, so that the genera founded upon it have usually been found to be natural. This has fortunately been the case with the present genus, the internal characters

* Both flexures are dorsal, but in different directions.

fully bearing out the propriety of its separation from the allied genera *Ascidia* and *Cynthia,* between which it is somewhat intermediate, and though more nearly allied to the latter, yet at the same time possessing characters distinct from both. Where external characters can be found to distinguish genera and species, it is always desirable that they should be adopted in description, though, of course, the whole structure of the animal must be studied in order to assign it its proper place in a natural arrangement. To any one conversant with the Tunicata, it must be obvious that external characters are often insufficient to determine the species, or sometimes even the genus, of many of the simple Ascidians. Internal characters must therefore be resorted to; and of these the structure of the branchial sac and the tentacular filaments are not only of most importance, but of most easy access for examination. The branchial sac of *Molgula* is very peculiar, the meshes being convoluted in an irregular manner, differing from any other with which I am acquainted. I propose, therefore, to re-define *Molgula* in the following manner:

Animal generally free, or only slightly attached by glandular hairs. *Test* thin and membranous, often covered with sand or fragments of shells, very slightly attached to the mantle except at the two apertures. *Branchial aperture* 6-lobed, *anal* 4-lobed; ocelli inconspicuous or none. *Tentacular filaments* branched. *Branchial sac* with longitudinal folds; the meshes more or less convoluted, without papillæ. *Ovaries* on both sides of the body, that on the right situated outside the flexure of the intestine. Stomach and intestine lateral and dextral, the latter bending upwards as in *Ascidia,* but with the flexure more compressed.

Molgula socialis, n. sp.

Body ovate, covered with fine sand, adhering by a small base. *Apertures* terminal, approximated, rather small, tubercular. *Test* greenish, thin, soft, covered with longish, unbranched, rather rugged, glandular hairs. *Mantle* greenish, soft. *Tentacular filaments* large, much branched, tripinnate. *Branchial sac* with six folds on each side, the meshes irregular and imperfectly convoluted. Height about half an inch. Densely gregarious.

For a knowledge of this species I am indebted to Dr. Bowerbank, who obtained it from the fishermen at Hastings. The specimens were attached to *Pecten maximus,* from the Diamond trawling-ground, about twelve miles from that place.

Unlike the other species of this genus, which are generally solitary, this *Molgula* is associated in dense masses, firmly adhering to each other, and so closely as often to press the sides into a square or hexagonal form. The tentacular filaments are large in proportion to the animal, and beautifully arborescent.

I am now acquainted with seven British species of this genus, including the *Ascidia conchilega* of Müller (which is a *Molgula*) and the following species, whose internal characters, however, show a considerable departure from the type of the genus.

Molgula arenosa, Alder & Hancock.

Body globular, hyaline, unattached, closely covered with sand, excepting generally a bright smooth area on one side. *Apertures* nearly terminal, approximated, not much produced, conical or slightly tubular, retractile, set in a small circumscribed area with a raised rim, appearing like a slit when contracted. *Test* soft, glossy, transparent, and colourless, with delicate slender hairs, sometimes a little branched. *Mantle* very thin, soft, and transparent, showing the viscera very distinctly through. *Tentacular filaments* bipinnate, beautifully spotted with bright opake yellow. *Branchial sac* with six longitudinal bands on each side, between which are six rows of conical eminences formed of a double spiral coil of delicate vessels meeting at the apex, and giving the sac a festooned appearance (Pl. VII. figs. 3 & 4). There are also transverse bands. *Ovaries* double, that on the right side lying within the loop of the intestine. Diameter half to three-quarters of an inch.

This species was described in the Transactions of the Tyneside Naturalists' Club (vol. i. p. 197), and is also the *Molgula tubulosa* of Forbes in the 'British Mollusca,' who referred it (we think erroneously) to the *Ascidia tubularis* of Rathke in 'Zoologia Danica.' It is probable, however, that he may have included more than one species under this name, as there are several sand-coloured Ascidians that are with difficulty distinguished on a superficial examination. His description belongs to *M. arenosa*, but the figure represents the tubes much longer and more cylindrical than the usual form.

Externally *M. arenosa* does not materially differ from the other *Molgulæ*, and it has the apertures divided into the same number of segments; but the branchial sac presents very marked characters in the beautiful spiral cones of which it is composed, and in the absence of regular folds. Besides the spiral vessels of the cones, others, less conspicuous, but of equal, if not greater width, pass downwards from the apex to the circumference. The whole structure is extremely delicate, and its fragility renders it difficult to preserve it entire for examination. A further difference between this and the other *Molgulæ* is observable in the position of the right ovary, which is situated within, and not outside, the intestinal loop.

The *Cynthia Dione* of Savigny has a branchial sac of a structure apparently similar to this, and, were it not for its four-cleft apertures fringed with small filaments, might have belonged to the same genus. The right ovary in that species is placed outside the intestinal flexure.

Ascidia parallelogramma on the one hand and *Molgula arenosa* on the other, form two links in the chain of affinities uniting *Ascidia* and *Cynthia*, while each at the same time possesses characters peculiar to itself.

Genus Cynthia, Savigny.

Savigny has divided *Cynthia* into four sections, which he names *Cynthiæ simplices*, *C. Cæsiræ*, *C. Styelæ*, and *C. Pandociæ*. The first and third of these only are represented in the British fauna, unless the second (containing one species only, *C. Dione*) may be considered congeneric with the *Molgula arenosa* already described. The fourth section * agrees in all respects with the third, excepting in the position of the ovary, which is confined to the right side of the body. The genus *Dendrodoa* of M'Leay also possesses similar characters, but with ovaries on the left side only. The form and position of the ovaries are very variable in the genus *Cynthia*, and, though affording good specific distinctions, can scarcely be considered of generic value.

Cynthia squamulosa, n. sp.

Body ovate or subglobose, of a pinkish hue, tinged with lilac, attached by a broad base. *Apertures* a little apart, rather large and conical, but not much produced; the branchial one terminal, the anal nearly so; each margined and rayed with violet. *Test* tough, smooth or slightly mammillated, covered with small scaly plates marked with concentric lines. *Tentacular filaments* slender, simply pinnate. *Branchial sac* with six folds on each side. *Ovaries* forming a double, linear, perpendicular series on each side, with a fimbriated mass of sperm-cells (?) between. Diameter about half an inch.

This species, which I first met with in Guernsey, in 1853, where several specimens occurred on oysters dredged in about fifteen fathoms, has since been sent me from Lulworth Cove by my friend Mr. J. Gwyn Jeffreys. It appears to be a southern form.

Cynthia rosea, n. sp.

Body cylindrical, short, nearly as broad as high, adhering to shells by a tolerably broad base. *Apertures* on large mammillæ, yellowish, with four double stripes of red, and covered with mi-

* The *Pandocia conchilega* of Dr. Fleming (Brit. Anim. p. 468), the generic character of which appears to be taken from this section of Savigny's *Cynthia*, is probably referred to it by some mistake.

nute, crystalline, pointed spicula. *Test* thick, tough, opake, smooth, rose-coloured, closely adhering to the mantle. *Mantle* flesh-coloured, opake. *Tentacular filaments* large, bipinnate. *Branchial sac* with seven deep folds on each side; ventral plait smooth, undulated above. Length about half an inch.

A single specimen of this beautiful *Cynthia* was procured by Dr. Bowerbank from the Diamond trawling-ground near Hastings. In some of its characters it approaches the *C. microcosmus* of Savigny, which Prof. Milne-Edwards informs me is distinct from the *C. microcosmus* of Cuvier; but its smooth test, without corrugations, and the absence of any parasitic growth over the surface, forbid our referring it to that species. The small crystalline spicula surrounding the apertures are very curious and peculiar.

Cynthia echinata, Müller.

Prof. E. Forbes has referred this species by mistake to *Ascidia*, and the apertures in his figure (Brit. Moll. vol. i. pl. c. fig. 4) are erroneously represented with six and eight lobes. They are both decidedly quadrate. The branchial sac has six folds on each side, and the smaller meshes have the peculiarity of being transverse instead of longitudinal as in the other species. The tentacular filaments are branched.

Cynthia mammillaris, Pallas.

The *Ascidia mammillaris* of Pallas does not appear to have been recognized by later naturalists. A *Cynthia* sent me by Mr. Spence Bate from Plymouth, by Mr. Jeffreys from Lulworth Cove, and by Dr. Bowerbank from Hastings, must, I think, be referred to this species, found "on submarine rocks in Cornwall" by Gærtner nearly a hundred years ago. It is very irregular in form, generally transversely ovate, deeply wrinkled, and strongly lobated. The test is tough, thick, and of a dirty yellowish colour, generally covered with small Zoophytes and other parasites, and with stones and fragments of shells adhering near the base. The apertures are not far apart, and rayed with red internally: the tentacular filaments are linear; and the branchial sac has four folds on each side. It therefore belongs, like the majority of our British species, to the third section of Savigny. It appears to be not uncommon on the south coast of England, and may perhaps be the species alluded to by Forbes under the head of *C. microcosmus*, to which in external appearance it bears some resemblance.

Cynthia sulcatula, n. sp.

Body subcylindrical when extended, hemispherical when contracted, attached by a broad base. *Apertures* terminal, on long tubes (about one-third the length of the body), approximated at the base, and nearly disappearing on contraction; they are margined with a red line, or entirely crimson. *Test* dark reddish brown, rough with longitudinal and transverse furrows, giving the surface a beaded appearance. *Mantle* bright crimson or scarlet. *Tentacular filaments* linear. *Branchial sac* with four folds on each side. *Ovaries* scarlet, disposed in spherical masses over the inner surface of the mantle. Length half to three-quarters of an inch.

This species is found on *C. tuberosa*, and on the roots of *Laminariæ* at Cullercoats. Mr. George Hodge has also sent it me from Seaham Harbour.

The approximated tubular apertures, regularly furrowed surface, and great contractility distinguish this species from the young of *C. tuberosa*; the character of the surface likewise distinguishes it from *C. coriacea* and *C. granulata*, to which it is more nearly allied. In a contracted state, the test becomes much corrugated, and the apertures then appear large and four-cleft.

Cynthia granulata, n. sp.

Body cylindrical when extended, nearly hemispherical when contracted, reddish, adhering at the base. *Apertures* terminal, slightly tubular, approximated; reddish, with a dark red line round the margin. *Test* tough, finely shagreened or granulated, but appearing nearly smooth to the naked eye, yellowish or brownish red. *Mantle* crimson above, passing to orange or yellow below. *Tentacular filaments* linear. *Branchial sac* with four folds on each side. Length about half an inch.

This species appears to be pretty widely distributed on the British coast. I have met with it on shells or on other *Ascidiæ*, from moderately deep water, on the coasts of Northumberland and Durham, as well as at Guernsey and the Isle of Man. Mr. Jeffreys has also got it at Lulworth Cove.

This *Cynthia* somewhat resembles the last, and is occasionally associated with it on the test of *C. tuberosa*. It may, however, be at once distinguished by the shagreening of the test, which is best seen when the surface is dry, it then appearing covered with minute shining facets. *C. granulata* may also be distinguished from *C. sulcatula* by its shorter tubes and smaller apertures.

Cynthia comata, Alder.

Cynthia ampulla, Forbes & Hanl. Brit. Moll. vol. i. p. 40; Alder & Hanc. in Tynes. Club Trans. vol. i. p. 197.

A more careful examination of this species, and a comparison of it with the original description and figure of Baster, convince me that it has been erroneously referred to his *Ascidium* (the *Ascidia ampulla* of Bruguière). That species is described to be thickly covered with minute hairs hooked at the points, and has the tubes granulated or shagreened, in neither of which characters does the present species agree with it: nor does Baster's *Ascidium* appear to be coated with sand—a character so remarkable in *C. comata,* from the depth to which it is generally covered. This arises from the great length of the glandular hairs, and is especially the case in old individuals, where the hairs are much branched and become thickened at the base, giving the test a peculiar appearance when the sand is removed.

This and the following species belong to the *Glandula* of Stimpson*, a genus separated from *Cynthia* on account of the individuals being unattached. As this character, however, is not corroborated by any structural difference, and is also found in some species of other genera, we have not thought it desirable to give it generic rank.

Cynthia glacialis, Sars.

Body orbicular or ovate, a little compressed, unattached, and entirely covered with sand and fragments of shells. *Apertures* approximated and slightly tubular when expanded, inconspicuous when withdrawn, of a dull, semitransparent white. *Test* smooth, whitish, soft and rather thin, a little wrinkled towards the apertures, apparently without hairs, the shelly fragments adhering directly to the skin. *Mantle* transparent and nearly colourless. *Tentacular filaments* simple, linear. *Branchial sac* with four folds on each side. *Ovaries* in parallel cylindrical masses, extending transversely, about four on each side. Diameter rather more than half an inch.

Two specimens were obtained from the fishing-boats at Craster, Northumberland, by Mr. J. Stanger, in 1860; and it has since been dredged on the northern part of the same coast.

Believing this species to be undescribed, I had proposed for it the name of *C. vestita,* under which appellation its discovery was announced by Mr. Stanger in the 'Transactions of the Tyneside Naturalists' Field Club' (vol. iv. p. 335). I have since found that Prof. Sars had previously met with it on the coast of Norway, and had published a notice of it under the name of *Glandula glacialis* (Forhandl. i Vidensk. Selsk. i Christiania for 1858).

Cynthia opalina, n. sp.

Body transversely ovate, strongly but irregularly mammillated, opaline white, attached by a broad base. *Apertures* not far apart, rather large; the branchial one placed not far from the

* Proceedings of the Boston Society of Natural History for June 1852.

anterior end. *Test* thick, smooth, white, semitransparent, adhering strongly to the mantle throughout. *Mantle* opake white, with one or two blotches of red near the apertures. *Tentacular filaments* linear (?). *Branchial sac* with four folds on each side (?); ventral line smooth, inconspicuous. Breadth three-quarters of an inch; height one-third less, rising a little towards the anterior end.

A single specimen of this pretty species was obtained by Dr. Bowerbank from the Diamond fishing-ground, near Hastings. As the internal parts were partially decomposed, their character could not be very satisfactorily made out. We know of no other *Cynthia,* however, with which it can be confounded. In its opaline and mammillated test it somewhat resembles a miniature *Ascidia mammillata*; but, besides its generic difference, it likewise differs in form, and in the more numerous and smaller mammillæ.

Cynthia violacea, n. sp.

Body very much depressed or nearly flat, transversely ovate or rounded in outline, and adhering by a broad expanded base. *Test* slightly hispid, and completely covered with small grains of sand. *Apertures* on rather long and slender tubes of a violet colour, set very little apart, and nearly equally distant from both ends. Diameter a quarter of an inch.

Two specimens occurred to me on an old shell of *Pecten maximus* among the rocks on Mrs. Hughes's Island, Menai Straits, in 1852.

Although, from its minuteness and delicacy, the internal parts of this species could not be examined, there can be little doubt of its distinctness from any other described *Cynthia.* The grains of sand adhere so closely that they can scarcely be removed without tearing the test, which is very thin.

Cynthia grossularia, Van Beneden.

The *Ascidia rustica* figured and described by Müller in 'Zoologia Danica' contains two, if not three species, supposed by him to be different stages of growth of one and the same animal. Continental authors have (and, I think, rightly) considered the largest or adult form to be the *Ascidia rustica* of Linnæus, agreeing with his description "*corpus oblongum, subcylindricum, brunneum.*" The supposed youngest form of Müller is undoubtedly distinct, and is the species which English authors have hitherto called *Cynthia rustica.* Having ascertained, however, from specimens sent me by the accomplished author, that Prof. Van Beneden's *Cynthia grossularia* is identical with our

British form, I do not hesitate to adopt his name. It appears also to be the *Cynthia gutta* of Stimpson. The true *Ascidia rustica* has not yet been met with in this country; but I have lately found, in the collection of the late Mr. Wm. Thompson, of Belfast, a *Cynthia* from Killery Bay, on the west coast of Ireland, which appears to be the second form figured by Müller, and which is probably also distinct from the *C. rustica*. It is nearly spherical, with a thin delicately wrinkled test, and is about three-quarters of an inch in diameter.

Cynthia grossularia is an extremely variable species, changing its appearance so much in different situations and under different circumstances, that we have sometimes been induced to think that more than one species might be included in it. When growing singly, it is rather depressed, and the test spreads into a thin membrane round the base; but, in sheltered situations, as under shelving rocks, the individuals accumulate in compact masses, so closely packed as to allow of growth only upwards, and adhering very firmly to each other at the sides. The young in such cases often attach themselves to the surface of the parent, so as, at first sight, to appear as if budding from it. In the more free state, likewise, the spreading bases of several individuals sometimes come into contact and unite; but, on careful inspection, the line of union can generally be detected. The test, viewed as a transparent object under the microscope, always shows transverse anastomosing corrugations; but it often appears smooth to the naked eye, especially in the young state.

Cynthia glomerata, n. sp.

Body ovate or subglobose, smooth, cherry-red, the individuals crowded into closely adherent clusters. *Apertures* rather small, not far apart, very slightly prominent, quadrate, but sometimes appearing as a simple slit when closed. *Test* tough, rather shining, smooth, or sometimes very slightly wrinkled in old individuals, closely adherent to the mantle. *Mantle* bright crimson. *Tentacular filaments* slender. *Branchial sac* red, with one large fold, and a smaller one on the left side, and two or three obscure ones on the right: the largest folds are near the ventral plait, which is smooth. *Ovaries* disposed in small crimson pellets over the inside of the mantle. Height from a quarter to nearly half an inch.

This interesting species was found cast up, after a storm, at Wick, by Mr. C. W. Peach. It differs from most of its congeners in the smoothness of its test and the little prominence of its apertures, which are generally level with the surface when closed. The beautiful group from which the description is taken, kindly forwarded to me by Mr. Peach, consists of a globular mass of individuals of all ages and sizes, piled upon each other so as to resemble a large fruit of the *Rubus* tribe. The extraneous substance to which they are attached is so completely covered as not to be discernible; and the individuals themselves adhere so closely that, at first sight, they appear to form one compound animal. That this is not the case, however, may be seen by a more minute inspection, when the line of junction between each can generally be detected, and, with a little care, an individual may be detached entire, showing no point of organic junction with the rest. The young fix themselves on all parts of the older ones, and in the spaces between them, so that, in process of time, a globular mass such as here described is the result.

Genus Thylacium, Victor Carus.

"Common base a broad fleshy structure supporting closely-set individuals; outer tunic coriaceous; both orifices with four lobes; abdomen as long as the thorax."

Dr. T. Victor Carus thus characterizes a genus established by him in the 'Proceedings of the Ashmolean Society' (vol. ii. p. 266) for the reception of an Ascidian found in the Scilly Islands. The connexion of the individuals of this genus by a solid fleshy base has induced the learned author to include it in the family *Clavelinidæ*. It has, however, a much closer affinity with the *Ascidiadæ*, especially with the two small gregarious species of *Cynthia* just described. Dr. Carus considers that this genus is propagated by gemmation as well as by ova. Further observations are desirable on this point.

Thylacium Normani, n. sp.

Body subclavate, rounded above and contracted a little below, reddish, firmly fixed in groups to a common fleshy base. *Apertures* rather large and prominent, set considerably apart at the upper end, quadrate, or nearly circular when expanded, sometimes appearing as a single slit when closed. *Test* strongly wrinkled or subtuberculated, rather smoother near the apertures. *Tentacular filaments* linear, very slender. *Branchial sac* with two or three (?) folds on each side. Height about two-tenths of an inch.

Mr. Norman, to whom I am indebted for the knowledge of this species, found it studding the roof and sides of the celebrated Gouliot Caves, Isle of Sark. It is much smaller than the *T. Sylvani* of Carus, of a different form, and appears to spread more horizontally.

Thylacium variegatum, n. sp.?

Body (in each individual) transversely ovate, depressed, doridiform, shaded with flesh-colour and red. *Apertures* not much apart on the upper surface, the branchial rather nearer the end. *Test* slightly wrinkled, or nearly smooth, generally red towards the anterior, and paler towards the opposite end, with a paler raised circle round each aperture, that of the branchial largest, and radiated with red. *Tentacular filaments* linear, stout. *Branchial sac* with folds. The individuals are connected by a membranous expansion at the base, of a paler colour. Length (transverse) of individuals about one-eighth of an inch. Diameter of the general mass one-half to three-quarters of an inch.

One or two specimens of this curious species were kindly sent me by Mr. Jeffreys, along with other Ascidians, from Lulworth Cove. I am much inclined to believe that this is the true *Distomus variolosus* of Gærtner, judging from the figures copied in Blainville's 'Manuel de Malacologie,' which greatly resemble our Ascidian, the only material difference being that the apertures are represented six-cleft. On turning to Gærtner's description, quoted in Savigny's 'Mémoire,' p. 38, we find it to agree even more closely with this species. The individuals (*verrucæ seu tubercula*) are "*ovalia et ex croceo rubra*," and the apertures are surrounded by a swollen margin with six rays, "*quasi in tot discissus fuerit dentes*." If we may understand this to apply to the coloured markings, giving the apertures the appearance *as if* cut into six segments, the description agrees with what is seen in the branchial aperture of the Lulworth-Cove specimens, which have the paler area surrounding it often divided into rays like the leaves of a flower; these rays are frequently six, though the aperture, which is small and inconspicuous when closed, is obscurely quadrate. Should this conjecture prove correct, Gærtner's *Distomus* has been entirely misunderstood by Savigny, as the present species has no relationship with the genus *Distoma* of the latter, founded upon the species he has so well described under the name of *D. rubrum*. Further investigation, however, is necessary; and the suggestion is now thrown out to induce naturalists who may meet with this Ascidian in a living state to examine it more carefully.

The specimens sent by Mr. Jeffreys are parasitical upon the test of *Cynthia mammillaris*, another lost species of Gærtner which has been already alluded to.

I lately received from Mr. George Hodge specimens of a *Thylacium* that may possibly be identical with this, though rather larger and of a deeper red. They were found on the fronds of *Laminaria digitata* cast ashore at the Island of Herm.

Diazona Hebridica, Forbes & Goodsir.

Syntethys Hebridicus, Forbes & Goods. in Trans. Roy. Soc. Edinb. vol. xx. p. 307; Forbes & Hanl. Brit. Moll. vol. iv. p. 244.

That the *Syntethys Hebridicus* of Forbes and Goodsir is really a *Diazona* will be obvious to any one who has the opportunity of carefully investigating its characters, one or two of which appear to have escaped the observation of the distinguished naturalists who first described it. The division of the apertures into six lobes is very difficult to make out, except in well-preserved specimens; and the elongated and pedunculated form of the abdomen is a character varying exceedingly according to the degree of contraction in which the animal is seen. I was so fortunate as to dredge large masses of this remarkable Ascidian at Guernsey in 1853, and had the opportunity of examining it in a living state, when it was at once recognized as the *Syntethys Hebridicus* of Forbes and Goodsir; but on placing specimens in spirits, the apple-green colour of the living animals began to change into a delicate violet, and the whole put on the appearance of *Diazona violacea* of Savigny. This author, whose anatomical details are admirable, has failed to give a good general representation of the animal, from having had access only to spirit specimens. His generic and specific names are in consequence somewhat of misnomers, as the flattening of the surface, from the individuals falling from the centre in dying, gives more of a circular arrangement than really exists in nature.

The change of colour has already been remarked upon. The question arises, therefore, whether *Diazona violacea* and *Syntethys Hebridicus* are not one and the same animal. The only difference I can find is that the papillæ of the branchial sac in the latter are stout and obtuse, very different from the slender, pointed form represented by Savigny; I have therefore determined to consider them distinct until further observations decide the point. Prof. Goodsir has kindly supplied me with a portion of a specimen from the original habitat, and, I believe, coincides in the view of its generic relation here taken. I am also indebted for specimens to Mr. M'Andrew.

Its vitreous transparency and the opake white lines of the thorax give this remarkable species very much the appearance of a huge group of *Clavelinæ* cemented together at the base.

Polyclinum succineum, n. sp.

Common body subglobose, a little depressed, very transparent, amber-coloured, attached by a broad base, the surface slightly lobated. *Individuals* disposed over the surface without apparent order, forming numerous systems, each with a prominent funnel-shaped common excretory orifice, of great transparency. *Branchial apertures* six-rayed. *Thorax* cylindrical, occupying more than one-third of the length of the body. *Abdomen* rounded, simple; postabdomen about the same length as the thorax, slightly pedunculated, and ending in a point below. Diameter of the mass about three-quarters of an inch.

This species was dredged by Mr. Norman on the haddock-ground about six miles north of the Whalsey Lighthouse, Shetland. It is remarkable on account of its great delicacy and the transparent funnel-shaped excretory orifices, which rise considerably above the surface.

Polyclinum cerebriforme, n. sp.

Common body transversely ovate, depressed, pretty largely attached, yellowish, the surface corrugated into folds like those of the surface of the brain. *Individuals* irregularly disposed over the surface; systems few; the excretory orifices rather small, circular, with the margin very slightly produced. Longest diameter of the mass three-quarters of an inch; shortest, about half an inch.

This is another of the species for which I am indebted to my friend Mr. Norman, who procured two specimens, between tide-marks, on the south side of Bantry Bay, in October 1858. It is distinguished from *Polyclinum aurantium* by the folds of the surface, as well as by its smaller and more circular common apertures. The character of the individuals could not be satisfactorily made out.

Amaræcium pomum, Sars.

Amaroucium pomum, Sars in Nyt Magaz. for Naturv. vol. vii. p. 155.

Common body globose, subcartilaginous, yellowish-grey, sessile, attached by a spreading base. *Individuals* straw-coloured, rather large, set in numerous regular systems of from six to twelve, in single series, round a prominent central orifice with a lobed margin; the lobes corresponding to the number of individuals. *Thorax* yellow, pellucid. *Branchial sac* with ten to eighteen rows of stigmata. *Abdomen* shorter than the thorax, oval; stomach brownish-yellow, areolated: *postabdomen* long, cylindrical, acuminated below. Diameter of mass various. Length of individuals nearly half an inch.

A specimen of this fine species was sent to me by Mr. Macdonald, of Elgin, obtained from deep water in the Moray Firth. It was much smaller than the Norwegian specimens described by Prof. Sars, the mass not measuring more than an inch and a quarter in diameter; but the agreement of its characters in other respects leaves little doubt of its identity with his species. The size of the mass is always variable, depending upon the age and other circumstances. *Amaræcium pomum* comes very near to the *A. Nordmanni* of Milne-Edwards; but it differs in colour, in the size of the individuals, and in the greater length of the postabdomen.

Amaræcium papillosum, n. sp.

Common body depressed, sessile, yellowish fawn-coloured. *Individuals* prominent, rising into distinct papillæ over the surface, and forming numerous, irregular, close-set, ill-defined systems, set round wide common orifices. *Branchial aperture* with six obtuse lobes. *Thorax* brownish fawn-coloured. *Abdomen* rather darker: *postabdomen* longish, cylindrical. Diameter of mass about an inch; height about one-third as much.

Two specimens of this *Amaræcium* were obtained by dredging in shallow water, Menai Straits, in 1852.

Sidnyum turbinatum, Savigny.

A compound Ascidian sent by Dr. Leach to Savigny, from the English coast, is described under this name by the latter, in a short Appendix to his Mémoire. Two different species have been referred to it by British authors, but, I think, erroneously. Dr. Fleming found what he was "inclined to consider" the *S. turbinatum* on the rocks of the Isle of May. His description in 'British Animals' is compounded of the characters of Savigny's genus combined with those of his own recent specimen. What we consider to be Dr. Fleming's species is not uncommon on the eastern coast. Prof. Edward Forbes, again, has described another species as the *Sidnyum turbinatum* of Savigny, and has altered the generic character to suit it. It is only necessary, however, to pay a little attention to Savigny's description to be convinced that our distinguished English naturalist was under a mistake, and that his species, which is composed of short, cylindrical, truncated masses, nearly as broad below as above, the individuals of which have a branchial aperture of eight rays and a broad postabdomen (see Brit. Moll. pl. B. f. 2), cannot be the animal described by Savigny with a turbinated common body, contracted below, the individuals having a branchial aperture with six rays, and a pedunculated postabdomen, dilated and filiform (*mince comme un fil*); besides which, Forbes's species has a common excretory orifice (mentioned only as a depression in the description), removing it to a different section from Savigny's *Sidnyum*, which, like *Aplidium*, is without this character. Add to which, the individuals of *Sidnyum* are arranged in narrow ellipses radiating from the centre to the circumference, like the plates of a Madrepore, while Forbes's species has the individuals arranged circularly round the common centre. Both the species described by British authors belong to the genus (or subgenus*) *Parascidia* of Milne-Edwards, which has been separated from *Amaræcium* on account of having eight lobes to the branchial aperture, none of the other genera of compound Tunicaries having more than six. I propose naming these two species *Parascidia Flemingii* and *P. Forbesii*. The *Sidnyum turbinatum* remains yet to be recognized.

Parascidia flabellata, n. sp.

Common body elongate, lobulated, transparent, consisting below of a very much produced peduncle, which is divided above into several oblong branches, variously lobed, forming a somewhat fan-shaped expansion at the free end; many orange masses or spots in the interior give an orange hue to the whole. *Individuals* elongate. *Branchial apertures* eight-lobed, tinged with orange. *Postabdomen* longish, linear, and rather thin. The whole mass is prettily and minutely speckled with orange.

The above account of a very interesting little *Parascidia* is extracted from the Rev. T. Hincks's manuscript notes of Tunicata obtained in Salcombe Bay in 1848, kindly placed at my disposal. Mr. Hincks met with this species hanging about a *Cellularia* in little orange transparent tufts. There can be no doubt of its distinctness from any species yet described.

Distoma vitreum, Sars.

Distomum vitreum, Sars in Nyt Mag. for Naturv. vol. vi. p. 154. Christiania, 1851.

Common body greyish-white, hyaline, subcartilaginous, clavate or fusiform, adhering by a narrow base. *Individuals* white or yellowish, irregularly disposed. *Branchial* and *anal apertures* each with six blunt lobes. *Abdomen* ovate-oblong, united to the thorax by a thickish peduncle; the stomach brownish and longitudinally plicated. Length of mass a quarter to half an inch.

A cluster of specimens of different sizes (mostly young), adhering to the stem of a Zoophyte, was dredged by Mr. Norman in the Channel Islands.

Botrylloides sparsa, n. sp.

Common body rather thick, encrusting, semitransparent, of a yellowish-brown colour. *Individuals* rather small, yellowish-brown, thickly sprinkled with dark brown spots, with a circle of

* Prof. Milne-Edwards makes both *Amaræcium* and *Parascidia* subgenera of *Polyclinum*. I prefer considering them genera.

sulphur-yellow round the branchial orifice, continuous with a stripe or blotch of the same colour above; they are arranged in short, ill-defined, branching systems, with the common orifices indistinct. Diameter of mass two to two and a half inches.

I met with this species on the under side of stones within tide-marks, St. Peter's Port, Guernsey, in 1853. This and the following species have the individuals more minute than is usual in the genus.

Botrylloides pusilla, n. sp.

Common body encrusting, semitransparent, orange-flesh-coloured, with yellow marginal tubes. *Individuals* small, bright orange-scarlet, consisting of a minute sprinkling of scarlet on a yellow ground; there is a yellow spot behind the branchial aperture, and the anal aperture is also yellow; the individuals are set in crowded double or treble rows, forming ill-defined systems. *Branchial sac* with ten rows of stigmata. Diameter of mass nearly two inches. Length of individuals half a line.

A single specimen of this beautiful and very distinct *Botrylloides* was got on the under side of a stone at Grand Havre, Guernsey, in 1853.

Figures of most of the species here described, along with others not previously or hitherto imperfectly figured, will be given in an illustrated Catalogue of British Tunicata, now preparing for the British Museum.

EXPLANATION OF PLATE VII.

Fig. 1. A portion of the branchial sac of *Ascidia parallelogramma*, highly magnified.
Fig. 2. Two spiral coils of the same, more highly magnified.
Fig. 3. A small portion of the branchial sac of *Molgula arenosa*, showing the cones in profile.
Fig. 4. Two of the cones seen in front.

XIX.—*On the Composition of the Head, and on the Number of Abdominal Segments, in Insects.* By Dr. H. Schaum.

[Plate VI.]

As the opinion has lately gained much ground among the comparative anatomists of England, chiefly through the embryological researches of Prof. Huxley, that the head of the Arthropoda is made up of a number of segments, I desire to draw attention to some facts which seem to militate against this view. Prof. Huxley* admits, with regard to the greatest number of

* "On the Agamic Reproduction and Morphology of *Aphis*," Trans. Linn. Soc. xxii. p. 229 &c.

appendages attached to the head in any case (in Crustacea), six segments composing the head of Arthropoda,—the first bearing the eyes, the second and third the two pair of antennæ, and the fourth, fifth, and sixth the three pairs of maxillæ (the third of which is soldered to the lower lip in insects). For *insects,* he reduces the number to five, as they have never more than one pair of antennæ.

In seeking for some arguments against this conclusion, I may be allowed to start, *not* from the head provided with the greatest number of appendages, but from the head of *insects,*—first, because the statement that a pair of appendages is the exponent of a separate segment may be considered as a *petitio principii* by one who desires to disprove it; and secondly, because it is only in insects that the head is a section of the body into which nothing but the head itself enters. In Crustacea, either a part of the thorax (as in Isopoda) or the whole thorax (as in Decapoda) is intimately united with the head into one portion; and in Arachnida there is no proper head at all.

In the head of insects we have five pairs of appendages, if we admit, from the analogy of the moveable eyes in the Podophthalmous Crustacea, that the sessile eyes are appendages comparable to the antennæ and maxillæ. As it is proved, by the second and third thoracic segments bearing wings and legs at the same time, that the same segment may be provided with a pair of both tergal and ventral appendages, we might at first conclude that the eyes and antennæ are the tergal appendages of the same segments which bear maxillæ as their sternal ones. The number of the segments of the head would thus be reduced to three, which is, indeed, a conclusion admitted by some entomologists*. But Prof. Huxley has been led, by his observations on the development of *Aphis,* to the conclusion that both eyes and antennæ are also sternal, and not tergal appendages. With regard to these observations, I cannot refrain from mentioning that scarcely any object could be chosen which offers a greater difficulty to the observer for seizing clearly this fact than *Aphis*; for the *Aphides* not only leave the egg in a comparatively perfect state, undergoing afterwards scarcely any metamorphosis, but they have also the front and even the vertex bent downwards, so as to be visible on the underside of the head. How is it to be decided, in such an embryo, which is the sternal and which the tergal part of the two segments, which, according

* The *labrum* is considered by some entomologists, as by Brullé (Ann. des Sc. Nat. 1844, p. 345), as representing also a pair of soldered maxillæ lying above the mandibles: this analogy is, however, completely rejected by Prof. Huxley, on the ground that the labrum is developed in the medial line of the body (*l. c.* p. 232. 9).

to Prof. Huxley, are situated *before the mouth*? We get no information from the author, as the terga of these segments are not traced by him.

But leaving the point whether the eyes and antennæ are tergal or sternal appendages in *Aphis*, sufficient proof can be given that it is inaccurate to state that a pair of appendages is always dependent upon a separate segment. It is a general law, that insects leave the egg with the full number of their segments, and that no segment is ever added during the metamorphosis, though some of the abdominal ones may disappear externally in the perfect state. A great number of larvæ, however, leave the egg completely blind, and even destitute of antennæ, with a head on which no trace whatever of a division into subsegments can be discovered. How, in this case, can the subsequently developed eyes (which are here certainly tergal, and not sternal appendages) be considered as appendages of a proper segment which has never existed? And how are the ocelli to be accounted for, which, like the wings, make their appearance first in the perfect state, but which cannot, like the wings, be referred to a proper pre-existing segment?

The abdominal segments of *Julidæ*, provided with a double pair of legs, furnish us with another proof that the same segment may bear more than one pair even of ventral appendages. To dispose of this proof it is usually asserted that there are two segments united into one; but not a single observation on the production of these segments during the growth of the animal has been made which supports that theory. On the contrary, I conclude, from Newport's observations and figures, that the new segments which are added to the abdomen appear always from the first with two pairs of legs, and never show a division into two.

If, therefore, the number of appendages is not a just test of the number of segments entering into a part, we have to inquire what are the requisites of a segment, when we undertake to settle the question whether the head is made up of one or of several segments. It will meet with no opposition when, in the first instance, we require that a segment must be marked by a transverse line of demarcation on the integument of the animal, at least in an early stage of its development. Another requisite of a segment is, that it must constitute a ring composed of a dorsal and a ventral arcus. A segment requires, further, normally, a set of proper muscles and a ganglion. A ganglion need not be traced in each segment of the perfect insect, where a number of segments are united to a greater section of the body (thorax or abdomen); but in the *larvæ*, with homonomous segments, the nervous system forms regularly a chain of ganglia corresponding to the segments. We find no trace of subsegments on the integument of the head in any stage of the development; we find no sets of different muscles, and never more than one *ganglion infraœsophageum* in the head. Are we not therefore entitled to draw from these facts the conclusion that the head of insects constitutes but a single segment, especially since we may trace in many Coleoptera a dorsal and a ventral arcus of it, united in two deep lines corresponding to sutures on the jugulum? It is certainly a segment more complicated than the others; but should we not expect this, since it contains the *ganglion supraœsophageum*, the principal organs of the senses, and the mouth*? Applying the same views to the Crustacea, we are not entitled to admit there, any more than in the Insecta, different segments of the head for the different appendages,—not even in *Squilla*, where the eyes and interior antennæ are inserted, it is true, on a separate plate, though a plate which is not analogous to a true segment†.

Keeping in view the requisites of a segment, we may also arrive at a positive and satisfactory result as to the normal number of segments composing the abdomen of insects, which has also been a subject of discussion in the memoir of Prof. Huxley on the development of *Aphis*. This result is, that in no case does the number of abdominal segments exceed *nine*. In insects which undergo a complete metamorphosis, this is satisfactorily proved by the fact that no larva has more than thirteen segments‡,—the first being the head, the three following constituting the thorax, and the last nine the abdomen. Newport (Todd's Cyclopædia) and Westwood (Introd. to the Modern Classif. of Insects, i. p. 194, and ii. p. 240) speak, indeed, of a fourteenth segment of the body in the larvæ of aculeate Hymenoptera and of the Scarabæidæ, in like manner as some lepidopterologists speak of a fourteenth (anal) segment of caterpillars; but it has long ago been proved by Erichson and Stein§ that this supposed tenth segment of the abdomen is nothing but the externally protruded anus, analogous to the anal proleg of the larvæ of many Coleoptera (which no one ever thought of considering a segment). As the number of segments does not increase after the larva has escaped from the egg, we cannot have more than nine segments in any insect undergoing a

* I may also mention that those who admit several segments have never undertaken to state the position which the *ganglion supraœsophageum* occupies with regard to these segments.

† Erichson, Entomographien. Berlin, 1840, p. 17.

‡ Some larvæ, as those of *Dytiscidæ* and *Hydrophilidæ*, have, however, but twelve (eight being abdominal).

§ Vergleichende Anatomie der Insecten, i. p. 23, not. 4.

complete metamorphosis. These nine segments are, however, but seldom conspicuous in the perfect insects of this division, and only their dorsal half-segments: the number of ventral half-segments is always less than that of the dorsal ones, although both half-segments are equally developed in the *larva*. Of the dorsal half-segments, the last, or even the last two, often disappear at the apex of the abdomen, being retracted within its cavity during the pupa state; of the ventral half-segments, not only the last or the last two are retracted at the apex during the transformation to the perfect state, but also the first, and often the first and second, disappear externally at the base of the abdomen, being usually pushed inwards so as to form a kind of *phragma* between the thorax and abdomen. The first conspicuous ventral arcus in the perfect insect is, therefore, not the one corresponding to the first, but the ventral arcus corresponding to the second or third dorsal arcus*. In this way it is to be explained how the number of visible ventral half-segments in perfect insects is often reduced to five, six, or seven, while the number of the dorsal ones amounts to seven, eight, or nine.

In counting the latter, we have always to begin with the one which bears the pair of large spiracles, so characteristic already, for the first abdominal segment, in the larva, however intimate the union of that half-segment with the metathorax may be. It is, for instance, so intimate in the Staphylinidæ, that even Erichson, neglecting the stigmata, considered it for some time as a part of their metathorax†. It is still more intimate in the Hymenoptera aculeata, where the first segment is severed from the rest of the abdomen by a more or less deep incision, and is immoveably applied to the metathorax—constituting that part which is called by MacLeay, Newport, and Westwood the postscutellum of the metathorax‡.

* Erichson, Archiv, 1848, ii. p. 61.

† Erichson, Archiv, 1845, ii. pp. 80, 81; Stein, Vergleichende Anatomie d. Ins. p. 11.

‡ That the so-called postscutellum of the metathorax in Hymenoptera aculeata is in reality the first dorsal abdominal segment, as contended by Audouin and Latreille, is not only proved by the size and position of its stigmata, corresponding to those of the first abdominal segment of the larva (while the metathorax has nowhere any stigmata), but also by the changes which take place in the segments during the pupa state. It is the *sixth* segment of the larva (second abdominal) which forms the petiolus, by which *what seems to be the whole abdomen* is attached to the thoracic portion, the *fifth* (first abdominal) applying itself intimately during these changes to the metathorax (Cf. the figures of Ratzeburg, copied by Westwood, Introd. ii. fig. 86. 4 & 5). The three parts of the body, so conspicuous in the Wasp, do not, therefore, as generally believed, exactly correspond to the head, thorax, and abdomen; but the first to the head, the second to the thorax + first abdominal segment, the third to the abdomen — the first segment.

When we determine the number of abdominal segments in those insects undergoing an incomplete metamorphosis*, we cannot start from the simpler organization of the larva; but we have here, as in the other section, a safe guide in the *stigmata*. With the exception of the last, all the dorsal half-segments of the abdomen are provided with a pair of spiracles in the soft membrane which connects them with the ventral half-segments; and the first is usually remarkable from its large size and its position on the back of the abdomen. Beginning with the arcus bearing those stigmata, we count on the back of the abdomen, in both sexes of *Locusta*, ten parts, which at first sight appear to be segments; but, on a closer examination, we are led to the conclusion that the tenth part (called *lamina supraanalis* by orthopterologists) is not to be considered as a segment. The first eight dorsal half-segments are easily identified by their stigmata (Pl. VI. fig. I. 1–8); the ninth has no stigmata, and is differently shaped in both sexes (figs. I. & II. 9), but is still united by a connective membrane to the last ventral half-segment, while the tenth (figs. I. & II. *c*), provided on its under side with a pair of *styli* (*d*), and also differently shaped in both sexes, is not connected by a membrane to the ventral segments. The number of the latter amounts to eight in the male, and to seven in the female†, the last being differently shaped in both sexes, and bearing in the male another pair of styli (fig. I. *e*). With the last of these (eighth in the male, seventh in the female), called *lamina subgenitalis* by orthopterologists, the ninth dorsal half-segment forms the apex of the abdomen and an involucrum both for the anus and the sexual organs, the dorsal arcus (9) being the bearer of the anus, and the ventral arcus (8 or 7) that of the sexual organs (figs. I. & II.,—the position of the rectum in the abdomen

* With regard to the movements which some Neuroptera undergoing a complete metamorphosis perform as pupæ, it has lately been denied by some entomologists that a distinct limit could be traced between a complete and incomplete metamorphosis when they approach the end of this period: in denying this, however, they lose sight of a fundamental difference in the organization of the pupa, which does not even admit the possibility of a passage. In the true pupa, the skin shuts both the mouth and anus, so that no food can be taken and no fæces be discharged; whilst in the pseudo-pupa of the hemimetabolous insects the mouth and anus are open, as in the larva and in the perfect insect.

† The posterior part of the metasternum (Pl. VI. fig. I. M, coloured blue), expanded between the posterior coxæ, might easily be taken for the first ventral segment, as it is separated from the anterior part of the metasternum by a deeply impressed line, by which the number of ventral segments would be raised to nine in the male and to eight in the female. That it is, however, in reality a part of the metasternum can be ascertained when we compare it with the corresponding part in *Pachytylus* (fig. III.) and *Forficula* (fig. V.), where there can be no doubt as to its nature.

being indicated in fig. II. by a double series of red, that of the vagina by a double series of blue points). The *ninth* dorsal segment is thus proved to be the last of the whole body; the tenth part (*c*) is nothing but a plate which covers the anus, as the upper lip covers the mouth, and can as little as the latter, or the anal proleg of a larva, be considered as a segment.

In *Pachytylus migratorius*, also, we count nine dorsal segments in both sexes, eight ventral segments in the male (fig. III.), and seven in the female (fig. IV.). The ninth dorsal segment is, in both sexes, apparently divided by a transverse impressed line into two; nevertheless in reality it is simple (figs. III. B 9 & IV. A 9); the *lamina supraanalis* (*c*) and the styli (*d*) are analogous to the same parts in *Locusta*. In the male, the last ventral segment has also on each side a transverse impressed line (fig. III. B 8), which might, as in the last dorsal segment, be considered (but erroneously) as indicating the demarcation of two segments; the last (seventh) ventral segment of the female (fig. IV. B) is without any trace of such a line. The ninth dorsal and the last ventral half-segment, forming the apex of the abdomen (figs. III. B & IV. A), involve, as in *Locusta*, the upper (9) the anus, shut by the *lamina supraanalis* (*c*), the lower (fig. III. B 8, fig. IV. A 7) the sexual organs, which open in the female (fig. IV. A) between the four parts constituting the ovipositor (fig. IV. A *o*) (as in *Locusta*, between the four laminæ of the sword, fig. II. *o*), and which are separated in this case from the anus by a transverse septum (fig. IV. A *d*, where the position of the rectum is, as in *Locusta*, indicated by a double series of red, and the position of the vagina by a double series of blue points*).

* M. Lacaze Duthiers states, in his memoir on the female genital apparatus of insects (Ann. des Sc. Nat. 1833, vol. xix.), that in Neuroptera, Orthoptera, and Hemiptera, three segments (somites) intervene between the *vulva*, which is said to open between the eighth and ninth abdominal segments and the anus, said to be situated on the eleventh segment. I have not been able to confirm these statements. In Hemiptera, in accordance with the observations of Fieber (the best monographer of this order), I never find more than eight dorsal segments. In the Neuroptera with complete metamorphosis, there cannot be more than nine segments, as the larvæ have but nine. In Orthoptera, where the anus and vulva open between the last dorsal and last ventral arcus, forming an involucrum (the ninth dorsal and the seventh ventral where that number is greatest), I see nowhere even the possibility of counting eleven segments, except in *Acridia* (*Pachytylus*), if there the ninth dorsal segment be counted as double and the *lamina supraanalis* as a segment, while the transverse septum (Pl. VI. fig. IV. *d*) is considered as a ventral half-segment. As to the view of M. Lacaze Duthiers, that the various female genital organs, such as sting, borer, ovipositor, &c. (the analogous composition of which in Hymenoptera had already been proved by Prof. Westwood), are the result of modifications of the ninth abdominal segment, I doubt much whether observations on the changes of that segment during the pupa state will confirm this

In the male of *Forficula gigantea*, and allied species, there are also nine dorsal segments (Pl. VI. fig. v. 1–9), a *lamina supraanalis* (*c*), which attains here a great size, a pair of forceps analogous to the style (*d*), and eight ventral segments; while in the female there are but seven dorsal and six ventral segments conspicuous externally. The *lamina supraanalis* has in this case been counted by Prof. Westwood, in a paper on the external anatomy of *Forficula* (Trans. Ent. Soc. i. p. 157, pl. 16. fig. 6), as the ninth dorsal segment of the male, because he erroneously considered the first abdominal segment (fig. v. 1 & fig. vi. 1) as a part of the metathorax (M), believing that it might thus be proved that in *Forficula* at least the metathorax is provided with a pair of spiracles (which is, however, nowhere the case). There can be no doubt as to the nature of the part in the apterous genus *Chelidura* corresponding to this in the *Forficulæ*. It fills there the posterior sinus of the metathorax, being quite separated from the latter, and covered at its sides by the produced angles of it, beneath which the stigmata of the first segment are concealed.

In all these insects, as in all those undergoing a complete metamorphosis, the number of ventral half-segments is less than that of the dorsal ones, being eight in the male and seven in the female of both *Locusta* and *Pachytylus*, and being also eight in the male of *Forficula**; and it is, as in the holometabolous insects, the first dorsal arcus which has no corresponding ventral arcus.

There remains, however, one group of insects in which, according to the general opinion, ten segments of the abdomen, both the dorsal and ventral half-segments, are fully developed,

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view, which, however, could only be proved in that way. Observations on the pupæ of Coleoptera led Erichson to the conclusion that the horny parts of the genital organs are not modifications of the last segments, but are developed independently of them (Erichson, Archiv, 1848, ii. p. 62). In trying to prove his thesis by the composition of those organs in perfect insects, M. Lacaze Duthiers starts from a theoretical axiom, that each segment of insects is normally composed of six parts—three tergal ones (one tergum and two epimera) and three sternal ones (one sternum and two episterna),—and that it bears a pair of tergal and sternal appendages, called by him "tergorhabdites" and "sternorhabdites." He then refers the parts composing the genital organs to the tergum or epimera, or sternum or episterna, or tergorhabdites or sternorhabdites of the ninth abdominal segment. It is, however, only in the wing-bearing segments that six parts can be really distinguished, and that tergal appendages exist; and here the epimera are sternal, and not tergal parts, like the pieces designated by M. Lacaze Duthiers the epimera of the ninth segment.

* By a mistake which I cannot explain, Prof. Westwood, in his paper on *Forficula* (*l. c.* pl. 16. fig. 6), figures the metasternum (Pl. VI. fig. v. M), to which the posterior legs are attached, as the first ventral segment of the abdomen, and thus enumerates *nine* ventral segments.

and in which the tenth bears the anal appendages—namely, the *Libellulæ*. In these insects what is generally counted as the first abdominal segment is, however, a posterior part of the metathorax—separated, it is true, by a deep incision and a softer membrane capable of some extension*, but not by a complete articulation, from the anterior portion of it. There are two reasons which seem to settle this point beyond doubt. In the first place, this apparent segment is destitute of spiracles, the first of the seven conspicuous pairs of spiracles lying in the connective membrane of the dorsal and ventral arcus of the apparently *second* segment†. A first abdominal segment destitute of spiracles is without any analogy in the Insecta, while, on the contrary, it is a characteristic feature of the metathorax that it never has spiracles. A second argument in favour of this opinion is, that the apparently first segment is developed, during the metamorphosis of *Libellula*, in proportion to the growth of the wings. In the young larva we count only nine abdominal segments, of which the ninth bears the anal plates; in a larva of moderate size which has already undergone some moultings, and where the future wings appear on the back of the thoracic segments, that part begins to show itself; even in the pseudopupa, previous to its last transformation, it is still but little developed; and it is only in the perfect insect that it completely assumes the shape of an abdominal segment. The metathorax there attains an unusual development, but a development quite in proportion to the posterior wings, which are, in the *Libellulæ*, of even a larger size than the anterior ones, and which are moved during flight by a system of proper muscles; while in other orders, as, for instance, in Hymenoptera, they are moved by the same system of muscles as the anterior ones, being connected to them, during flight, by the hooks of their anterior margin.

According to this view, the penis of the *Libellulæ* is situated, not on the second, as usually stated, but on the first ventral segment; and the outlets of the generative organs are, in both sexes, on the eighth, and not on the ninth, ventral segment—those of the male in the middle, those of the female at the base of it. In this group the posterior part of the eighth and the whole ninth ventral segment intervene between the vulva and the anus, the latter occupying, as usual, the end of the ninth segment, which bears the anal appendages; and in this group, also, the nine ventral half-segments are all developed.

Having thus ascertained that in insects the abdomen is as

* A similar soft membrane exists between the anterior and posterior portions of the mesothorax (scutellum and postscutellum) in the Hymenopterous genus *Eupelmus*.

† Hagen, Stett. Entom. Zeit. 1853, p. 319.

well defined as is the thorax by the number of segments which compose it, we may certainly take the three divisions of the body, as they are constituted in insects, as the standard to which the segments of the higher Crustacea are to be referred, if we desire to settle what are their cephalic, thoracic, and abdominal segments. We will not state, then, that the thorax of Arthropoda is normally composed of seven segments. In Isopoda and Amphipoda, where the part usually called the thorax is divided into seven leg-bearing segments, the segment corresponding to the prothorax of insects has completely disappeared, its legs being added to the head in the shape of a lower lip with palpi; the first and second of the seven leg-bearing segments are analogous to the meso- and metathorax, and the five others, as well as the segments of the so-called abdomen, to abdominal segments,—the abdomen being here, as in all higher Crustacea, composed of a greater number of segments than in insects, and divided into an anterior (pectoral) and posterior (caudal) portion*. To the five segments constituting the pectoral part of the abdomen in Isopoda the five leg-bearing segments of Decapoda are analogous, whose thoracic segments are all united to the head (their legs constituting the three pair of accessory masticatory organs) and whose pectoral portion also enters into the part usually called the cephalothorax†.

EXPLANATION OF PLATE VI.

Fig. I. *Locusta viridissima*, ♂, seen sideways.
Fig. II. The same, ♀; apex of abdomen.
Fig. III. A. *Pachytylus migratorius*, ♂, seen from beneath.
Fig. III. B. Terminal segments of the male of *Pachytylus migratorius*, seen sideways.
Fig. IV. A. *Pachytylus migratorius*, ♀; last abdominal segments, seen sideways.
Fig. IV. B. The same, seen from beneath.
Fig. V. *Forficula gigantea*, ♂; abdomen seen sideways.
Fig. VI. *Forficula gigantea*; metathorax (M) and first two abdominal segments.

XX.—*Note on the Colouring Matter of the Red Sea.* By H. J. Carter, F.R.S. &c.

To those who have sought for all that has been published on the colouring matter of the Red Sea, it will be well known that the excellent memoirs on this subject by M. C. Montagne in 1844, and M. C. Dareste in 1855 (both in the 'Ann. des Sc. Nat.,' the former in sér. 3 (Bot.) t. ii. p. 331, and the latter in

* Erichson, Entomographien, pp. 14–16.
† Brandt, Medic. Zoolog. ii. p. 58; Erichson, *l. c.* p. 19.

sér. 4 (Zool.) t. iii. p. 179), are the most elaborate. But to Ehrenberg is due the merit of having first described (in 1826) the nature of the organism from which this colouring matter is derived. He found it in the Bay of Tor itself, pronounced it to be an Oscillatoria, and called it *Trichodesmium erythræum*, which Montagne has advisedly changed to *T. Ehrenbergii*.

No one who has read Montagne's memoir, and seen his illustration together with the organism itself, can doubt that the chief source of the red colour of the Red Sea is owing to the presence of this little Oscillatoria. Nor can any one doubt, who who has read M. Dareste's memoir, that this is not the only organism which colours the sea red in different parts of the world.

It was to confirm the observations of the latter, as well as to record the fact itself, that I wrote the paper in these 'Annals' for 1858 (vol. i. p. 258), entitled "On the Red Colouring Matter of the Sea on the Shores of the Island of Bombay," wherein it is shown that this colour depends on the presence of a *Peridinium* (*P. sanguineum*, Cart.) in innumerable quantities, in which the chlorophyll at first is green, then becomes yellow, and lastly red, when the latter, mixing with the oil-globules generated *pari passu* in the cell, gives rise together to greater opacity, and thus reflecting more strongly, makes the presence of the *Peridinia* more evident, and causes the sea in which they are contained rapidly and almost suddenly to become of a vermilion or minium-red colour; after which, the *Peridinium* falls to the bottom and thus disappears, as if this were the termination of a cycle in its existence.

It was not, however (although I had formerly spent many months on the coasts of Arabia), until returning to England in June 1862, on board the Peninsular and Oriental Company's steamer 'Malta,' that I had an opportunity of seeing the colour of the Red Sea which is produced by *Trichodesmium Ehrenbergii* —a circumstance to which I should not have alluded, had not Montagne appended to his memoir certain queries which, in part, I can answer, at the same time that, with much diffidence, I offer a few remarks on Montagne's generic characters of this organism, which are repeated by Kützing in his 'Species Algarum.'

Commencing, then, with a short account of my own experience of *Trichodesmium Ehrenbergii* in the Red Sea, I would observe that, on the 31st of May 1862, when approaching Aden, we passed through large areas of a yellowish-brown oily-looking scum on the surface of the sea, and that on the 2nd of June, when off the Arabian side of the first islands sighted in the lower part of the Red Sea after leaving Aden, it again appeared, and we frequently passed through large areas of it, sometimes continuously for many miles, until we arrived off Jubal, or the last island in the upper part of the Red Sea, when, from a calm, we steamed into a strong northerly breeze accompanied by heavy sea, and saw no more of it. Once only I saw a portion of brilliant red and one of intense green together, in the midst of the yellow.

The odour which came from this scum was like that of putrid chlorophyll, well known to those who have had much to do with the filamentous Algæ, both marine and freshwater, but more familiarly, to those who have not had this experience, by that which comes from water in which green vegetables have been boiled,—and hence very disagreeable.

I drew up some of this scum in a bottle, and found it to be composed of little short-cut bundles of filaments like Oscillatoria; for I had only a Coddington lens with me for their observation; and on showing them to Mr. Latimer Clark, the well-known Superintendent for laying down the telegraph-cable through the Red Sea, &c., to Kurrachee, who was on board, Mr. Clark stated that he had observed the same phenomenon in the Sea of Oman, where he had examined the filaments of the little bundles with a microscope, and had found them to be "beaded," to use his expression, "with rounded extremities."

On arriving in England, I had no time for examining microscopically the specimens which I had obtained, and which had been preserved in an equal quantity of alcohol added to the seawater in which they had been taken, till January (1863), when I found the little bundles, which were still just visible to the unassisted eye, and like so much fine "sawdust" (to which they have been aptly and commonly compared by previous observers who have seen them without knowing what they really were), varying in point of measurement, although, on the average, perhaps about $\frac{1}{50}$ inch long by $\frac{1}{100}$ broad, containing about twenty-five to sixty filaments, each of which is about $\frac{1}{50}$ inch long by $\frac{1}{2400}$ broad, their cells, which of course are so many disks, being sometimes thinner, sometimes thicker, than the breadth of the filament, with rounded cells terminately at the extremities where entire, but square when the latter have been broken off from the filament. The bundles bore no evidence of an investing sheath, but of the filaments being held together by mucus secreted from them generally.

Further into this description I need not enter, except to state that the cell was a true Oscillatorial one, charged with a few granules suspended in its protoplasm, and that I saw nothing like sporidification.

The colour of the bundles to the unassisted eye was still faint yellowish; but the filaments, under the microscope, were faintly green.

Of the questions proposed by Montagne (*op. cit.* p. 355), the second calls for more information on the size of the bundles. This has been supplied above, so far as my observation extends.

The third question calls for information respecting the presence of *Trichodesmium* in the Sea of Oman, &c., as bearing upon the origin of the name "Erythræan Sea," applied by Herodotus to *all* the seas washing the shores of Arabia.

I have already stated that I saw the scum in the Gulf of Aden, also that Mr. Latimer Clark had seen it in the Sea of Oman; and the following extract from the late Dr. Buist's observations on the "Luminous and Coloured Appearances in the Sea" (Proceedings of the Bombay Geographical Society for 1855, p. 120) will show that it exists in the upper part of the Indian Ocean. The account from which this is taken was communicated to Dr. Buist by Dr. Haines, as witnessed on board the 'Maria Soames,' in lat. 21° N. and long. 42° E., and it stands thus:—

"In May 1840, when one-third across from Aden to Bombay, the aspect of the sea suddenly changed upon us, and at once seemed as if oil had been poured upon its surface. It was still as a mill-pond, and of a brownish, soapy hue. The water, on being examined, was full of little fibrils, like horsehair cut across, in lengths of the tenth of an inch or so. A wine-glass full of it contained hundreds of them.... We sailed through them for about five hours; so that they probably extended over a surface of 500 miles."

The occurrence, then, of *Trichodesmium Ehrenbergii* in the Red Sea, the Gulf of Aden, the Indian Ocean, and the Sea of Oman is so far substantiated; and as the yellow colour in all instances probably passes into red, we have apparently the explanation of the whole of these seas having been called by the Greeks "Erythræan." I have not, however, heard whether it has been seen in the Persian Gulf.

Further, we learn from M. Dareste's memoir (*op. cit.* p. 208) that João de Castro, in July 1541, when off Cape Fartak, which is about the middle of the south-east coast of Arabia, found the sea so red that it appeared as if it had been coloured with bullocks' blood.

In my own experience of the Sea of Oman and the whole shore-sea of the south-east coast of Arabia from Muscat to Aden, where, under its survey, I passed all the months of the years 1844–45 and of 1845–46, with the exception of those of the stormy monsoon, viz. June, July, August, and September, the presence of the scum above described never, to my knowledge, was once observed. I am therefore inclined to infer that it is chiefly confined to the sea some distance off shore. Yet Ehrenberg, in 1823, saw the Bay of Tor covered with it, even up to the sands.

Lastly, I would advert, but, as before stated, with much diffidence, to that part of the generic characters of *Trichodesmium Ehrenbergii* in which we find the expression "*prime rubro-sanguineæ, tandem virides,*" first used by Montagne (*l. c.* p. 346), and then repeated by Kützing in his 'Species Algarum,' because the facts connected with the accounts given of those who have seen the scum formed by *Trichodesmium,* together with my own experience of Algæ generally, lead me to the opposite conclusion, viz. that *Trichodesmium* is at first green, and subsequently becomes red.

It is true that its chief colour in the Bay of Tor, when seen by Ehrenberg, was red; it was red, like "red sawdust," when seen by M. E. Dupont in the Red Sea (*ap.* Montagne, *l. c.*): but, on the other hand, what I saw in the Gulf of Aden and in the Red Sea, together with what Mr. Latimer Clark saw in the Sea of Oman, and Dr. Haines, as above stated, in the Indian Ocean, was nearly all of a yellow oily colour; and this is the appearance that I have heard generally assigned to it by those who have been in the habit of traversing the seas mentioned.

Next to the yellow colour, red is the most prevalent, and green least of all. Some of that seen by Ehrenberg was intensely green; this was the case also with the green portion that I saw with the red above noticed; while Ehrenberg saw other portions of a less green colour. So much for what has been stated respecting the colours under which *Trichodesmium* has appeared.

We come now to the usual course presented by other Algæ in arriving at a red colour. If we take the *Peridinium* which colours the sea red on the shores of the island of Bombay, we shall find, as above stated, that it is at first green, then yellowish, and lastly red. In the green stage, the contents of the cell are so thin and watery that they easily allow the light to traverse them, and thus the *Peridinium* passes unobserved; but as they become inspissated, oil-globules generated, and the chlorophyll changed first to yellow and lastly to red, these contents become more opake; and thus the *Peridinium,* by reflecting much more light than it did at first, comes rapidly into notice, and by its numbers gives a general red colour to that part of the sea in which it may be present. The same is frequently, indeed commonly, the course with *Euglena* in freshwater ponds. The little *Protococcus* which colours the salt red in the salt-pans of the Island of Bombay, is green in the active period of its existence, but becomes red, and settles down into the "still form" of the same colour; while the common green *Protococcus* of the fresh-water tanks loses its red spot in the still form, and gains it again in the active or reproducing period of its existence. So red *Euglenæ* often become green; but the usual course appears to be for the green to appear first.

The red colour also appears to herald the termination of some period in the existence of the species. Thus the *Peridinium* above mentioned, after becoming red, loses its cilia, assumes the still form, and sinks to the bottom. The same is the case with the *Protococcus* of the salt-pans of Bombay; but instead of adhering to the salt, it seeks out and settles upon the crystals of carbonate of lime that are among those of the salt. The chlorophyll changes from green to red also in some of the resting spores of the confervoid Algæ, as in *Sphæroplea** and in *Protococcus pluvialis*, where also in both it becomes green again on germination, which led Cohn to state that the green colour is connected with "vegetation" or the early part of the existence of the individual, and the red with "fructification" or the termination†. So that, altogether, the passage of the colour from green to red in the filament seems to be more likely than the opposite.

Thus, as the evidence regarding *Trichodesmium* in the seas above mentioned is more, if anything, in favour of its yellow than its red colour, and that it is also sometimes green, while, in the common course, where Algæ present red and green colours in their respective cycles of existence the latter appears first, and the *Peridinium* above mentioned passes from green to yellow and then to red, &c., it seems not unreasonable to infer that *Trichodesmium Ehrenbergii* does the same, and that, therefore, so much of Montagne's generic characters of *Trichodesmium Ehrenbergii* as relate to its colour (viz. that it is "at first red and at length green") should be reversed.

If it were desirable to adduce evidence of the faint green colour which *Trichodesmium* probably presents in the first stage of its existence, from the observation, too, of probably the same organism in other parts of the world, one might cite those of Péron, who likens it to "poussière grisâtre," and of Darwin, who compares it to "cut hay," &c. (*op. cit.*); but it seems better for this argument not to go beyond the seas washing the shores of Arabia.

To what the "intense green," under which this organism sometimes presents itself in the Red Sea, owes its production I am ignorant, unless it be indicative of sporidification, which,

* Cohn, Ann. des Sc. Nat. 4e sér. t. v. p. 187.

† Ray Soc. Vol. for 1853, p. 519.

from what I think that I have seen in *Oscillatoria princeps,* seems to take place in this family, not from the conjugation of its cells, but from the division of their contents into zoospores. Much therefore remains to complete the history of this little plant; and this, unfortunately, can only be obtained by watching it long and narrowly in its proper habitat.

XXI.—*On the Contractile Tissue of Plants.* By Prof. FERDINAND COHN*.

PROF. COHN commences his interesting essay by remarking that, though modern discovery has rendered the boundary-line obscure between the animal and the vegetable kingdoms, with respect to the lowest organisms in each, yet the differential characters between the higher forms of each subkingdom remain sufficiently well marked. Nevertheless the phenomena of irritability and of movement in parts of many higher plants bear a general resemblance to those presented by the tissues of the higher classes of animals, though their active cause has been attributed to mechanical forces in connexion with structural peculiarities. Cohn addresses himself to the question whether these mechanical hypotheses are sufficient and satisfactory, or whether the movements and irritability of plants are not referable to structures homologous with those concerned in their production and manifestation in animals.

To solve this interesting question, Cohn appeals to observations made by himself and by a talented pupil, M. Krabsch, who was induced by the Professor to repeat, in the first instance, the old experiments of Treviranus and Morren on the irritability of the filaments of *Centaurea,* as a prelude to new researches. Köhlreuter established the fact of the irritability of the stamens of *Scolymus hispanicus, Serratula arvensis, Cynara scolymus,* and *C. cardunculus, Onopordum arabicum, Centaurea moschata, C. nigra, C. spinosa,* and *C. ragusina, Cineraria, Scabiosa glastifolia, S. benedicta, S. eriophora,* and *S. salmantica, Buphthalmium maritimum, Cichorium intybus,* and *C. endivia,* and *Hieracium sabaudum.* Sowerby noticed the contractility of the anthers in *Centaurea Isnardi,* and L. C. Treviranus made a particular study of the movements of the filaments of *Centaurea pulchella,* whilst Morren did the same for those of the *Centaurea ruthenica.* Krabsch especially studied the movements of the anthers of *Centaurea macrocephala.*

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To witness the phenomena of motion and irritability in the stamens, it is only necessary to isolate a floret, as of *Centaurea*, and to cut away one-half of the corolla in such a manner as to expose the stamens, from their point of attachment, their whole length. After a period of rest of a few minutes, the filaments, which have hitherto been straight and in close apposition with the central style, are seen to curve themselves outwards, leaving, however, their terminal anthers still closely applied to the upper part of the style. This bending proceeds until it reaches its maximum, when each filament stands out in a half-circle from the style. On now touching a filament with a needle, they all, so to speak, collapse and resume their vertical direction and close apposition with the style. Bearing in mind the fact that the filaments are fixed at their two extremities (at the upper by the anthers, which are immoveable, and at the lower by their insertion into the receptacle of the floret), it becomes evident that, to produce the remarkable curvature they exhibit, they must undergo considerable elongation. Indeed, the degree of curvature does not represent the whole amount of elongation; for the filaments necessarily affect the length of the anthers by the tension exercised upon them. The extent to which they pull upon the anthers may be demonstrated by cutting across one or more of them, when the lower half becomes drawn apart from the upper, and thrust upwards above the line of section. The maximum of this movement of the cut filament is stated to be half a millimètre.

The movements of the filaments in two species of *Centaurea* (viz. *C. macrocephala* and *C. americana*) were carefully measured by means of the micrometer, due regard being given to the temperature, time of day, and other conditions likely to influence the phenomenon. These measurements are given in detail; but it is unnecessary to copy them here, and we shall content ourselves by stating the general results of Cohn's inquiries.

1. The touching of a filament of *Centaurea* is at once followed by shortening, which, in its extent, bears a direct relation to the intensity of the irritation produced.

2. The irritated filament undergoes shortening in its entire length. All other parts of the flower seem incapable of a similar process.

3. The shortening commences from the moment of contact, and proceeds rapidly (though not so much so as to appear instantaneous) until it attains its maximum. A sudden act of irritation, as with a needle, induces the most complete contraction.

4. Hence it also follows that the impulse to shortening is transmitted from the point irritated to both ends of the filament, or from one end to the other.

5. The degree of shortening varies according to the age of the stamens, the temperature, and other influences which exalt or reduce their irritability, as, for instance, the integrity of the flower, and the condition of the other filaments when irritation is applied to one of their number.

6. The medium degree of shortening, in thirty-one measurements, was rather above twelve-thousandths of a Viennese line, or about one-eighth of the length of the filaments. Thus, a filament which, when extended, is 12 millimètres in length, shortens, when touched, to 10·5 mill. This estimate is within the truth; for the whole amount of contraction cannot be measured.

7. Immediately after the shortening has attained its maximum, elongation commences, and proceeds much more rapidly at first than subsequently. The curve, consequently, is much more abrupt at first, and of a larger arc afterwards. The same law obtains in the case of muscle after irritation.

8. The interval between the maximum contraction and the maximum extension varies in length : the medium time is about ten minutes; but in some instances only six, and in others fifteen, minutes elapse. The irritability depends greatly on the age of the flower : it is greatest when the style has not yet fully extended itself beyond the yet closed anthers encircling it; and it is lost when the style has reached its maximum length and the anther-cells are divergent, although the corolla do not then show the least sign of withering. It therefore follows that the period at which the stigma can be impregnated is subsequent to the loss of irritability on the part of the stamens.

9. By repeated irritation, a maximum contraction may be obtained and kept up for some time. Whether the irritability of the organ undergoes diminution, and may be eventually destroyed by long repeated excitation, is not determined. The decision of this question is theoretically of much moment; for if such decrease and loss occur, then the phenomenon of fatigue, as witnessed in muscular fibre, ranks also as a property of the irritable substance of plants. To solve the question, an appeal may be made to other plants exhibiting irritability, such as the *Berberis*, *Mimosa*, *Drosera*, and *Dionæa*; and in the two last-named examples experiment has positively shown that too often repeated contact paralyzes the irritability of their leaves.

10. By prolonged irritation of the stamens, their subsequent extension is found to decrease progressively, both in degree and in the rapidity with which it occurs.

11. The capacity of shortening themselves, even irrespectively of the irritation of an external excitant, continues in the filaments for a considerable time, though it gradually declines.

12. At first sight it might be supposed that the shortening

of the filaments independently of the operation of external excitants is a consequence of the drying up of their tissue; but such is not the case.

13, 14. On the contrary, this shortening is a consequence of an active process of contraction. That it does not depend on desiccation of the organs, Cohn proved by contriving in some experiments to keep them moist, and in others to immerse the whole sexual apparatus in water. In the former series the power of contractility remained, whilst in the latter their capability of rapidly shortening themselves on the application of an excitant was almost instantaneously lost, though, after a time, it gradually revived.

15. From these experiments it was undeniably established that the filaments have their maximum length at the epoch of their highest irritability, and that subsequently they continuously and gradually contract, and also that this phenomenon is not dependent on the hygroscopic conditions of the parts. These facts necessarily imply that a direct relation subsists betwixt the contractility of the filaments, the loss of their irritability, and the gradual death of their tissue. To demonstrate this, Cohn subjected the prepared sexual apparatus of a floret to ether, with the view of destroying its vitality by the vapour, when he found that the filaments shortened themselves greatly, whilst the style remained unchanged. To obviate the desiccating effects of the ether-vapour on the tissue in this experiment, he introduced water so as to keep the parts moist.

16. Mechanical contact is not the only excitant to active contraction, but electricity is so likewise, and acts powerfully when the current is transmitted through the sexual apparatus. Moreover, when the current is strong, the shortening is not succeeded, as after ordinary stimulation of the filaments, by elongation; on the contrary, their irritability is destroyed, and they remain shortened. Parallel phenomena have been noted by Schlacht and Pfluger in the leaves of *Mimosa pudica* when an induction-current traverses them; and by Nasse in the stamens of *Berberis.* The effects of a continued constant current Cohn has not yet been able to determine.

17. From the observations made, it is presumable that the lasting and permanent shortening of the filaments, with loss of irritability, is a symptom of its extinction, whether produced rapidly by ether-vapour, by water, or by strong electrical action, or whether it happens spontaneously and gradually. The shortening also appears in all cases, under similar circumstances, to advance at a constant minimum rate, whatever may be the cause of the extinction of irritability.

The proximate active agent in the process of shortening is the elasticity of the cell-tissue, or the property to which a structure owes its permanence of form and its capability of renewing that form after disturbance from any cause. Moreover, the elastic powers of the stamens differ, as in muscle, under different circumstances. In the irritable stage the elasticity is great, but the extensibility small; and on the contrary, when the irritability is lost, the elasticity is decreased, and the filaments can then be readily extended. Still the elasticity remains so far as to assert its power by shortening the filaments when the extending force is removed; and this holds true even after their vitality has ceased.

18. We may probably arrive at a better apprehension of the phenomena detailed by endeavouring to discover in what tissues the contracting and the extending forces of the irritable stamens reside. The filaments of *Centaurea* are composed of very delicate cells, mostly somewhat longer than broad. Their softness or delicacy is so great that they are easily crushed by the glass cover in a microscopical examination. They are cellulose in chemical composition, and covered by an epidermis consisting of still larger though very delicate cells, three to four times as long as broad. Their outline is gently undulating, and their protoplasm is thick and coarsely granular; externally they give off conical-cylindrical hairs from over the septa between adjoining cells, so that these hairs are themselves divided by the longitudinal septa, being, as it were, prolonged into them. A cuticle encloses both the epidermic or epithelial cells and the hairs growing from them. In the interior of each filament is a bundle of spiral vessels with prosenchyma-cells and air-passages.

The question is, whether the cellular structure possesses, as a whole, the extending and contractile power, or whether the several tissues distinguishable have different and special functions. Microscopic examination can afford no positive answer to this question; but the following deductions may be made:—

a. The contraction proceeds in the cell-structure at large. If not, contraction would involve folds or wrinkles at parts; and such are not discoverable. *b*. On the other hand, the vascular bundle in the centre exhibits no activity in the process of contraction; for in a contracted filament the vessels are not in a state of tension, but wavy. *c*. The stretching of the different parts varies in degree greatly; for when a filament is slit longitudinally, it curves itself spirally, and so that the cut surface occupies the convex side. This shows that the tissues nearest the epidermis undergo greater shortening. Morren has made the remark that the centre of motile stamens possesses contractile power, and that the superficial epidermis and cuticle constitute the elastic portion; but Cohn inclines to the opinion that the entire parenchyma possesses the properties of extensibility and contractility, together with those of contractility and elasticity; but he would not deny that probably the different layers of cells partake of these properties in various degrees.

19. Another question is, supposing contractility to reside in the cells, whether the cell-membranes or their contents are the active agents in its manifestation. Dutrochet's hypothesis of endosmose as the cause of plant-movements has given place to the hypothesis of Hofmeister; and Cohn is disposed to believe that the primordial layer or the proteine contents are endowed with contractility, and that the enclosing cellulose membrane gives the required elasticity to cells.

20. It is, again, necessary to determine whether the changes in form of contractile cells are exclusively effected by the shortening of the long diameter which may be actually recognized. Cohn can give no decisive opinion on this matter, but presumes that the decrease in length must be followed by an increase in the width of the cells. But, even after the solution of these questions, the problem would remain unsolved, On what histological qualities and relations does the circumstance depend, that cells should by irritation undergo a change of form, and, whilst contracting in one dimension, expand in another? But the same difficulty prevails with regard to animal contractile tissue on these physiological points.

21. On comparing together the several observations adduced, two interpretations are possible. In the filament of *Centaurea* two properties exist in a state of antagonism—viz. elasticity, a physical property independent of vitality, and seated in the cell-wall, and an expansive power, associated with living action, and probably referable to the cell-contents (the primordial lamina). So long as the living filament retains its irritability, the property of expansion predominates, and the filaments are consequently extended and curved, and most so when they are exempt from irritation, though still in a considerable degree after having been temporarily shortened in consequence of irritation. Again, as the expansive energy declines with the vitality of the filaments, the elasticity comes more and more into play, and causes a progressive shortening of those organs. Irritation acts in a certain measure as a momentary and partial death, and paralyzes the expansive power; and when the vitality of the stamens actually vanishes, elasticity assumes the entire sway, and gives rise to a maximum degree of shortening. Thus, according to this interpretation, the shortening of the cells after an external irritation is peculiarly a passive phenomenon; and the active power is displayed in their extension during life in general, and particularly during the period of elongation.

22. Another interpretation offers itself when the above observations are viewed in comparison with those made respecting the contractile tissue in animals; and although, in the higher animals, contractility is found in association with highly organized muscular fibre and nerve-tissue, yet, in the lowest animal organisms, contractility and irritability exist even without the formation of distinct cells, as in the sarcode of *Hydra*, of *Amœbæ*, &c.; consequently these properties as exhibited in plants become more correctly comparable with such similar endowments in the animal kingdom. The comparison of vegetable contractile tissue with true muscular structure can, indeed, be only by way of analogy, and not of homology.

23. The greatest analogy obtains between the smooth organic muscles of animals and the contractile tissue of plants. The effect of contraction on muscle is to shorten and thicken it: this effect is speedy, but the subsequent elongation more gradual; this latter likewise proceeds in a curvilinear manner, similar to what may be seen in the contractile filament of the plants. However, the contraction of muscular tissue exceeds in extent that witnessed in the contractile substance of the plant.

Again, in muscle, contractility is opposed to elasticity; for, like the filament, muscular fibre is endowed with a small amount of elasticity. The degree of elasticity of muscle is smaller, and the extensibility greater, in the contracted than in the extended condition; and, though not demonstrated, it appears probable that the contracted filaments are more readily and largely extensible than the outstretched ones.

Further experiments are needed to decide whether the elastic property of the contractile filaments in all cases follows the same laws as Weber has clearly proved to exist in muscles.

The most powerful excitant of muscle is electricity, by the medium, however, of the nerves. Its operation is nevertheless similar in the case of the motile filaments. Mechanical contact operates alike in the two structures, and affects the entire length of the contractile organ. But, besides electricity, there are several other stimulants of muscular energy, such as warm and cold water, vegetable poisons, prussic acid, ether, and chloroform, not yet experimented upon in the case of the stamens of *Centaurea*, but which, judging from their action on *Mimosa pudica*, may be presumed to react on their irritability much as they do on that of muscles.

24. With the facts now advanced, the differences subsisting between the motory phenomena of contractile filaments and of muscular fibre may be examined and compared. Now, the extended condition is considered to represent the passive and normal state of muscle, and its contraction an active condition

opposed to the natural elasticity of its tissue. On the contrary, in the filaments of the plant, elasticity seems to act as the shortening agent, and to represent the passive condition, whilst extension or elongation appears to be a state of activity. A difference such as this implies in the active causes in operation in the contractile parts of plants and animals is, however, not probable. Indeed, presuming the physiology of muscular action, as generally taught, to be correct, we may still assume that the contraction of the filaments, like that in muscle, is a sequel to the operation of an active force—of contractility—which has been suspended in consequence of irritation, and also associated, as is true of muscle at the moment of its activity, with a change in the elasticity of the tissues.

25. We should be in a better position towards understanding the true relations between the contractility of plant- and of animal tissue did we rightly comprehend the remarkable contraction which the withered filaments undergo. So far as concerns the fact itself, it appears not to be without analogies in the animal kingdom, among the lowest classes endowed with contractile parenchyma. For instance, in Amœbeæ and Foraminifera, the contractile processes are retracted on the application of an excitant, and also on the approach of death, and the whole animal shrinks into a smaller compass. So it is in *Vorticella* and in *Stentor*, and also in *Hydra*. Such analogy is more obscure in the muscles of the higher animals; yet Cohn believes that the rigidity after death is a fact of the same class.

26. It is improbable that contractility as exhibited in the stamens of *Centaurea* should be an isolated phenomenon in the vegetable kingdom. On the contrary, a very large number of facts are on record respecting many plants, parallel in kind to those detailed. The peculiar phenomena attributed to vegetable "*irritability*" are of this order: such are the movements of the stamens of *Berberis, Cactus, Cistus*, &c., of the anthers of Gesneraceæ and of the Stylideæ, of the labella of some Orchideæ, of the leaves of many Leguminosæ, Oxalidaceæ, Droseraceæ, &c., of the climbing stems and tendrils of many climbing plants and creepers—all more or less affected by external excitants, electrical, chemical, and mechanical. To the same category belong also those phenomena described as the sleep of plants (regulated by and dependent upon the intensity of light), the movements of all younger parts of plants towards the light, and those changes in form, lately remarked by Hofmeister, in all young shoots and leaves, which become curved by mechanical shaking.

27. It has been generally assumed that these phenomena of irritability in plants have nothing in common with those witnessed in animals, but are to be explained by the action of some me-

chanical forces. Hofmeister's researches have set aside the hypothesis of Dutrochet, of endosmotic force called into play by excitants; but the theory advanced in its place, that the movements are not dependent on shortening, but on an augmented expansion or turgescence as the effect of excitation, cannot itself be maintained. In this hypothesis, the pith, as being very full of sap, is assumed to take the most important part in producing the movements—an assumption which Cohn shows, from *à priori* considerations, to be untenable. Moreover, the positive fact above advanced, of the occurrence of shortening when a part is irritated, stands in direct opposition to this general hypothesis of Hofmeister; for, without doubt, the movements of the young shoots are of a similar nature to those of the stamens exhibited in *Centaurea*.

28. Cohn has, from the researches entered into, arrived at the conviction that the accepted dogmas of physiology are erroneous in ascribing sensation and motion to animals as characteristics—a conviction further strengthened by all the newly observed facts relative to the lowest grades of animal life, and the distinctions existing between animals and plants. Sensation in the higher animals is linked with sensory perception or sensibility, and with a medium of connexion between the sensorium and surface in the system of nerves; but in the lowest animals this complex apparatus is absent, and the whole tissue responds to impressions from without, these latter operating by the existence of what is called "irritability," or of a degraded sort of sensation. This low form of sensation must be also attributed to plants; for these organisms exhibit it in a threefold manner: 1st, by the property of receiving impressions from without, *i. e.* by *irritability*; 2ndly, by the property of responding to such impressions by internal movements and by changes in form, *i. e.* by *contractility*; and 3rdly, by the power of propagating these impressions from their point of contact to the tissues and parts around, which are themselves, as a result, thrown into action, *i. e.* by *diffusibility* of impressions. The action of excitants in developing irritability and calling forth movements is not simply and directly dependent on their mechanical, physical, or chemical characters, but the organized tissue has an organic modifying power upon them, and the irritation gives rise to internal movements resulting in change of form, the suspension of elasticity, or the production of heat, &c. This organic power is the *vis nervosa* of Haller.

29. When an act of irritation is propagated within the tissue, this again is dependent on an internal motor power, called into activity by the external impression, without which the internal movements necessary to diffusion could not take place. Thus,

when a nerve is mechanically, chemically, or electrically injured, and the muscles in relation with it are thrown into activity, this happens not by transmission of the mechanical or other force, but by the calling forth of a motor nerve-force which propagates itself along the nerves.

On applying flame to a leaflet in the compound leaf of *Mimosa pudica*, it is not only that particular leaflet that is affected (for if so, it might be fairly attributable to the direct effect of the heat); but all the other leaflets, and the entire leaf, including its attachment to the stem, are similarly affected, and collapse; and what is more, the direction of the propagation of the impulse varies according to the point at which it impinges. Indeed, it is impossible to reduce these movements to the level of mechanical results; and the same holds true when electrical is substituted for mechanical force.

All such facts and considerations concur in proving that the propagation of external excitation in *Mimosa* proceeds in the same mode as in animals; and there is little doubt that the vascular bundles constitute the special tissue adapted for this object, and that the phenomena of contractility depend upon a muscular tissue.

Though not so perfectly, these properties are also displayed in *Dionæa*, *Drosera*, and the stamens of *Centaurea*. The filaments of the last named contract themselves in their entire length when only one point is touched; and the act of contraction manifests itself by undulatory movements, just as in organic muscle. This fact is best shown by preparing the flower of *Centaurea* so that the filaments are left by themselves, attached below, but set free above by having the anthers dissevered from them. This done, the filaments curve themselves gently outwards, and look like the arms of a *Hydra* extended. In this state any one of the filaments may be irritated (as by the point of a needle), with the effect of inducing a series of movements; these at first being a bending of the fibre towards the side on which it is touched, followed by curvature to the opposite side, and, lastly, by undulatory movements along its entire length. On irritating the five filaments on different aspects, they are bent about in various directions, curving over and crossing one another.

So far, however, as observation has extended, it would seem that in *Centaurea*, *Dionæa*, and *Drosera* the power of conduction of external impressions is not located in any one tissue, but equally partaken by all, as is seen in the instance of those lowest animals that are destitute of definite nervous and muscular tissue.

30. On now collecting the facts that energetic movements

as the result of irritation are seldom observed in the vegetable kingdom, but that the anatomical structure of irritable tissues presents no appreciable characteristic peculiarities not seen in other vegetable tissue, and that the suceptibility to the excitation of light, as well as to that of mechanical and probably of electrical impulse, is possessed by all young vigorous tissues; and further, on comparing these phenomena with those of animal irritability, the conclusion forces itself upon us, that the faculty of responding to external irritation by internal movements and changes of form belongs to cells as such, and holds good as well in the vegetable as in the animal kingdom. To be irritable, to change its normal form as a result of excitation, and to revert to it after a while by its inherent elasticity, are characteristics of the living cell. In plants, these properties are met with only when the vital processes are in full activity, and therefore are particularly noticed during the period of flowering, when those processes are at their maximum. And here it may be remarked that the stamens, in which irritability is more frequently noticed, are the only organs in which an elevation of temperature, measureable by the thermometer, occurs, although doubtless a certain degree of heat is generated in all plant-cells by the chemical processes going on within them. So soon as the processes of life in an organ begin to fail in power, so soon also does their irritability decline, so far, at least, as its external manifestations are concerned.

These circumstances suggest a reason for the rarity of the phenomena of irritability and contractility existing in any considerable degree in plant-cells; but they furnish no ground for concluding that irritable tissues possess properties not to be found in other vegetable tissues; on the contrary, it is to be supposed that similar properties belong to all, but exist in an intensified degree, and for a certain epoch, in those parts where their results arrest observation. There is a difficulty in believing that, in possessing the faculties of sensation and motion, the animal kingdom, including its lowest and most simple representatives, partakes of vital endowments entirely denied to plants for the sole reason of their being plants.

There is a physiological differentiation in the organs and cells of the higher animals, which progressively declines as we descend the scale of animal life; and we find in the lower grades of animals the same tissue, and this, too, in a less elaborated form, carrying on functions which, in the higher, are shared in by two or more highly organized special structures. The same holds good in a higher degree with respect to plants, in which, as a rule, one and the same cell performs all the functions necessary to life, though in some cases certain cells are constituted into a homogeneous tissue for the more special (but by no means the exclusive) performance of one or other of those functions. The hypothesis now contended for is, that plant-cells possess irritability and contractility as do animals, though in a much less complete manner, and without the mechanism of the specially devised tissues—muscle and nerve. And whoever will deny to plants the property of responding by movements to the act of irritation because they possess neither muscles nor nerves, by similar reasoning should deny their capability of taking up nourishment because they have neither mouth nor stomach, or their power to circulate the sap because they have no heart, or their faculty of respiration because they are destitute both of lungs and gills. In short, the plant has, by the medium of the simple cell alone, to accomplish all that is effected in the higher animals by different organs in a more complete and efficient manner.

31. In the foregoing discussion, Cohn has contented himself by assigning to vegetable tissue the property of irritability and the power of responding to irritation, or the function of contractility; and he would leave to a more imaginative dissertation the task of claiming for plants the possession of localized sensation, of consciousness, and of volition—properties which, in his apprehension, are absent also in the lowest forms of animal existence.

If sensation, as manifested in animals, could be predicated of tissues which respond by movements to external irritation and in consequence of it, no difficulty would be found in proving its existence in the vegetable kingdom, and particularly by reference to the influence of light upon the green parts of plants, the leaves and stems, in the production of correlative movements.

32. The movements of the contractile filaments of *Centaurea* must be acknowledged as having a special purpose when the process of fructification in this plant and its allies is studied. The anthers in Cynareæ reach maturity before the stigma. When the apex of the style has as yet not advanced in length beyond the surrounding ring of anthers, the pollen already distends, and exudes from, the cavities of the anthers. If at this period, when the irritability of the filaments is at its maximum, the floret be touched, the filaments are immediately shortened, and the anthers, as a consequence, are simultaneously retracted; a quantity of lumpy pollen is at the same time seen to be extruded from the apices of the anthers. However, this pollen is not in a condition to fructify the stigma, in consequence of the peculiar disposition of hairs upon the nodule supporting the fissured apex, which prevent the passage upwards of the pollen to the yet closed stigma-orifice; and it is not until after the

filaments have lost their irritability that the stigma and pollen are mutually fitted for the process of fructification. This extrusion of pollen on primary contact has, upon such grounds, been designated "pollution" by Meyer. From the above facts, it follows that the several florets in the flower of *Centaurea,* although they have their anthers and stigma in immediate contact, are nevertheless incapable of self-fructification, are only apparently hermaphrodite, and, in point of fact, dichogamic.

It is further remarkable that the pollen-grains remain united in lumps, and therefore less diffusible in the currents of air as dust; and consequently the fructification, in these as in many other plants, is effected by the agency of insects. When an insect alights on a flower of *Centaurea,* it produces by its contact a retraction of the irritable filament and anther, and at the same moment a discharge of pollen from the apex of the latter, which adheres to the legs of the insect, and serves to fructify, not the stigma of that particular floret, which as yet is, in fact, unfit for the process, but the female organ of some other floret, arrived at maturity, in the same or, it may be, in some other flower.

The researches of Köhlreuter and others prove that this process prevails throughout the entire family of Cynareæ, and affords an explanation of the frequency of bastard forms in this section of the Compositæ, and particularly in the genus *Cirsium.* Conrad Sprengel has pointed out that the sexual organs in *Carduus nutans* do not simultaneously reach maturity, and that therefore the florets are dichogamic. Köhlreuter also states that the filaments in *Cichorium intybus* and *Hieracium sabaudum* are equally irritable with those of *Centaurea*; and the frequency of bastard forms in the Hieraceæ renders it probable that their florets are also dichogamic. The same condition is moreover presumable in the case of other plants with syngenetic stamens, particularly in that of the Campanulaceæ, Lobeliaceæ, Violaceæ, &c.

Köhlreuter has likewise announced the fact of the irritability of the filaments in Cacteæ and Cistineæ; and those of the former tribe offer themselves as peculiarly adapted to further researches on this matter, and particularly with relation to the effects of electricity on the contractile tissue of plants. The physiology of contractile tissues is still in its infancy; but we anticipate that its more profound investigation will only supply additional evidence in favour of the proposition which we believe is the starting-point for general physiology and the science of development, viz., that the principle of life, both in the animal and vegetable kingdom, is one and the same, multifariously diversified by different gradations in organization, and that all vital phenomena of living organisms are referable to the life of the cell.

33. The following is a summary of the foregoing researches on the stamens of *Centaurea*:—

1. The stamens shorten themselves, on mechanical contact, instantaneously throughout their length. This holds true, also, when only one point is touched, and also of all parts of those organs. The contraction amounts to one-seventh of their length, and, in certain conditions, to one-fourth. Simultaneously with their contraction, the stamens also become thicker.

2. After the shortening has attained its maximum, the filaments begin to extend themselves, and to acquire a curved condition similar to what occurs in an irritated muscle. After the lapse of ten minutes, they regain their former length.

3. Other excitants, especially a current of electricity transmitted through the filaments, produce immediate contraction.

4. The irritability of the filaments vanishes spontaneously after a while—in the living flower, about the time when the segments of the style expand themselves and the stigma is in a condition for fertilization. But, coeval with these changes, the stamens become progressively shorter, and, when completely deprived of their irritability, are only one-half the length they were when in the full possession of that property.

5. This persistent shortening, which must not be confounded with contraction resulting transiently from previous irritation, is a symptom of death, not a hygroscopic phenomenon. At the same time it is induced much more rapidly when the irritability of the stamens is destroyed by the vapour of ether, by immersion in water, or by strong electric discharges.

6. The shortening in death is chiefly an effect of elasticity, which, in the irritable filaments, is subordinate to an expansive power; but, in the dead or withered state, the antagonism of this latter is withdrawn, and the filaments become shortened to one-half their length, and are highly elastic, like threads of india-rubber.

7. The property of shortening resides in the parenchyma of the stamens, which presents no especial difference from ordinary cell-structure; and the vascular bundle is at least passive during contraction.

8. The foregoing, along with other similar researches, go to demonstrate that the cell-tissue of the filaments of *Centaurea* possesses irritability (in the sense used by Haller) and likewise an innate motor power, both these properties resembling in all essential points their like as found in the contractile and irritable parts of animals. This analogy does not imply the existence of muscles and associated nerves, as found in the higher animals, where a physiological differentiation of tissues prevails in order to qualify for the performance of functions of the highest

order, but points much more precisely to the irritable and contractile tissue of the lowest animals, which possess neither muscles nor nerves.

9. As it is, on the one hand, most improbable that these conditions should obtain in the tissue of the filaments of *Centaurea* as a solitary instance, so, on the other, it is much more credible that similar properties (motory phenomena consequent on irritation) prevail throughout the vegetable kingdom. That this is so, is exemplified in all those movements which have a recognized object, as those of the young parts of all plants towards the light, and in the curved motions of such parts induced by mechanical and electrical contact; and the conclusion is inevitable, that irritability and contractility, or, in other words, the faculty of undergoing changes in form or outline in response to external excitation, are not restricted to the animal kingdom, but, like assimilation, respiration, the distribution of nutritive juices, development, &c., are the vital endowments of the cell simply as such, and are manifested in plant-tissue only exceptionally with less distinct energy by reason of a simpler organization and weaker vital power.

10. Teleologically considered, the irritability of filaments is subservient to the production of movements in the Cynareæ and the florets of probably all the other Compositæ, in connexion with dichogamic fertilization, as the frequency of bastard forms in *Cirsium* and *Hieracium* indicates. In this process insects constitute the principal agents, causing by their contact the contraction of the stamens and the consequent extrusion of pollen from the anthers, and then carrying the pollen so discharged to other florets, the stigmas of which are (unlike the organ of the floret, with its highly irritable stamens, which has furnished the fertilizing powder) in a condition to receive it.

XXII.—*On the Japanese Species of* Siphonalia, *a proposed new Genus of Gasteropodous Mollusca.* By Arthur Adams, F.L.S. &c.

Genus Siphonalia, A. Adams.

Testa ovato-fusiformis, plerumque variegata, non epidermide induta; anfractu ultimo ventricoso, plerumque nodoso-plicato. Apertura antice in canalem curtum recurvatum desinens.

Most of the typical species comprising this group have been described by Lovell Reeve in his Monograph of *Buccinum*. They are, *B. cassidariæforme*, Rve., *B. lineatum*, Kien., *B. signum*, Rve., *B. modificatum*, Rve., *B. spadiceum*, Rve., *B. fusoides*, Rve., *B. hinnulus*, Ad. & Rve. Their operculum, however, is fusoid, and their shells more nearly resemble those of *Neptunea* than of *Buccinum*. They appear to be principally from China and Southern Japan, while the species of *Neptunea* are chiefly northern shells, and are numerous in the northern parts of Japan and Manchuria. The species of *Siphonalia* are commonly variegated and destitute of epidermis, and are thin ventricose shells; while the species of *Cantharus* and *Cuma*, which somewhat resemble them in form, are dense solid shells, and are covered with a thick brown epidermis.

1. *Siphonalia cassidariæformis*, Reeve.

Buccinum cassidariæforme, Rve. Conch. Icon. sp. 11.

Hab. O-Sima; Simoda.

2. *Siphonalia signum*, Reeve.

Buccinum signum, Rve. Conch. Icon. sp. 6.

Hab. O-Sima; Hakodadi.

3. *Siphonalia trochulus*, Reeve.

Buccinum trochulus, Rve. Conch. Icon. sp. 7.

Hab. O-Sima.

4. *Siphonalia fusoides*, Reeve.

Buccinum fusoides, Rve. Conch. Icon. sp. 9.

Hab. Satanomosaki; Tsu-Sima.

5. *Siphonalia fuscolineata*, Pease.

Neptunea fuscolineata, Pease, Proc. Zool. Soc. 1860.

Hab. Mino-Sima.

6. *Siphonalia modificata*, Reeve.

Buccinum modificatum, Rve. Conch. Icon. sp. 67.

Hab. Kuro-Sima; 56 fathoms. Fatsijeu; 29 fathoms.

7. *Siphonalia spadicea*, Reeve.

Buccinum spadiceum, Rve. Conch. Icon. sp. 64.

Hab. Mino-Sima; 63 fathoms.

8. *Siphonalia hinnulus*, Adams & Reeve.

Buccinum hinnulus, Ad. & Rve. Moll. Voy. Sam. pl. 7. f. 10 *a*, *b*.

Hab. Tsusaki; 35 fathoms. Tatiyama.

9. *Siphonalia commoda*, A. Adams.

S. testa acuminato-ovata, sordide alba, epidermide tenui fugacea obtecta; spira aperturam vix æquante, conica; anfractibus 7, planis, in medio subangulatis, obsolete nodoso-plicatis, transversim liratis; liris majoribus albidis, minoribus fuscis, alternantibus;

interstitiis longitudinalibus crebre striatis; apertura oblongo-ovata, intus alba; labio lævi, canali aperto, mediocri, reflexo; labro intus lævi, margine crenulato.

Hab. Tsaulian.

A very neatly-formed and modest-coloured shell, differing from every species with which I have compared it.

10. *Siphonalia corrugata*, A. Adams.

S. testa acuminato-ovata; spira brevi, acuta; anfractibus 6, planis, longitudinaliter rugoso-plicatis, plicis in medio anfractuum nodulosis, transversim liratis; liris rugulosis, griseis cum albidis alternantibus, antice validioribus et distantioribus; anfractu ultimo magno, plicis antice obsoletis; apertura ovata, canali brevi, recurvato; labio lævi, calloso; labro intus lirato, margine albo.

Hab. Kino-O-Sima.

A grey species, with transverse white lines alternating with brown ones. It somewhat resembles *S. trochulus*, Reeve; but in that species the whorls are rugosely plicate.

11. *Siphonalia conspersa*, A. Adams.

S. testa acuminato-ovata; spira brevi, conica, lutescente, castaneo variegata et rufo-fusco conspersa; anfractibus 6, longitudinaliter plicatis, plicis postice nodulosis, in anfractu ultimo antice obsoletis, transversim liratis, liris validis, æqualibus; apertura ovata; labio lævi, calloso, incrassato, canali brevi, valde recurvo; labro intus sulcato.

Hab. Japan. Coll. Cuming.

A very pretty species, resembling in form *S. cassidariæformis*, Reeve, but with very different colouring and sculpture.

12. *Siphonalia concinna*, A. Adams.

S. testa ovato-conica; spira elata, quam apertura breviore, fulva, fasciis duabus latis transversis albidis ornata; anfractibus 6, lævibus, in medio angulatis, longitudinaliter plicatis, plicis distantibus, postice nodulosis, in anfractu ultimo obsoletis; anfractu ultimo antice transversim sulcato; apertura ovata; labio lævi, tenui, canali brevi, valde reflexo; labro intus lævi.

Hab. Kuro-Sima.

A neatly-painted species, with smooth and nodosely plicate whorls.

13. *Siphonalia ornata*, A. Adams.

S. testa ovato-fusiformi; spira conica, quam apertura breviore, fulva, lineis transversis rubris (in anfractu ultimo septem) ornata; anfractibus 6, planis, serie nodulorum in medio instructis, longitudinaliter striatis, transversim liratis; apertura ovata; labio crasso, calloso, canali subproducto, ad sinistram inclinato, valde recurvo; labro intus valde lirato.

Hab. Japan. Coll. Cuming.

An elegant lineated species, with a series of conspicuous nodules in the middle of the whorls.

14. *Siphonalia filosa*, A. Adams.

S. testa ovato-fusiformi; spira elata, acuta, aperturam æquante, pallide fulva, lineis transversis filiformibus aurantiacis ornata; anfractibus 8, convexis, longitudinaliter plicatis, plicis rotundis, vix nodulosis, in anfractu ultimo obsoletis, transversim liratis, liris confertis, æqualibus; apertura ovata; labio callo lævi instructo, canali mediocri, ad sinistram inclinato, recurvato; labro intus lævi.

Hab. China Sea; 14 fathoms. Coll. Cuming.

A slightly plicate subfusiform species, with the whorls adorned with orange thread-like lines.

15. *Siphonalia ligata*, A. Adams.

S. testa acuminato-ovata; spira conica, quam apertura breviore, alba, lineis filiformibus pallide aurantiacis distantibus ornata; anfractibus 6, planatis, postice angulatis, longitudinaliter subplicatis, transversim valde liratis, liris ad plicas nodulosis, elevatis, distantibus, regularibus; apertura ovata; labio tenui, simplici, canali brevi, lato, vix recurvato; labro postice angulato.

Hab. Japan. Coll. Cuming.

A delicate white species, adorned with elevated pale orange transverse lines, and most nearly resembling *S. lineata*, Kiener.

16. *Siphonalia grisea*, A. Adams.

S. testa acuminato-ovali, cinerea aut grisea; anfractibus 6, planis, oblique nodoso-plicatis, transversim valde liratis; liris æqualibus, planis, interstitiis profunde exaratis; anfractu ultimo magno, serie nodulorum ad peripheriam instructo; apertura ovata, canali brevi, aperto, recurvato; labio vix calloso; labro intus lirato.

Hab. Simidsu.

An ashy-grey species, with a series of nodules in the middle of the last whorl.

17. *Siphonalia colus*, A. Adams.

S. testa ovato-fusiformi, pallide fusca; spira elata, aperturam æquante; anfractibus 8, convexis, postice excavatis, longitudinaliter obtusim plicatis, plicis rotundis, transversim liratis; liris confertis, filiformibus, subæqualibus; apertura ovata, canali elongato, aperto, subrecurvato; labio lævi; labro intus sulcato.

Hab. Mino-Sima; 63 fathoms.

An elegant fusiform species, with the whorls finely lirate, and with the siphonal canal produced anteriorly into a somewhat long recurved beak.

18. *Siphonalia acuminata*, A. Adams.

S. testa ovato-fusiformi, pallide fulva aut alba, hic et illic rufo tincta; spira acuminata, quam apertura longiore; anfractibus 9, convexis, postice excavatis, longitudinaliter plicatis, plicis rotundis, regularibus, subconfertis, transversim striatis, in medio anfractuum biliratis, liris ad plicas nodulosis; anfractu ultimo liris 6 instructo; apertura rotundato-ovata, canali subproducto, tortuoso, vix recurvo.

Hab. Gotto; 48 fathoms.

A light brown acuminate species, with the whorls nodosely plicate, and with the siphonal canal rather produced and tortuous.

19. *Siphonalia pyramis*, A. Adams.

S. testa pyramidato-fusiformi, pallide fusca; spira elata; anfractibus 7, subimbricatis, planis, longitudinaliter plicatis, transversim liratis, liris confertis, æqualibus, ad plicas subnodulosis; apertura ovata, canali brevi, tortuoso, recurvo; labio lævi; labro intus sulcato.

Hab. Satanomosaki; 55 fathoms.

A somewhat pyramidal species, with an elevated conical spire, subimbricate whorls, and a short, tortuous siphonal canal.

20. *Siphonalia munda*, A. Adams.

S. testa ovato-fusiformi, pallide fulva, hic et illic fusco tincta, maculis subquadratis rufo-fuscis, in serie unica dispositis, in medio anfractuum ornata; spira producta, quam apertura longiore; anfractibus 9, convexis, postice excavatis, longitudinaliter nodoso-plicatis, transversim crebre liratis, liris confertis, regularibus, æqualibus; apertura ovato-oblonga, canali subproducto, tortuoso; labio lævi, simplici.

Hab. Kuro-Sima; 35 fathoms.

A neat, fusiform, fulvous species, with a series of subquadrate red-brown blotches in the middle of the whorls.

21. *Siphonalia nodulosa*, A. Adams.

S. testa ovato-fusiformi; spira acuminata, aperturam æquante, pallide fusca; anfractibus 7, convexis, postice subexcavatis, longitudinaliter valde plicatis, plicis distantibus, antice et postice obsoletis, transversim liratis, liris confertis, regularibus; apertura ovata; labio lævi, canali mediocri, tortuoso; labro in medio recto, postice rotundato-angulato.

Hab. Mino-Sima; 63 fathoms.

A somewhat fusiform species, with strongly nodulous plicate whorls. Colour uniform pale brown.

XXIII.—*On the higher Subdivisions in the Classification of Mammals.* By James D. Dana*.

The precise position of Man in the system of Mammals has long been, and still remains, a subject of discussion. There are those who regard him as too remote from all other species of the class to be subject to ordinary principles of classification. But zoologists generally place him either in an independent order (or subclass, if the highest divisions be subclasses) or else at the head of the order containing the Quadrumana. Science, in searching out the system in nature, leaves psychical or intellectual qualities out of view; and this is right. It is also safe; for these immaterial characteristics have, in all cases, a material or structural expression; and when this expression is apprehended, and its true importance fully admitted, classification will not fail of its duty in recognizing the distinctions they indicate.

Cuvier, in distinguishing Man as of the order Bimana, and the Monkeys of the order Quadrumana, did not bring out to view any profound difference between the groups. The relations of the two are so close that Man, on this ground alone, would be far from certain of his separate place. No reason can be derived from the study of other departments of the Mammals, or of the animal kingdom, for considering the having of two hands a mark of superior rank to the having of four.

Prof. Owen, in his recent classification of Mammals †, makes the characteristics of the brain the basis of the several grand divisions. But, as he admits, the distinctions fail in many cases of corresponding to the groups laid down; and although the brain of Man (his group Archencephala) differs in some striking points from that of the Quadrumana, yet no study of the brain alone would suggest the real distinction between the groups, or prove that Man was not coordinal with the Monkeys. In fact, the nervous system is a very unsafe basis of classification below the highest grade of subdivisions—that into subkingdoms. The same subkingdom may contain species with, and without, a distinct nervous system, and a class or order may present very wide diversities as to its form and development, for the reason that the system or plan of structure in species is far more authoritative in classification than the condition of the nervous system.

The fitness of the parts of the body of Man for intellectual uses, and his erect position, have been considered zoological

* From the American Journal of Science and Arts, vol. xxxv. Jan. 1863. Communicated by the Author.

† Journal of the Proceedings of the Linnean Society of London, for Feb. 17 and April 21, 1857.

characteristics of eminent importance, separating him from other Mammals. But even these qualities, although admitted to be of real weight, are not, to many zoologists, unquestionable or authoritative evidence on this point.

But while the structural distinctions mentioned may fail to establish Man's independent ordinal rank, there is a characteristic that appears to be decisive, one which has that deep foundation in zoological science required to give it prominence and authority.

The criterion referred to is this—that while all other Mammals have both the anterior and posterior limbs organs of locomotion, in Man the anterior are transferred from the *locomotive* to the *cephalic* series. They serve the purposes of the *head*, and are not for locomotion. The *cephalization* of the body—that is, the subordination of its members and structure to head-uses—so variously exemplified in the animal kingdom, here reaches its extreme limit. Man, in this, stands *alone* among Mammals.

The author has shown elsewhere* that this cephalization is a fundamental principle, as respects grade, in zoological life. He has not only illustrated the fact that *concentration of the anterior extremity of the body and abbreviation of its posterior portion* is a mark of elevation, but, further than this, that *the transfer of the anterior members of the thorax to the cephalic series* is the foundation of rank among the orders of Crustaceans. In the highest order of this class, that of the Decapods (containing crabs, lobsters, shrimps, &c.), *nine* pairs of organs out of the *fourteen* pertaining to the head and thorax belong to the head—that is, to the senses and the mouth. In the second order, that of the Tetradecapods, there are only *seven* pairs of organs, out of the fourteen, thus devoted to the head, two of the pairs which are mouth-organs in the Decapods being true legs in the Tetradecapods. In the third or lowest order, that of the Entomostracans, there are only *six*, *five*, or *four* pairs of cephalic organs; and, besides, these in most species are partly pediform, even the mandibles having often a long foot-like branch or extremity, and the antennæ being sometimes, also, organs of prehension or locomotion.

Two of the laws bearing on grade, under this system of cephalization or decephalization, have been stated—its connexion with (1) a concentration of the anterior extremity and abbreviation of the posterior extremity, and the reverse, and with (2) a

* See his Report on Crustacea, the chapter on Classification, p. 1395; also Silliman's Journal, vol. xxii. p. 14, 1856, where the principles explained in this paper are illustrated by many examples, and with direct reference to the general subject of classification.

transfer of thoracic members to the cephalic series, and the reverse. There is a third law which should be mentioned to explain the relations of the Entomostracans to the other orders, namely, (3) that a decline in grade, after the laxness and elongation of the anterior and posterior extremities have reached their limit, is further exhibited by a *degradation* of the body, and especially of its extremities.

In the step down from the Decapods to the Tetradecapods, there is an illustration of this principle in the eyes of the latter being imbedded in the head instead of being pedicellate. In the Entomostracans (1) the elongated abdomen is destitute of all but one or two of the normal pairs of members, not through a system of abbreviation, as exhibited in crabs, but a system of *degradation*; and in some species all the normal members are wanting, and even the abdomen itself is nearly obsolete. Again, (2) the two posterior pairs of thoracic legs are wanting in the species, and sometimes more than two pairs. Again, (3) at the anterior extremity, one pair of antennæ is often obsolete, and sometimes the second pair nearly or even quite so. The *Limulus*, though so large an animal, has the abdomen reduced to a straight spine, and the antennæ to a small pair of pincer legs, while all the mouth-organs are true legs—the whole structure indicating the extreme of degradation.

In the order of Decapods having nine as the normal number of pairs of cephalic organs, the species of the highest group have these organs compacted within the least space consistent with the structure of the type; in those a grade lower, the posterior pair is a little more remote from the others, and begins to be somewhat pediform; a grade lower, this pair is really pediform, or nearly like the other feet; and still lower, two or three pairs are pediform. Still lower in the series of Decapods (the Schizopods), there are examples under the principle of *degradation* above explained—(1) in the absence of two or three pairs of the posterior thoracic appendages, (2) in the absence or obsolescence of the abdominal appendages, (3) in the Schizopod character of the feet. These Decapods, thus degraded, approximate to the Entomostracans, although true Decapods in type of structure. Thus the principle is exemplified within the limits of a single order, as well as in the range of orders.

This connexion of cephalization with rise of rank is also illustrated abundantly in embryonic development. It is one of the fundamental principles in living nature*.

* In his 'Manual of Geology,' just published, the writer, speaking of the ancient Ganoids, has preferred to use the term *vertebrated* tails rather than

When, then, in a group like that of Mammals, in which *two* is the prevailing number of pairs of locomotive organs, there is a transfer of the anterior of these two from the locomotive to the cephalic series, there is evidence, in this exalted cephalization of the system, of a distinction of the very highest significance. Moreover, it is of the more eminent value that it occurs in a class in which the number of locomotive members is so nearly a constant number. It places Man apart from the whole series of Mammals, and does it on the basis of a character which is fundamentally a criterion of grade. This extreme cephalization of the system is, in fact, that material or structural expression of the dominance of mind in the being, which meets the desire both of the natural and intellectual philosopher.

This cephalization of the human system has been recognized by Carus, but not in its connexion with a deep-rooted structural law pervading the animal kingdom. It is the comprehensiveness of the law which gives the special fact its great weight. Aristotle, in his three groups of Mammals, the *Dipoda* or two-footed, the *Tetrapoda* or four-footed, and the *Apoda* or footless species, expresses distinctions according with this law. The term *Dipoda*, as applied to Man, is far better and more philosophical than *Bimana*.

The erect form of the structure in Man, although less authoritative in classification, is a concomitant expression of this cephalization; for the body is thus placed directly beneath the brain or the subordinating power, and no part of the structure is either anterior or posterior to it. Two feet for locomotion is the smallest possible number in an animal. Cephalic concentration and posterior abbreviation are at their maximum. The characters of the brain distinguishing the Archencephala (Man) in Prof. Owen's system, so far as based on its general form or the relative position of its parts, flow from the erect form.

Man's title to a position by himself, separate from the other Mammals in classification, appears hence to be fixed on structural as well as psychical grounds.

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heterocercal, because this characteristic of a prolonged vertebral column is a mark of inferiority of grade, on the principle explained; and the disappearance of it, in the Mesozoic era, was an instance of that abbreviation of the posterior extremity connected with a rise in grade. It is well exemplified also, as Agassiz has made known, in the development of the modern Ganoid, the young having a vertebrated upper lobe of the tail, which is lost before reaching the adult size. Another reason for using the term vertebrated is, that in some of the ancient Ganoids with vertebrated tails the vertebral prolongation is central in the tail, and the form is therefore not at all heterocercal.

The other Mammals are either true *viviparous* species, or *semi-oviparous.*

The latter, including the Marsupials and Monotremes, constitute a natural group, as usually so regarded, the most fundamental characteristic of which—the immaturity of the young at birth, by which they are related to oviparous Vertebrates—suggests the name *Oöticoids.*

The viviparous species are variously arranged by different zoologists*. Prof. Owen, basing his subdivisions largely, as has been stated, on the characters of the brain, makes the two groups Gyrencephala and Lissencephala, the former so named from having, in general, the surface of the brain *convoluted,* and the latter from its being, with some exceptions, *smooth.*

The Gyrencephala include, in Prof. Owen's system, three groups:—I. the Unguiculata (consisting, as presented by him, of the orders 1, Quadrumana, 2, Carnivora); II. the Ungulata (1, Artiodactyla or Ruminantia; 2, Perissodactyla or Solidungulata and Multungulata, 3, Proboscidia, 4, Toxodontia); III. the Mutilata (1, Sirenia, 2, Cetacea). The Lissencephala comprise four orders, arranged by him as follows: (1) Bruta or Edentata (Sloth, &c.), (2) Cheiroptera or Bats, (3) Insectivora (Mole, Hedgehog, &c.), (4) Rodentia.

Although the characteristics of the brain do not set forth satisfactorily the distinctions between the Gyrencephala and Lissencephala, the groups themselves (first laid down with the limits here assigned, as Prof. Owen states, by Jourdan) appear to be founded in nature. In the arrangement of the groups under these two divisions, however, the system proposed below widely differs from the above.

The Crustaceans have here also afforded the writer the principles of classification on which he rests his conclusions†.

The orders among Crustaceans are based not only on a difference of structure and cephalization, but also on a difference

* See Professor Owen's memoir already referred to, for an account of different earlier systems of the classification of Mammals.

† Principles are none the less important because indicated among these lower Articulates. The turns of a closed spiral are easily mistaken for circles, as was long the case with those of flowers in plants; but if the spire be drawn out long, it then exhibits its true characters, and may display details that are otherwise undiscoverable. The class of Crustaceans is an example of a type of structure thus *drawn out*, its species ranging from the microscopic memberless Rotifer to the highest crabs; and the genera are distributed, so to speak, at distant intervals along the course of the series, since they are comparatively few in number. Fundamental principles in zoological science are therefore exhibited in this class on a magnified scale, easily perceived and understood.

in the normal magnitude of the life-system. The Decapods are built on a life-system of large size as to plan as compared with that of the Tetradecapods. Deducing the relative size from the mean dimensions of the active species under the two types, the ratio is nearly as 4 : 1. (See the papers of the author already referred to.) Moreover, while thus distinct, the subdivisions of the two orders form parallel series,—the Brachyurans, Anomourans and Macrourans running a close parallel with the Isopods, Anisopods and Amphipods; for the Isopods are literally *Brachyural* Tetradecapods, and the Amphipods *Macroural**.

The life-system in the Entomostracans is on a still smaller plan.

Among the viviparous Mammals (exclusive of Man) the *first* group differs from the *second* on this same principle—the fact of a larger and more powerful type of structure or life-system. This fact stands out boldly to view on comparing active species of each—the orang-outang with the largest bat, the tiger with any Insectivore, the horse or elk with any Rodent, a Cetacean with any Edentate. The species of the second division are relatively small and feeble animals; and if they are sometimes of great bulk, as some ancient sloths, it is an example, though natural to the species, of vegetative overgrowth; for the bodies of the sloths, great and small, are, in fact, too bulky to be wielded well by the small life-system within.

Adopting this view as presenting the true basis for the subdivision of the viviparous Mammals, the two groups are significantly designated (1) *Megasthenes* (from μεγας, *great*, and σθενος, *strength*), and (2) *Microsthenes* (from μικρος, *small*, and σθενος). Judging of the mean size of the life-system in the two divisions from their more active as well as powerful species, the lineal ratio is not far from 4 : 1, as between the Decapods and Tetradecapods.

The orders in these two groups, the Megasthenes and Microsthenes, have throughout a precise parallelism. The Bats or Chiropters in the latter represent the Monkeys or Quadrumanes in the former, these orders having such close relations that they are made to follow one another in Cuvier's system; the Insectivores represent the Carnivores; the Rodents represent the Herbivores; and the Brutes or Edentates the Mutilates.

* The parallelism is complete; for the Amphipods differ from the Isopods just as the Macrourans from the Brachyurans, in having a larger and less compacted head, looser and larger mouth-organs, longer segments to the body, and an elongated foot-bearing abdomen—all points of inferior concentration and cephalization.

The classification indicated is then as follows:—

I. Archontia (vel Dipoda)—Man (alone).

II. Megasthena.	III. Microsthena.
1. Quadrumana.	1. Cheiroptera.
2. Carnivora.	2. Insectivora.
3. Herbivora.	3. Rodentia.
4. Mutilata.	4. Bruta (Edentata).

IV. Oöticoidea.

1. Marsupialia.
2. Monotremata.

It is interesting to observe, also, that the four orders of Megasthenes rise in grade, from the 4th to the 1st, on the principles of cephalization stated; and this affords other evidence, *superadded* to that of higher importance based on difference in type of structure, as to the naturalness of these subdivisions. The species of the 4th (the Mutilates) are characterized by a degradation and partial obsolescence of the limbs, by the body being massively prolonged behind, by a large part of the elongated vertebral column being used for locomotion, by the form and the low grade of structure of the head, and by the teeth, always of extreme simplicity of form, in most species of one set only, in some excessively multiplied in number, in others all wanting—peculiarities indicating a very low degree of cephalization, and even a *degradation* of the anterior as well as posterior extremity. Those of the 3rd (the Herbivores) by a more abbreviated body, by the two pairs of limbs being complete, but serving only for locomotion, by an elongated head. Those of the 2nd (the Carnivores) by the limbs being still more perfect, and serving, the anterior especially, for grasping, by the head being shorter and more compacted and, in general, more complete in the series of teeth. Those of the 1st (the Quadrumanes) by the anterior limbs serving still more perfectly as hands, by the cephalic extremity being further shortened, also by the mammæ being pectoral, as in Man. There is, in the series of orders, an advance by stages towards that acme of cephalization, Man.

Among the Microsthenes, the rise in rank on this principle is no less apparent. It is well seen between the lowest (the Brutes) and the others. These have posteriorly a remarkably lax vertebral column, but two or three of the vertebræ being soldered together to form the sacrum. The cephalic extremity exhibits, not only a low grade of cephalic concentration, as shown in the larger number of cervical vertebræ in some species, the excessive number of teeth in some species, the characters of the skull, but also a marked example of cephalic *degradation* in the jaws, in the very few teeth in most species and their total absence in some, in the inferior character of the teeth and the growth of but one set—in all of which characteristics, as well as their bulky bodies, there is a close parallelism with the Mutilates, the lowest of the Megasthenes.

XXIV.—*Diagnostic Notices of New Canarian Coleoptera.* By T. Vernon Wollaston, M.A., F.L.S.

Having been occupied for some time past in preparing a Catalogue of the Coleoptera of the Canarian Archipelago, and being unavoidably delayed in the completion of it, the following diagnoses of a few of the new forms which have long been described at considerable length in my manuscript, and many of which are now widely distributed in European collections, may serve to secure the priority of the names which I have imposed upon them.

Fam. Carabidæ.

Genus Metabletus, Goebel.

1. *Metabletus inæqualis.*

M. æneus, distincte alutaceus, sat nitidus; prothorace cordato; elytris plus minus inæqualibus, distincte striatis, utroque foveis 2 magnis notato; antennis femoribusque nigro-piceis, illis ad basin, tibiis tarsisque plus minus piceo-fuscis.

Long. corp. lin. $1\frac{1}{3}$–$1\frac{2}{3}$.

Habitat in Canaria, Teneriffa, Gomera et Palma, præsertim in sylvaticis degens.

Genus Tarus, Clairv.

2. *Tarus zargoides.*

T. subnitidus, fusco-piceus, pilis mollibus erectis brevissimis sat dense vestitus; capite prothoraceque dense et profunde scabroso-punctatis, hoc cordato angulis ipsis posticis paulo exstantibus; elytris ovalibus, subconvexis et undulato-inæqualibus, profunde (sed subirregulariter) punctato-striatis, interstitiis minute punctulatis, limbo vix rufescentiore; antennis palpisque testaceis, pedibus pallido-testaceis.

Long. corp. lin. $2\frac{1}{3}$–$2\frac{2}{3}$.

Habitat in sylvaticis montosis Teneriffæ, sub lapidibus rarissimus.

Genus Masoreus, Dej.

3. *Masoreus arenicola.*

M. nigro-piceus, distincte (oculo armato) alutaceus; prothorace transverso, subconvexo, postice in medio plus minus conspicue transversim impresso sed vix rugato, canalicula centrali haud profunda necnon antice et postice plus minus sub-obsoleta; elytris leviter subcrenato-striatis, ad basin plus minus distincte rufescentioribus; antennis, palpis pedibusque piceo-testaceis; unguiculis leviter denticulatis.

Long. corp. lin. 2–2⅓.

Habitat in arenosis maritimis (plus minus salinis) Lanzarotæ et Fuerteventuræ, tempore hiberno et vernali, hinc inde vulgaris.

Genus Amara, Bon.

(Subgenus Leiocnemis, Zimm.)

4. *Amara versuta.*

A. breviter ovata, nigro-picea, æneo-micans, convexa; prothorace brevi, transverso, ad latera marginato et æqualiter rotundato, basi vix punctato (interdum impunctato) sed utrinque foveis 2 (interna sc. majore longiore, sed externa parva, minus profunda, subrotundata) notato, postice in medio transversim impresso; elytris paulo dilutioribus (fusco-piceis), crenato-striatis; antennis, palpis pedibusque testaceis.

Long. corp. lin. 2–2⅓.

Habitat Lanzarotam et Fuerteventuram, sub lapidibus, passim.

Genus Cratognathus, Dej.

5. *Cratognathus solitarius.*

C. ater, subcylindrico-oblongus; capite magno; prothorace subquadrato, postice vix angustiore, basi utrinque fovea sat profunda punctata impresso; elytris oblongis, profunde crenato-striatis, interstitio septimo ad apicem ipsissimum punctulis circa 2–4 (interdum indistinctis confusis) notato; antennis, palpis tarsisque rufoferrugineis, femoribus tibiisque piceis.

Long. corp. lin. 4½–5.

Habitat Lanzarotam et Fuerteventuram, sub lapidibus in locis intermediis et editioribus sat vulgaris.

6. *Cratognathus fortunatus.*

C. piceus, oblongus; capite magno; prothorace subquadrato, postice subrecte angustiore, basi utrinque vix punctulato vix impresso; elytris subovato-oblongis, striatis, interstitio septimo ad apicem punctis circa 2–4 notato; labro rufo-piceo; antennis, palpis pedibusque rufo-ferrugineis.

Long. corp. lin. 5–5⅔.

Habitat montes Canariæ Grandis, in pineto quodam regionis "Tarajana" dictæ mense Aprili A.D. 1858 sat copiose repertus.

7. *Cratognathus micans.*

C. præcedenti similis, sed paulo minor, in utroque sexu fere æqualiter nitidus; prothorace ad latera paulo magis sinuato; elytris antice paulo magis truncatis (ergo vix brevioribus), interstitii septimi punctis obsoletis; pedibus paulo pallidioribus.

Long. corp. lin. $4\frac{1}{2}$–5.

Habitat in Teneriffa et Gomera, hinc inde haud infrequens.

Genus Trechus, Clairv.

8. *Trechus flavolimbatus.*

T. niger, nitidus; prothorace transverso-subquadrato, postice paulo angustiore, angulis ipsissimis posticis minutissime prominulis, basi utrinque leviter foveolato; elytris oblongo-ovalibus, subdepressis, limbo plus minus flavo-testaceo, striatis (striis vix subcrenatis, exterioribus obsoletis); antennis nigro-fuscescentibus, ad basin rufo-testaceis; pedibus pallido-testaceis, tibiis plus minus obscurioribus.

Long. corp. lin. $1\frac{1}{3}$–$1\frac{3}{4}$.

Trechus flavolimbatus, Schaum, in litt.

Habitat in Canaria, Teneriffa, Gomera, Palma, et Hierro, vulgaris.

Genus Perileptus, Schaum.

9. *Perileptus nigritulus.*

P. omnino *P. areolato* similis, sed vix major minusque nitidus (oculo fortissime armato grossius, præsertim in elytris, alutaceus), paulo magis pubescens; capite postice dilute rufescentiore; elytris (limbo postico pallido excepto) totis nigris, paulo magis parallelis, interstitiis vix minus convexis; antennis paulo longioribus, robustioribus.

Long. corp. lin. 1–$1\frac{1}{3}$.

Habitat Teneriffam, inter lapillos per marginem paludis cujusdam parvæ prope urbem Sanctæ Crucis sitæ copiose deprehensus.

Fam. Dytiscidæ.

Genus Haliplus, Lat.

10. *Haliplus suffusus.*

H. oblongus; capite nigro-piceo, latiusculo, punctato; prothorace testaceo, antice, postice in medio, necnon in disco nigrescente, basi lato (elytrorum basin paulo superante), ad latera oblique subrecto, in medio profunde punctato, postice utrinque linea curvata abbreviata notato; elytris testaceis (præsertim pone discum), nigro suffusis, antice subparallelis, punctato-striatis, interstitiis parce punctatis; antennis pedibusque testaceis.

Long. corp. lin. $1\frac{1}{3}$–$1\frac{1}{2}$.

Habitat in aquis Canariæ et Gomeræ, hinc inde parum vulgaris.

Fam. Anisotomidæ.

Genus Anisotoma, Ill.

11. *Anisotoma canariensis.*

A. ovalis, convexa, nitida, nigro- vel fusco-picea; capite prothoraceque sat distincte punctatis; elytris versus basin paulo rufescentioribus, sat profunde punctato-striatis, interstitiis punctulatis; antennis ad basin pedibusque piceo-ferrugineis, femoribus muticis. *Mas* tibiis posterioribus distinctius arcuatis.

Long. corp. lin. 1.

Habitat in Canaria et Hierro, rarissima.

Fam. **Nitidulidæ.**

Genus Brachypterus, Kugel.

12. *Brachypterus velatus.*

B. oblongo-ovatus, subconvexus, viridescenti-niger, nitidus, grosse flavescenti-cinereo pubescens, dense punctatus; prothorace ad latera subæqualiter rotundato, angulis posticis obtusis; scutello obtuse triangulari; antennis pedibusque rufo-testaceis, illarum clava tarsorumque apicibus ipsissimis nigrescentibus.

Long. corp. lin. $\frac{3}{4}$–1.

Habitat in Lanzarota, Canaria, Teneriffa et Hierro, super folia *Urticæ urentis*, L., parum vulgaris.

Fam. **Cucujidæ.**

Genus Sylvanus, Lat.

(Subgenus Æraphilus, Redt.)

13. *Silvanus nubigena.*

S. angusto-elongatus, subconvexus, fusco-niger, dense flavescenti-cinereo pubescens; capite prothoraceque rugose punctatis, hoc æquali, angusto, subcylindrico, postice vix angustiore, ad latera subrecto ac distincte crenulato, angulis ipsis posticis obtusis sed argute determinatis, penicillatis; elytris rugose et dense seriatim punctatis, versus humeros interdum paulo fuscescentioribus; femoribus piceis; antennis, tibiis tarsisque piceo-ferrugineis.

Long. corp. lin. 1–$1\frac{1}{3}$.

Habitat in aridis excelsis Teneriffæ, inter lapillos ramulosque emortuos sub arbusculis *Spartii nubigenæ* humi jacentibus, velocissime currens, necnon fere ad 9000′ s. m. ascendens.

Fam. **Cryptophagidæ.**

Genus Cryptophagus, Herbst.

14. *Cryptophagus hesperius.*

C. fusiformi-oblongus, rufo-ferrugineus, pube brevi albida parce vestitus; prothorace profunde et dense punctato, postice angustato, angulis anticis ampliatis, ad latera denticulis acutis circa 4–5 armato; elytris subfusiformibus, sat dense punctatis; antennis pedibusque longiusculis, graciusculis, vix pallidioribus.

Long. corp. lin. $\frac{2}{3}$–$\frac{3}{4}$.

Habitat in sylvaticis subsylvaticisque Canariæ, Teneriffæ, Gomeræ, Palmæ, et Hierro, vulgaris.

Fam. **Dermestidæ.**

Genus Telopes, Redt.

15. *Telopes multifasciatus.*

T. ovalis, niger, nigrescente pubescens; prothorace utrinque et in maculis 2 posticis elytrisque in fasciis 3, necnon ad apicem, pallido pilosis; antennis nigris, ad basin picescentibus, articulo ultimo (in utroque sexu) parvo; pedibus piceis, tarsis vix pallidioribus.

Mas. Antennarum clava paulo longiore, articulis penultimo et antepenultimo leviter elongatis.

Fœm. Antennarum clava paulo breviore, articulis penultimo et antepenultimo terminali vix (singulatim) majoribus.

Long. corp. lin. $1\frac{1}{3}$–$1\frac{2}{3}$.

Habitat Canariam Grandem, ad flores varios tempore vernali frequens.

16. *Telopes fasciatus.*

T. breviter ovalis, niger, nigrescente pubescens; prothorace utrinque et in maculis 2 posticis elytrisque in fasciis 2 (postica subevanescente), necnon mox ante apicem, pallido pilosis; antennis nigris, ad basin picescentibus; pedibus piceis, tarsis vix pallidioribus.

Mas. Antennarum clava paulo longiore, articulo ultimo leviter elongato.

Fœm. Antennarum clava paulo breviore, articulis tribus inter se subæqualibus.

Long. corp. lin. $1\frac{1}{4}$–vix $1\frac{1}{2}$.

Habitat in floribus Teneriffæ, Gomeræ et Palmæ, tempore vernali frequens.

Fam. **Elateridæ.**

Genus Coptostethus, Woll.

17. *Coptostethus brunneipennis.*

C. elongatus, niger vel fusco-niger, elytris plus minus brunneis, fulvo pubescens; prothorace elongato, basi paulo angustato; elytris pube suberecta tenui vestitis, sat profunde crenato-striatis, interstitiis subconvexis; antennis pedibusque elongatis, testaceis.

Long. corp. lin. $2\frac{2}{3}$–$3\frac{1}{2}$.

Habitat in Teneriffa, Palma et Hierro, sub lapidibus, passim.

Fam. **Curculionidæ.**

Genus Nanophyes, Schön.

18. *Nanophyes lunulatus.*

N. ovatus, pallido-testaceus, flavescenti-albido pubescens; elytris profunde subpunctato-striatis, fascia media parva subluniformi utrinque valde abbreviata (interdum per suturam fracta), necnon in interstitio quinto sæpe maculis (una vel duabus) parvis, nigro ornatis.

Long. corp. lin. $\frac{2}{3}$–$\frac{3}{4}$.

Habitat Canariam Grandem, in foliis arbuscularum *Tamaricis gallicæ* per margines rivuli ad Mogan crescentium deprehensus.

Genus Acalles, Schön.

19. *Acalles verrucosus.*

A. lateraliter compressus, supra valde arcuatus, squamis nigrescentibus densissime tectus et dilutioribus irroratus; prothorace postice paulo angustato, ad latera late albido squamoso, ante medium setoso 4-tuberculato; elytris postice paulo coarctatis sed ibidem decurvis, nodulis plurimis setosis instructis, argute striato-punctatis, mox pone medium macula parva obluniformi utrinque valde abbreviata albido ornatis: pedibus tarsorumque articulo 1^{mo} elongatis, tibiarum squamis erectis elongatis.

Long. corp. lin. $2\frac{1}{2}$–3.

Habitat in elevatis sylvaticis Teneriffæ et Palmæ, rarissimus.

Genus Echinodera, Woll.

20. *Echinodera crenata.*

E. squamis fuscis nigrescentibusque dense variegata et cinereis plus minus maculata, setis longiusculis suberectis obsita; prothorace profunde et dense punctato, setis apicalibus vix longioribus; elytris elongato-ovatis, ad humeros vix oblique truncatis, sat profunde crenato-striatis, pone medium macula magna obluniformi (antice et postice plus minus nigro terminata), necnon nebula (plus minus magna, suffusa) versus humeros, cinereo ornatis.

Long. corp. lin. $1\frac{1}{2}$–2.

Habitat in montibus editioribus Teneriffæ, sub lapidibus inter 6000′ et 9000′ s. m., ultra regiones sylvaticas, occurrens.

Genus Atlantis, Woll.

21. *Atlantis angustula.*

A. angustulo-subcylindrica, atra, subnitida, subtiliter pubescens pilisque elongatis erectis in elytris obsita; rostro crassiusculo, punctato, oculis rotundatis, prominentibus; prothorace convexo, per basin ipsissimam subsinuato et distincte marginato, sat profunde subruguloso-punctato punctulisque minutis intermediis valde distinctis parum crebre irrorato; elytris subcylindricis, profunde punctato-striatis; antennis tarsisque piceis; femoribus tibiisque nigris.

Long. corp. lin. 3–$4\frac{1}{2}$.

Habitat Canariam Grandem, sub lapidibus in inferioribus et intermediis late diffusa.

Genus Laparocerus, Schön.

22. *Laparocerus excavatus.*

L. niger, nitidus, fere calvus; prothorace convexo, minutissime, dense et levissime punctulato punctisque majoribus sed vix profundis parce notato, fere simplici; elytris basi subbisinuato-truncatis, callo humerali valde incrassato, profunde punctato-striatis, interstitiis minutissime transversim substriguloso-rugatis et punctis remote obsitis; antennis rufo-ferrugineis, pedibus rufo-piceis.

Mas sæpius nitidior, tibiis anticis intus versus apicem profunde excavatis, posticis fortiter sed parce serratis.

Long. corp. lin. 4–5½.

Habitat in montibus sylvaticis Teneriffæ, præsertim inter muscos et lichenes ad truncos arborum crescentes.

23. *Laparocerus crassifrons.*

L. niger vel piceo-niger, parum nitidus, plus minus dense et grosse submetallico-squamoso tessellatus; capite convexo, crasso, rostro crasso subtriangulari grosse denseque punctato et profunde canaliculato; prothorace convexo, punctato punctulisque minutis intermediis dense irrorato; elytris oblongo-subovalibus, punctato-striatis, interstitiis vix punctulatis et pilis brevibus suberectis remotis præsertim postice obsitis; antennis rufo-ferrugineis; pedibus rufo-piceis.

Long. corp. lin. 3½–5.

Habitat sub lapidibus scoriisque in regionibus Teneriffæ valde elevatis, usque ad 8000′ s. m. ascendens.

24. *Laparocerus inæqualis.*

L. ænescenti-niger, nitidus, parce submetallico-squamoso tessellatus pilisque plus minus elongatis erectis fulvescentibus præsertim in elytris parce obsitus; prothorace parvo, angusto, subcylindrico-conico, sat grosse punctato punctulisque minutissimis intermediis dense irrorato; elytris latiusculis, subquadrato-oblongis, punctato-striatis, interstitiis alternis valde tuberculato-inæqualibus, tuberculis paulo fulvescenti-squamoso fasciculatis; antennis, tibiis tarsisque ferrugineis, femoribus ferrugineo-piceis.

Long. corp. lin. 3–4.

Habitat Teneriffam sylvaticam, in lauretis editioribus supra Taganama captus.

25. *Laparocerus ellipticus.*

L. ferrugineus, subnitidus, dense sericeo-metallico-squamoso tessellatus pilisque elongatis suberectis postice obsitus; rostro crasso, oculis magnis; prothorace parvo, angusto, ruguloso-subalutaceo, parce et leviter punctato, basi subemarginato; elytris ovato-ellipticis, basi conjunctim trisinuatis, leviter punctato-striatis, interstitiis alternis plus minus læte tessellatis.

Long. corp. lin. 4–5.

Habitat in sylvaticis excelsis Teneriffæ et Palmæ, vel inter muscos lichenesque ad truncos arborum crescentes, vel sub cortice laxo latitans.

Genus Sitones, Germ.

26. *Sitones punctiger.*

S. oblongus, squamis griseis cinereisque variegatus et setis piliformibus demissis obsitus; capite prothoraceque profunde rugoso-punctatis, illo postice punctis duobus cinereis ornato, oculis oblongis rotundatis valde prominentibus, hoc ad latera pallidiore rotundato, linea media et punctis 2 vel 3 utrinque annexis pallidioribus ornato; elytris cylindricis, per suturam obscure albidis, interstitiis alternis læte fulvo nigroque tessellatis; antennis ad basin pedibusque (squamosis) clarioribus.

Long. corp. lin. $2\frac{1}{2}$–3.

Habitat Lanzarotam et Fuerteventuram, sub lapidibus in aridis arenosis et calcariis degens.

27. *Sitones setiger.*

S. oblongus, squamis griseis inæqualiter vestitus; capite prothoraceque densissime et profunde rugoso-punctatis, illo oculis oblongo-rotundatis prominentibus, hoc subcylindrico, intra apicem (subelevatum) constricto, ad utrumque latus linea paulo albidiore ornato; elytris profunde punctato-striatis, vel obscure variegatis (interstitiis alternis obsolete tessellatis) vel dense fusco aut ochraceo-fusco squamosis, sæpius versus latera squamis albidioribus obscure plagiatis, interstitiis setosis (setis nigrescentibus sed in interstitiis alternis setis albidioribus distantibus commixtis); antennis brevibus pedibusque rufo-ferrugineis, capitulo femoribusque obscurioribus.

Long. corp. lin. $1\frac{1}{2}$–2.

Habitat in aridis insularum Canariensium, in Palma sola hactenus haud detectus.

BIBLIOGRAPHICAL NOTICE.

Outlines of Botany, designed for Schools and Colleges. By J. H. Balfour, M.D. &c., Prof. of Botany in the University of Edinburgh. 12mo, pp. 712. Black, Edinburgh, 1862.

The title of this book shows the intention of its author in the present republication of the article "Botany" from the 'Encyclopædia Britannica.' We are sorry to add that we look upon it as a mistake to think that the book is well fitted for schools and colleges; for we presume that here "colleges" is simply a synonym of "schools." It does not differ sufficiently from the same author's valuable books entitled 'Manual' and 'Class Book' to be suited to the inferior class of teaching usually, and perhaps necessarily, given in those places. It seems to us far too hard, much too long, and not sufficiently authoritative for young scholars. In short, it is too good for its purpose. If Dr. Balfour had allowed this treatise to continue in the position for which it was written, and to which it is well fitted, and had prepared a small—very much smaller—book containing the elements of botany in simple language, he would have done more service to science. Such simple elements should be written as by a master stating his determinations, and usually omitting all notice of the opinions of others (which are to be found properly in the larger *Class-books* and *Introductions*), leaving out most of the chemistry as unintelligible to the young student, and omitting the greater part of the technicalities relating to the Natural Orders, but inserting in their place an outline of the natural arrangement adopted by De Candolle and most modern systematic writers. We think that 150 pages devoted to this latter part of the science is almost altogether out of place in a book "intended to give the important facts of botanical science as briefly and popularly as possible."

But we must not be misunderstood. This is an excellent book, and well fitted to follow a "brief and popular" primary volume, such as Henfrey's 'Rudiments.' It will even, we suspect, supersede Balfour's 'Manual' in many places where that has been usually employed: this is a misfortune; for the 'Manual' is far better fitted for the more advanced student than are these 'Outlines.'

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

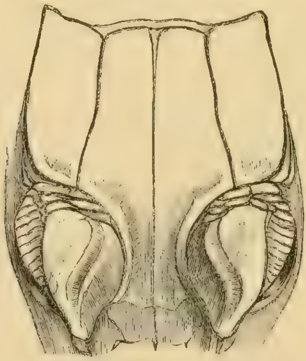
June 24, 1862.—E. W. H. Holdsworth, Esq., F.L.S., in the Chair.

Description of Crocodilus frontatus, a new Crocodile from Old Calabar River, West Africa. By Andrew Murray, Assist. Secretary, Royal Horticultural Society.

Crocodilus frontatus, nov. sp.

Head broad and deep, much broader than in *C. vulgaris*, very flat on the vertex, and with the margins of the flat portion slightly raised; the lateral margins very slightly curved; the suture inside of the lateral margin placed at rather more than a fourth of the breadth of the vertex from its side. This suture is not throughout parallel to the lateral margin; it is nearly so for about two-thirds of its

Fig. 1.



posterior length; towards the front it bends a little outwards. Fig. 1 shows the form of the sutures in this species, while fig. 2 shows their form in *C. vulgaris*, and fig. 3 in *C. leptorhynchus*. The vertex in the two last, although flattened, is not so depressed, but is slightly rounded, so as to be somewhat higher at the middle than at

Fig. 2.

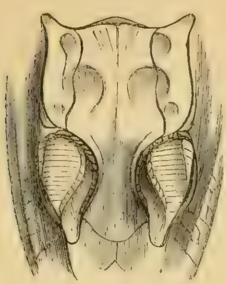


Fig. 3.

the margin. The colour in *C. frontatus* is yellowish with blackish spots, instead of brown with blackish spots, as in *C. vulgaris* and *C.*

Fig. 4.

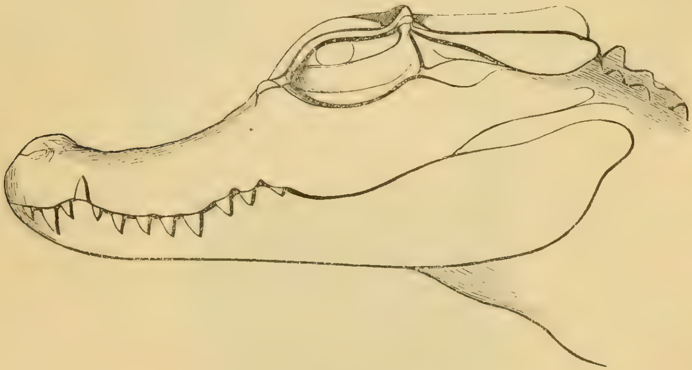
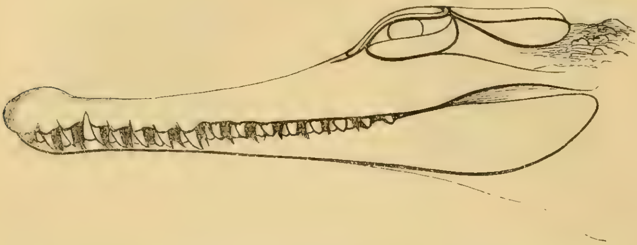


Fig 5.

leptorhynchus. The muzzle is shorter than in either of the others, deeper, and the front rises higher above it; the nostrils are more prominent and turned up. Both the head and the lower jaw are deeper than in *C. vulgaris* and *C. leptorhynchus.* (See fig. 4, which represents the head of *C. frontatus* seen in profile, and figs. 5 and 6, which respectively represent the profiles of the head of *C. vulgaris* and *C. leptorhynchus.*) The disposition of the scuta or plates along

Fig. 6.



the nose or muzzle is different in each species. Fig. 7 shows them in *C. frontatus* ; fig. 8, in *C. vulgaris* ; and fig. 9, in *C. leptorhynchus.* It will be seen that the arrangement in *C. frontatus* is much nearer that in *C. vulgaris* than that in *C. leptorhynchus,* which is upon

Fig. 7.

a totally different plan, the middle space in it being free from scuta, soft, and smooth, with transverse wrinkles or lines, while in the other two the space is covered with scuta, those in the middle being transverse. The commencement of these transverse scuta between the eyes is also different.

The scuta on the nape of the neck are differently proportioned and placed in all three; and here the arrangement in *C. frontatus* bears most affinity to that of *C. leptorhynchus,* instead of to that of *C.*

Fig. 8.

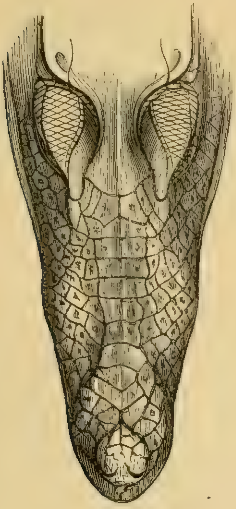
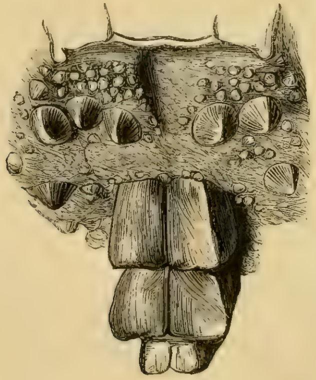


Fig. 9.

vulgaris. Fig. 10 shows this arrangement in *C. frontatus*; fig. 11, in *C. vulgaris*; and fig. 12, in *C. leptorhynchus.* In *C. frontatus*

Fig. 10.



and *C. leptorhynchus* the four large scuta are of a subquadrate form; in *C. vulgaris* they are irregularly subhexagonal. In the latter, not only these but also the scuta generally are flat, with a longitudinal raised line or carina. In *C. leptorhynchus,* those in the neighbourhood of the four larger scuta bear a projecting oblong umbo; and *C. frontatus* has this developed in a manner still more marked.

Fig. 11.

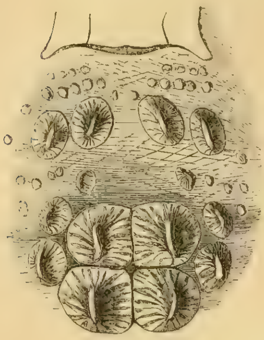
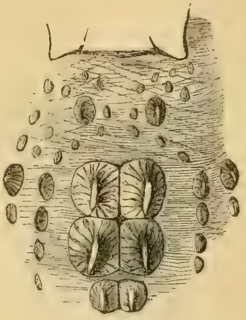


Fig. 12.



The same character prevails in the rest of the scuta. In all three species there are six rows of large scuta down the back, varying in width, diminishing to four rows in the lumbar region. In *C. vulgaris* these scuta are flat, with only a slightly raised longitudinal line or carina. In *C. leptorhynchus* this carina is much more raised, so as to form regular crests. In *C. frontatus* some of them have an oblong umbo, others a crest, and others only a raised line: the affinity in this respect is greater with *C. leptorhynchus* than *C. vulgaris*. It is the same with regard to the crest down the tail. In all three the rows of dorsal scuta down the back become only four in number after passing the hind legs, forming four raised lines, two on each side of the spine; the inner crests or lines on each side then gradually approximate (in *C. vulgaris* forming a narrow channel) and thin off and become obliterated. The outer crest on each side, at about the seventh or eighth joint behind the hind legs, becomes broader and spreads out into a flat plate or leaf turned out horizontally on each side. There are about seven joints in which this flat table-shaped position of the scuta occurs, and about the same number prevails in all three. As this disposition, however, does not commence suddenly at any particular joint, but proceeds by gradations out of the crest on the back, the number may be modified according to the degree at which the observer reckons the horizontal leaf to commence. The size of these scuta is proportionally larger in *C. frontatus* and *C. leptorhynchus* than in *C. vulgaris*. These horizontal thin scuta extend one on each side for a certain distance; and then all at once the double row ceases, and is replaced by a series of single erect scuta running down the top of the tail. In my specimens the number of joints before this single crest commences, reckoning from immediately behind the hind legs, is as follows:—

C. vulgaris	18
C. leptorhynchus	17
C. frontatus....	13

And the number of erect terminal joints is—

C. vulgaris	26
C. leptorhynchus	19
C. frontatus	19

The colouring of *C. frontatus* is much nearer that of *C. leptorhynchus* than *C. vulgaris*. The latter is coloured pale ashy brown, blotched irregularly with dark brown. The other two have the dark blotches distributed in transverse bands,—*C. frontatus* having every alternate two rows of transverse scuta pale and dark—a disposition followed in *C. leptorhynchus*, but not so regularly.

Total length of my specimen, 21 inches; total length of head, from tip of snout to back of under jaw, $3\frac{1}{2}$ inches; breadth of head, $1\frac{3}{4}$ inch; length of muzzle to front of eye, $1\frac{1}{4}$ inch; length of eye, nearly 1 inch; height of head, 2 inches; length of body, from occiput to back of hind legs, 8 inches; total length of tail, 12 inches; length of tail to commencement of single crest, $5\frac{1}{2}$ inches; length of the part of it with single crest, $7\frac{1}{2}$ inches.

On the whole, this new species seems to combine many of the characters both of *C. vulgaris* and *C. leptorhynchus*. In its head it is nearest to *C. vulgaris*; in its colouring, scuta, and tail to *C. leptorhynchus*.

I owe this specimen to the kindness of the Rev. W. C. Thomson, the accomplished missionary at Old Calabar. He wrote me word long before I received it that there was another species of Crocodile in the Old Calabar besides the two generally known, that it was extremely scarce, but that he would endeavour to procure a specimen for me. He did so, and sent me the individual from which this description is taken, alive. It reached Liverpool in good health, but, most unfortunately, was drowned on the railway on its passage to Edinburgh. The gentleman who was kind enough to charge himself with it thought it would not live unless brought in water, and he put it in a foot-pail half full of water. The water was too deep to allow the poor animal to rest on the bottom of the pail and stretch up its head for breath; and when the jolting of the railway commenced, it was kept in a constant state of submersion. The consequence which might have been anticipated ensued, and my Crocodile arrived dead. There is no doubt that it is a good species, halfway between *C. vulgaris* and *C. leptorhynchus*.

Note on the Habits and Affinities of the Kagu (Rhinochetus jubatus). By A. D. Bartlett.

At the first sight of this bird, one is struck with its resemblance to several different genera, and at once calls to mind *Eurypyga*, *Œdicnemus*, *Cariama*, *Psophia*, *Nycticorax*, and *Scopus*: one and all appear more or less represented in its singular combination of characters.

The actions and movements of the Kagu are generally quick and lively, so opposite to the slow and chameleon-like movements of the true Herons that one can hardly suspect it to be an Ardeine bird.

This, however, it doubtless will prove to be, but so modified and adapted to a different kind of diet and mode of life, that its real affinities are difficult to recognize.

With its crest erect, and wings spread out, the Kagu runs or skips about, sometimes pursuing and driving before him all the birds that are confined with him in the same aviary [among these are several Blue Waterhens (*Porphyrio*)], evidently enjoying the fun of seeing them frightened; at other times he will seize the end of his wing or tail and run round, holding it in his bill: from a piece of paper or dry leaf he derives amusement by tossing it about and running after it. During his frolic he will thrust his bill into the ground and spread out his wings, kick his legs in the air, and then tumble about as if in a fit. At other times he appears intent upon catching worms: he steps slowly, his neck close to his body, his crest flat on his back, all his feathers smooth and close; he raises one foot, and with two or three gentle strokes he paws the ground, swiftly he darts his bill into the earth and draws forth a worm, a sudden shake and it is swallowed; again he runs; stopping suddenly, he makes another dart; and thus he continues to capture this kind of food. With respect to feeding, this bird differs much from the Heron family, seeking out, in every hole and corner, worms, snails, and other living things, whenever they are not in motion: as soon as a snail is found, he breaks its shell by repeated knocks upon the ground, and after shaking the fragments of the broken shell off, the animal is swallowed. In no instance, however, that I have observed, does this bird eat bread; seed, or any kind of vegetable, but he strictly confines himself to insects and other animal substances.

The skeleton and internal anatomy of the Kagu being entirely unknown to me, I can only form an opinion of the affinities of this bird by its external characters, habits, &c.; and I find that the remarkable powder-down tufts, which are well developed in all the Ardeines, are carried to a greater extent in this bird; for above and around the wings, on the breast beneath the wings, and on the back and belly, this structure exists, and the enormous quantity of the white powder given off is surprising. I have seen the bird enter the small pond and attempt to wash; and upon dipping partly under water, the whole surface of the water was covered with a white film, like French chalk. The strong resemblance between this bird and *Eurypyga*, even in the markings upon the wing- and tail-feathers, the mode of spreading out the wings, and other resemblances, convince me that I am right in considering the Kagu to be more closely allied to *Eurypyga* than to any other bird that has come within my notice.

MISCELLANEOUS.

Notice of a Flycatcher new to the Fauna of Great Britain. By G. R. Gray.

An imperfect specimen of a bird in flesh has been received from G. A. Copeland, Esq., of Carneythenack House, Constantine, near

Falmouth, who informed me that it was shot, while resting on the house, on Saturday the 24th of January last. Its imperfectness, Mr. Copeland tells me, was occasioned by mice having carried off the head. The rest of the bird, however, was in a sufficient state of completeness for me to prove its identity with the Red-breasted Fly-catcher, *Muscicapa* (*Erythrosterna*) *parva*, Bechst. I believe this example is the first of that species which has been obtained in this country. I have therefore thought that a notice of the capture of so remarkable an insectorial bird at this season of the year might interest some of the readers of the 'Annals,' and have therefore sent it for insertion.

On the Development, Structure, and Functions of the Tissues of the Anther. By A. Chatin.

The successive investigations of Mirbel, Meyen, and Purkinje have furnished the following data:—

The anther is divided at first into four and afterwards into two cells (Mirbel).

The anther has its valves formed of two membranes, first distinguished by Mirbel, and denominated *exothecium* and *endothecium* by Purkinje.

The endothecium, or internal membrane, is formed of cells called fibrous by Purkinje, lobate by Mirbel, filamentous by A. DeCandolle.

The filamentous cells are only produced towards the moment of dehiscence (Mirbel).

The whole of the subepidermic tissue is converted into filamentous cells.

The conversion of the simple utricles into filamentous cells is so rapid that the moment of its taking place cannot be perceived (Mirbel).

There is a relation between the form of the cells of the endothecium and the natural families (Purkinje).

These cells are the agent of dehiscence.

The vessels of the filament often pass into the connective (Mirbel); they never penetrate there, but run through the whole filament (A. Richard).

It may be added that the observations of M. Duchartre show that the cells may be localized towards the line of dehiscence.

I. *Development of the Tissues of the Anther.*—The author's observations, like those of M. Duchartre, confirm the following results of Mirbel's investigations:—Each of the two lobes of the anther is at first a homogeneous cellular mass; subsequently the utricles of the middle of each half-lobe acquire a special development: these are the pollinic utricles, which disappear after the grains of pollen are produced in their interior.

His observations also agree generally with Mirbel's upon this point: towards the period of dehiscence, the partition of the cells disappears. He has, however, seen numerous cases in which, by the persistence of this septum, the anther continues quadricellular. In this case, usually (*Lycopersicon*, *Tradescantia*, &c.), two half-valves rest by their commissure upon the septum, which, after their dehiscence, becomes contracted or destroyed; and at this moment it might be supposed that the separation or destruction of the septum preceded, instead of following, the dehiscence. A second type is furnished by *Æchmea*, in which each of the four loculi splits in its median line. A third type of quadricellular anthers is presented in *Passiflora*, *Scabiosa*, *Schaueria*, &c.: in these the subdivision of each lobe is maintained until the dehiscence; but this is less by the septa, which are too short, than by the contiguous valves reflected and applied against each other.

On the question whether all the subepidermic utricles become changed into filamentous cells (as would appear to be the case from the statements of Mirbel, Meyen, and Purkinje), the author says that, by tracing the development of the tissues of the anther in *Tradescantia*, it is distinctly seen that of two layers of utricles situated beneath the epidermis, only one (the outer) is converted into filamentous cells, whilst the inner layer is destroyed. This tissue within the endothecium of Purkinje was perceived in the young anther by Mirbel and Meyen, who paid no further attention to it. It is more distinct still in *Passiflora*, where its utricles, which alone are tinted yellow, papilliform, and radiate, are already distinct at the appearance of the pollinic utricles, and are developed parallelly to these and the pollen, but disappear a little after the production of the filaments in the utricles of the middle zone.

In *Tradescantia* and *Passiflora*, as in most plants observed by the author, the internal tissue is not tranformed; it is destroyed after a transitory existence. In other plants also it is not transformed, but persists until the dehiscence of the anther (*Canna*, *Colchicum*, *Pedicularis*, &c.); and this persistence is general(?) in the anthers which are destitute of filamentous cells (*Pyrola*, *Melastoma*, &c.).

The tissue indicated as being more interior than the membrane called endothecium, and as lining the cavity of the cells, is not only characterized by its position and evolution, but also frequently by the form, consistence, and coloration of its utricles. It is as distinct from the endothecium of Purkinje as the latter from the exothecium, and is, in fact, a third membrane, which must henceforward be included in the general structure of the anther. This third membrane, from its position, will be the true *endothecium*, the membrane so named by Purkinje becoming the *mesothecium*; and thus the anther, at least when young, consists, not of two, but of three membranes. Nevertheless, at the approach of dehiscence, these membranes may be reduced to one in the anthers of some species (*Calendula*, &c.); and in some plants even the young anthers only contain two layers of utricles.

With regard to the conversion of the simple utricles into filamentous cells, the author states that, although rapid, it may be followed, and usually commences in the anther at its point of attachment and at its line of dehiscence.

The exothecium is at first confounded with the other membranes in the homogeneous mass of primordial cellular tissues, and may remain for a long time, or even always, in an indistinct state; most commonly, however, it gradually acquires its characters; its utricles, which rise in papillæ, or even in hairs on some parts, sometimes acquire an extraordinary development. The cuticle itself may form a thick crust, which assists in limiting the phenomenon of dehiscence.

Lastly, as with the production of the filamentous cells and the destruction of the third membrane, it is at the approach of the dehiscence of the anther that the abnormal development, or even the destruction, of the outer membrane takes place.—*Comptes Rendus*, Dec. 22, 1862, p. 911.

On a New Pteropus *from New Holland.* By W. Peters.

P. scapulatus, n. sp.; auriculis elongatis, patagio anali ad coccygem coarctato; facie ex fusco canescente, mento fusco, torque collari rufo-ferrugineo; macula scapulari utrinque ochraceo-flavida; dorso fusco-ferrugineo, obsolete fusco maculato; pectore ventreque fusco-ferrugineis, lateribus dilutioribus; fasciculo pilorum suprahumerali vellereque patagiali humeri et antibrachii fulvis.

Long. tota 0·230 metre; cap. 0·065; auric. 0·030; antibrachii 0·137; dig. 1. 0·053; dig. 2. 0·098; dig. 3. 0·265; dig. 5. 0·182; tibiæ 0·065; patag. analis medii 0·003.

Hab. Promontorium York, Novæ Hollandiæ.

The present species nearly approaches *Pteropus medius* in size, and is very easily distinguished from all other species by the two humeral spots, and also by the golden-yellow colour of the abundant woolly hair on the ventral side of the wing-membranes, which appears near the lumbar region, on the humeral membrane, and near the forearm almost to its end.

The ears are about one-half longer than the distance between the eyes and the apex of the muzzle. The upper incisors are of nearly equal size, and stand at equal distances apart; the lower ones, on the contrary, stand in pairs, and the inner one on each side is scarcely one-third of the size of the outer one, which, however, is much smaller than the upper ones. The upper canines are slender and pointed, furnished with a broad furrow in front, and about one-half longer than the lower ones. The first upper false molar is not larger than the outer lower incisor, it stands near the canine, and is separated by a great space from the second caniniform false molar. The third true molar is small, as also the molars in general, the series of the three true and the hindermost false molar measuring 0·011 metre, and the entire dental series to the anterior margin of the upper incisor teeth only 0·020. The anterior lower false molar, which agrees pretty nearly in size with the hindermost lower true molar, stands scarcely the half of its diameter from the canine, but nearly twice its diameter from the following caniniform false molar. The length of the dental series, composed of the three true and two false molars, amounts to 0·0125 metre, and of the whole lower series of teeth 0·020. The hair of the body is dense and lies smooth, and extends, gradually becoming shorter, as far as the first third of the forearm; and on the hinder extremities, externally, to one-, and internally to scarcely two-thirds of the shank. The hair of the coccygeal region is softer and entirely covers the middle of the membrane, which is here very narrow. The hair of the ventral surface is softer and more undulating; the upper arm and thigh are here more sparingly clothed with hair, and a long woolly clothing of the wing-membranes appears at the sides of the lumbar region, on the humeral membrane, and below the forearm nearly to its end. The teats are situated, as always in the genus *Pteropus* s. str., in the axilla; and in the lumbar region the wing-membranes approach each other within about 0·025 metre. The colour of the face is blackish brown, mixed with grey; on the forehead and crown the hairs are dark brown, with ochreous tips or subapical rings of the same colour. The chin is blackish-brown. The entire neck is reddish-brown, somewhat darker on the nape. The back is dark rusty-brown, and this colour extends between and round the two yellow humeral spots up to the middle of the nape. The forepart of the back, below the two humeral spots, as also the region of the upper arm, is sprinkled with grey; both here and on the lower part of the back there are faint blackish-brown spots, which, on the lumbar region, stand in about six or seven irregular transverse rows. The breast and belly are dark rusty brown, the former darker than the latter; the sides, especially before the teats, appear much lighter and paler. The woolly hair of the ventral side of the wing-membrane near the loins, and before and behind the arms, and also a tuft of hair above and in front of the insertion of the wings are of a fine yellow. The narrow margin of the femoral membrane is free on the ventral side, and not covered with hairs.

The description is from the skin of a full-grown female specimen recently obtained by the Museum from Mr. Frank.

A second new species, *Pteropus chrysauchen*, from the Island of Batjan, has been obtained by the Museum from the same naturalist. It has much resemblance to *P. Alecto*, Temm., the brownish-black head, back, and belly being sprinkled with grey, the anal membrane very narrow in the middle, and the woolly hair on the lower surface of the wing-membranes blackish-brown. It is distinguished by its narrower ears, by the greater approximation (0·036 metre) of the wing-membranes on the back, and by the pale ochreous mark which not only occupies the whole nape, but descends upon the sides of the neck, and extends upwards between the ears to the vertex. The dorsal surface of the arms and the whole of the shanks are naked. Total length of the skin of an old female 0·28 metre; head 0·080; ear 0·026; forearm 0·175; thumb 0·079; second finger 0·125; third finger 0·325; tibia 0·080.—*Monatsber. der Berl. Akad. der Wiss.* August 1862, p. 574.

# THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 64. APRIL 1863.

XXV.—*On the Classification of the Brachyura, and on the Homologies of the Antennary Joints in Decapod Crustacea.* By Wm. Stimpson, M.D.*

Dr. Strahl has recently been making some carcinological investigations†, which have led him to propose a new classification of the higher Crustacea. He considers the characters of the external antennæ, particularly of their second joint (basicerite) of paramount importance, and would divide the suborder Brachyura, in accordance with these characters, into four groups, namely,

Orbata, with the first two joints of the antenna only present, the rest wanting, as in *Acanthocyclus*.

Liberata, with the basicerite free, as in *Oncinopus*.

Incuneata, with the basicerite wedged in between the pterygostomium and the epistome, as in *Cancer*.

Perfusa, with the basicerite completely united with the neighbouring parts, as in *Stenorhynchus*.

These differences are certainly of great importance, and have not generally received sufficient attention from carcinologists; but they can scarcely be used for the primary subdivisions, as they are not coincident with characters of still higher value. By their use we should be required to dismember well-marked groups—to separate, for instance, *Macrocheira* from the Maioids, and *Gecarcinus* from the Ocypodoids; while strange approximations would occur, as of *Oncinopus* with *Myctyris*. Experience has long since shown us that it is impossible to group animals upon the variations of a single organ.

Some of Dr. Strahl's conclusions are so surprising that they

* From Silliman's American Journal for January, 1863.

† Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin, 1861; Ann. Nat. Hist. vol. ix. p. 299.

may well require the closest scrutiny before acceptation. For example, he says, "The *Leucosiæ* I consider to include only Dana's *Leucosidea*, with *Dorippe* and *Æthusa*. I separate the *Calappidæ* and *Matutidæ* from them, and unite them with the *Parthenopinæ* rejected from the *Oxyrhyncha*." This combination is justified "by the agreement in the situation of the afferent canal of the branchial cavity and of the male sexual organs," &c. But the *Calappidæ* are entirely removed from the *Parthenopinæ* in the structure of the mouth-parts; the buccal cavity is narrowed anteriorly so that the efferent branchial channels terminate at the middle instead of the sides of the endostome, and are covered by the indurated summits of the laciniæ of the first pair of maxillipeds (tritocheirognathites). Like the *Leucosidea* they are oxystomatous, as Milne-Edwards has shown. They, indeed, differ from these latter in the situation of the efferent canals, and should therefore be separated as a distinct group; but they should no more be united to the *Parthenopinæ* than should the *Dorippidæ*, which Dr. Strahl would unite with the *Leucosidea*, although these are far more nearly allied to the *Calappidæ*, not having the afferent canal covered by the exognath of the outer maxillipeds, which is the case in all *Leucosidea*.

Again, Dr. Strahl remarks, "The genus *Grapsus*, limited by the rejection of *Leptograpsus*, *Metopograpsus*, &c., and represented by the species *Pharaonis*, *strigosus*, *Webbii*, &c., must be removed not only out of the *Grapsoidea*, but even entirely out of the Brachyura, because the structure of the external antennæ differs completely from that which prevails amongst the Brachyura. *Grapsus*, for instance, has no operculum at the base of the external antennæ, but a perforated tubercle, as in the Macrura, and must therefore at least be placed among the Anomura." Here we would have *Leptograpsus variegatus* and *Grapsus strigosus*, for instance—forms so closely allied that they are placed in one and the same genus by so skilful a naturalist as Dana—separated so widely from each other that the latter species is placed among the Anomura! Let us examine fresh or wet specimens to ascertain whether *Grapsus* in reality has, at the base of the antennæ, a structure so essentially differing from that found in ordinary Brachyura. Dried specimens are too commonly used in these investigations, and are very apt to lead to error. The "operculum" spoken of above is the coxal joint (coxocerite) of the external antennæ, which is moveable in all crabs, even where the next (basicerite) is not. In a *Maia*, for example, this coxal joint may be raised a little, so that the membranous areola* which occupies its postero-interior surface may

* The so-called *tympanum*. It is very doubtful whether the auditory organ is ever here situated. Kröyer has demonstrated (Kongl. Danske

be partially seen. In *Leptograpsus* this areola is more exposed, encroaching somewhat upon the margin or outer surface of the coxal joint, or, in other words, this joint is kept permanently a little raised. In *Grapsus* the coxal joint (here the "perforated tubercle" of Strahl) is still more evolved, and its sides are folded in, giving it a globular form, and contracting the areola, which is thus placed in a slit, and becomes almost wholly external. The different form of the coxocerite in *Grapsus* is therefore the result of a simple modification, not of structural importance. In *Dromia* the coxal joint is also slit at one side, but the areola is on the inner surface. This joint in *Dromia* is not "so shrunken that only the tubercle remains." It is far larger in proportion than is usual in the higher Crustacea. Dr. Strahl says that "if we imagine the slit in the tubercle of *Dromia* carried out to one side, so that here the peripheral margin is completely separated, we have the operculum of the Brachyura in its perfect form." But this prolongation of the slit would cut the coxal joint in two, which is not the case in the "operculum;" for this "operculum" is truly the homologue of the coxocerite of *Dromia* and *Homarus* in its entirety, as may be seen by comparison with this part in *Pilumnus*, for instance, where the basicerite is not soldered to the contiguous parts as is usual in Cancroids, but is free and articulated directly with the "operculum" in the same manner as it is with the coxal joint in the other two genera named. *Pilumnus*, we may remark incidentally, would be classed with *Parthenope* by the character of its antennæ.

Dr. Strahl proposes new names for the first two joints of the external antennæ: the first (coxocerite) he would call *intercalare*; the second (basicerite) *armiger*, while the third (ischiocerite) he calls the first joint of the antennæ, which is certainly liable to mislead. Prof. Milne-Edwards, who has done so much towards elucidating the homologies of these joints, has given to them the names in brackets, which are more appropriate; for there is undoubtedly a perfect correspondence between them and the joints of the maxillæ or feet. I believe it possible to carry the homology even further than the celebrated French zoologist has done, and that the antenna in question, like a foot or maxilliped, consists normally of seven joints. In the embryo of *Hippolyte*, as figured by Kröyer*, there are five distinct joints beyond the basicerite, which would make seven in all. Moreover, they can be demonstrated in the adult *Squilla*, *Axius*, and *Pagurus*, and

Vidensk. Selskabs Skrifter, 1856, iv. 288) that a far more complicated auditory apparatus exists at the base of the internal antennæ.

* Monog. Fremst. af Hippolyte's Nordiske Arter, &c. tab. vi. f. 121.

particularly well in *Homarus*, where the parts are more distinct from their large size. The "peduncle" of the antenna in the Lobster is considered by Milne-Edwards to consist of five joints; but a sixth is indicated at the base of the penult, on the lower side of the member. Here there is a small triangular piece, articulating with the second and third joints as well as the penult, perfectly mobile, and dependent upon no one of these joints more than another. An additional evidence that this piece is the representative of a distinct joint is furnished by the fact that the articulations of the two proximate joints are in the same plane, and not, as should be the case were they normally contiguous, in planes perpendicular to each other. To complete the number (seven) of joints, we have the flagellum, which corresponds to the dactylos or terminal joint of the thoracic members. This homology is rendered probable by the occurrence, in the remarkable Hippidean genus *Mastigopus**, discovered by me in the Chinese seas, of a multiarticulate dactylus to the chelipeds perfectly similar to the flagelliform terminal appendage of an antenna.

The squamiform appendix of the antenna is attached to the second joint, and is homologous to the exopod of the feet, or the exognath of the maxillipeds, which has the same position. It is called *scaphocerite* by Milne-Edwards, but would be more appropriately named *exocerite*, a term indicating its relations with greater exactness, and corresponding in construction with that of its homologues. This appendage is normally two-jointed, as is seen in the embryo *Homarus* and in the adult *Squilla*; its basal joint is obsolete or coalesced with the terminal squamiform joint in adult Macrura and Anomura, while in Brachyura the entire appendage disappears with perfect development. The little basal joint of the exocerite in the embryo *Homarus* is mistaken for the "armiger" (basicerite) by Dr. Strahl, who considers the large joint which supports both branches of the antenna as the "intercalare" (coxocerite), on the ground that in the adult the third joint is articulated with both the coxocerite and the basicerite. But this is so only in appearance: if the antenna in a fresh Lobster or Cray-fish be bent outward, it will be seen that the posterior condyle of the third joint articulates with the basicerite alone. The basicerite, in the embryo Decapod, is far from being the trifling joint seen at the base of the scale-like appendage, but is, in fact, that large supporting joint which is the first to make its appearance, and which often reaches, with its exocerite, a large size before any trace of other joints, either coxal or terminal, can be perceived. In the figures accompanying the

* Proc. Acad. Nat. Sc. Philad. December 1858. Not the *Mastigopus* of Leuckart, which is a *Sergestes*.

valuable observations of Mr. C. Spence Bate*, this character of the basicerite is well shown in representations of the Zoea of *Carcinus mænas.* Here we have the joint in question very large, armed with a long spine on one side and the exocerite on the other, while the rest of the antenna is in a rudimentary condition, and there is no coxocerite visible. This latter joint, with its areola, makes its appearance at a later date, at the base of the basicerite.

The large comparative size of the exocerite in the embryo is in accordance with what we observe in the gradations of adult Crustacea. Those lowest in the series have generally the external branch of their members most developed; as we rise in the scale, we observe the inner branch becoming more and more developed, while the outer branch is reduced, and may disappear entirely. Compare, for example, the thoracic feet of some Schizopods with those of the Caridea and Brachyura.

XXVI.—*Notes on rare and little-known Fishes taken at Madeira.* By James Yate Johnson, Cor. Mem. Z. S.

No. III.

Fam. **Pleuronectidæ.**

Solea oculata, Risso.

D. 68. A. 51. P. 7. V. 4. C. 15.

Left side white; right side a pale brown, marbled with deeper brown. On the anterior part of the body are five large patches of very dark brown. The tail is also of this colour, and the patch is divided from the paler colour of the body by a series of six yellow spots. The most noticeable markings on the right side of the body consist of four round or oval dark-brown, almost black spots, each surrounded by a ring of small bright yellow spots. These are arranged in two pairs, the members of each pair being placed over against each other at the base of the dorsal and anal fins respectively. A line drawn from one spot of the first pair to the other would divide the fish into two nearly equal portions. All the fins are edged with white. At the base of the caudal fin there is a narrow band of pale brown; the rest of the fin is a darker brown. The irides of the eyes are bright greenish-blue, surrounded by a ring of gold.

The length of the head, compared with the total length, is as 1 to $5\frac{1}{3}$; the height, to the total length, is as 1 to 3.

There are numerous soft papillæ in the neighbourhood of the

* Phil. Trans. 1858, pl. xl. f. B 3, &c.

mouth on the left side of the body, and this side of the body is rough with ciliated scales. Both jaws are set with minute teeth, but only on the left side.

The *dorsal* fin commences in front of the eyes, is rounded behind, and is distinct from the *caudal*, which latter is slightly rounded. The *anal* fin does not join the caudal, but terminates over against the end of the dorsal. On both these fins a series of small roughly ciliated scales extends along each ray. Both are coloured pale brown, with dark brown spots forming irregular lines. The left *pectoral* fin is shorter than the right in the proportion of 2 to 3.

Between the opercle and the caudal fin 70 scales were counted, and in the height about 44. The lateral line is straight throughout.

A single example of this species has occurred, which was taken in the month of February. It had a length of $5\frac{3}{8}$ inches, and a height of 2 inches. The right pectoral fin was $\frac{3}{8}$ inch long. The fish took fifty inspirations per minute. This Mediterranean species has been taken at the Canaries, and has been described by M. Valenciennes in Webb and Berthelot's 'Hist. Nat. des Canaries.' That naturalist assigns 50 rays to the dorsal fin; but this may possibly be a mistake of the printer; and he says that he found 50 rays in the anal fin, 8 rays in the pectoral fin, and 5 in the ventral fin. He counted only 60 scales along the flank.

Rhombus cristatus, Lowe, Trans. Zool. Soc. iii. p. 15.

D. 94. P. 10. V. 6. A. 74. C. 17.

Elliptico-oblong, sole-like; the right side white, the left side a palish sepia-brown, faintly marbled with deeper brown. The height of the body to the total length is as 1 to $2\frac{4}{5}$, and the head to the total length is as 1 to $4\frac{1}{3}$. The oval eyes are close together, being only separated by a simple crest. The hinder one is distant by about its own longer axis from the snout. The iris next the mesial line of the body is spotted with white, is much wider than on the outer side, and makes an angular projection upon the pupil. There are minute pointed *teeth* on both sides of both jaws; and I can only detect one row of each, although Mr. Lowe says, "dentibus in maxilla superiore uniseriatis, in inferiore anguste scobinatis."

The *dorsal* fin commences, on the right side of the body, in front of the eyes, and extends almost to the caudal fin. Some of the rays at its fore end are produced (in the specimen the second, third, fifth, and sixth), and these rays are free for much of their length. The pointed *pectoral* fins are small, that on the left side being longer. They are inserted below the middle of the height. The first ray is very short. The left *ventral* fin commences much before the right fin, whilst it extends quite as far back. They are inserted in front of the pectoral fins, and are both short. The *anal* fin commences immediately behind the vent, gradually decreases in height backwards, and terminates opposite the end of the dorsal. The *caudal* fin is pointed, and is about as long as the longer pectoral.

The scales are rather large, and have their free edges pectinate. The *lateral line* forms an arch over the root of the pectoral fin, and is then straight along the middle of the body to the base of the caudal fin. Its scales are about 62 in number; the scales in the height are about 33, the number above being equal to the number below the lateral line at the middle of the fish.

This rare fish, of which only one example has occurred (taken in the month of February, is easily distinguished from the much commoner *Rhombus maderensis*, Lowe, by its elongate sole-like form, the approximate eyes, the produced rays at the fore end of the dorsal fin, and the absence of pale annular markings on the coloured side of the body.

	inches.
Total length	$5\frac{6}{10}$
Height, nearly	2
Head	$1\frac{3}{20}$
Eyes, greater axis	$\frac{4}{10}$
Dorsal, length of 2nd and 3rd rays	1
Pectorals, length of left fin	$\frac{19}{20}$
,, distance from snout	$1\frac{1}{5}$
Ventrals, length of left fin	$\frac{6}{10}$
Caudal, length	$\frac{19}{20}$
,, width of base	$\frac{6}{10}$

Order ACANTHOPTERYGII, Cuv.

Fam. Triglidæ.

Scorpæna ustulata, Lowe, = *Sc. scrofa*, Linn.

There lately came into my hands three specimens of a *Scorpæna* which seem to prove that the fishes from which Mr. Lowe sketched a new species, that of *Sc. ustulata* (Proc. Zool. Soc. 1840, p. 36, and Trans. Zool. Soc. iii. p. 2), were merely young specimens of *Sc. scrofa*, a common fish at Madeira. As it is of much importance that all false species should be expunged from our books, I will state the facts that have led me to conclude that *Sc. ustulata* falls into this category.

All three specimens have the occipital depression which Dr. Günther has pointed out as specially distinguishing the artificial genus *Scorpæna* from that of *Sebastes*; and there can be no hesitation in ascribing all three to the same species, whatever that may be. The longest has a total length of $7\frac{8}{10}$ inches, and a height of $2\frac{1}{4}$ inches. The head measures $2\frac{5}{8}$ inches in length, the eye $\frac{3}{4}$ inch in diameter. The distance from eye to eye is $\frac{7}{16}$ inch. The pectoral and ventral fins are respectively $1\frac{7}{8}$ and $1\frac{1}{2}$ inch long. These dimensions correspond closely with those given from Mr. Lowe's notes in Dr. Günther's 'Catalogue of Acanthopterygian Fishes,' vol. ii. p. 112. The second specimen is $6\frac{8}{10}$ inches long, and the third $6\frac{1}{2}$ inches.

The diagnosis of *Sc. ustulata* given in the Catalogue, and there stated to have been drawn up from Mr. Lowe's manuscript notes, is this:—

"D. $\frac{12}{9}$. A. $\frac{3}{5}$. (L. lat. 24). Vert. 10/14.

"The height of the body is $3\frac{2}{5}$ in the total length, the length of the head nearly three times. The head is scaleless, but *the cheeks and opercles are pustulate or granulated.* The length of the snout is one-fourth that of the head, the width of the space between the orbits one-seventh or one-eighth. Space between the orbits deeply concave (groove on the crown of the head as in *Sc. scrofa*); orbital tentacles none or small. The fourth dorsal spine is the longest; the anal spines as in *Sc. scrofa* (the second the longest). A black blotch between the sixth and ninth dorsal spines; an irregular chestnut-brown and blackish mark behind the eye, extending principally over the opercle."

Now, turning to my three specimens, I find that in the two larger the dorsal-fin formula is $\frac{12}{10}$, in the third, $\frac{12}{9}$; whilst the anal-fin formula is in all $\frac{3}{5}$. The head is scaleless, and destitute of skinny appendages, except a tag at the posterior margin of the anterior nostril, such as is seen in *Sc. scrofa.* The top of the head, the cheeks, and opercles are without scales, and distinctly pustulate or granulate. The muzzle is very short, broad, and obtuse, extending only once the diameter of the eye before it, as is stated with reference to *Sc. ustulata.* The length of the muzzle is one-fourth that of the head, whilst the width of the space between the eyes, which is deeply concave, is not quite one-sixth the length of the head. In the largest specimen, the fourth dorsal spine is the longest; in the second specimen, the anterior dorsal spines have been broken; but in the third specimen the third, fourth, and fifth spines are of the same length, as nearly as may be. Comparing the length of the head and the height with the total length, the proportions in my specimens are—

	A.	B.	C.
Head in length	2·83	3	3
Height in length	3·77	3·55	3·6.

Mr. Lowe having stated that in *Sc. ustulata* the lateral line consists of 24 scales, each marked with a little tooth or point, Dr. Günther remarked that he had evidently counted the small scales only by which the lateral line itself is constituted; but it was to be presumed that, if the transverse series of scales had been counted, their number would be nearly the same as in *Sc. scrofa, i. e.* from 40 to 46. Now, in my specimens, the scales furnished with a projecting duct (evidently the "little point or tooth") are 24 in number, whilst the rows of scales abutting on the lateral line are about 45.

In regard to colour, the throat and belly are of a rich pinky red; the body reddish-brown, with dark spots and pale dapplings; the dorsal, pectoral, and caudal fins are washed with orange and sprinkled with black spots, the ventral and anal fins being nearly immaculate. In the largest specimen there is a faint dark blotch between the eighth and ninth spines of the dorsal. In the second specimen, there is a well-marked dark blotch between the eighth and ninth spines, and another similar blotch between the ninth and tenth spines. In the third specimen, there is a large continuous deep black blotch extending from near the seventh spine to beyond the tenth. It is evident that there is considerable irregularity in the position and intensity of the black blotch on the dorsal fin. In other respects, the colours, as I have described them, agree sufficiently nearly with those assigned by Mr. Lowe to the species *Sc. ustulata*. But then he has stated that "the great peculiarity of that species is an irregular chestnut-brown and blackish mark behind the eye, extending principally over the opercle." Of this mark I perceive not the slightest trace in any one of my specimens. Looking, however, at the variations of colour which Mr. Lowe has himself pointed out, it may well be doubted whether any reliance can be placed upon this mark as a criterion of species.

After considering the facts here stated, I venture to think that ichthyologists will conclude that the supposed species *Scorpæna ustulata* must be erased, on the ground that the fishes upon which it was founded were merely forms of *Scorpæna scrofa*.

Fam. Scombridæ.

Echeneis brachyptera, Lowe,

Günther's Cat. Fishes Brit. Mus. ii. 378.

An example of this species, 12½ inches in length, had a suctorial disk of 16 pairs of laminæ. The length of this disk, compared with the total length, was as 1 to $3\frac{2}{3}$; and the width of the body between the pectoral fins, compared with the total length, was as 1 to 7·15. The lower jaw was rounded and longer than the upper, which was angular, the premaxillaries forming a somewhat obtuse angle with each other. The tongue was rough at the middle with small teeth. The caudal fin was truncate. The dorsal fin had 28 rays, the anal 23; they terminate in the same vertical, short of the caudal fin. The colour was a uniform brown, with a slight trace of a white edge to the anal fin at the anterior end. The pectoral fins had rounded apices. The lateral line was straight, save for a slight rise and fall above the pectoral fins.

The following are the measurements of the principal parts in inches:—

Width of body between pectorals	$1\frac{6}{8}$
Dorsal, length of base	$3\frac{3}{4}$
,, distance from tip of snout	$6\frac{3}{4}$
Pectorals, length	$1\frac{1}{2}$
Ventrals, length	$1\frac{1}{4}$
Vent, distance from tip of mandible	6
Anal, length of base	$2\frac{7}{8}$
Caudal, height	$3\frac{1}{4}$
Eye, longer axis	$\frac{4}{10}$
,, distance from tip of snout	$1\frac{3}{10}$
Suctorial disk, length	$3\frac{3}{10}$
,, width	$1\frac{9}{10}$

Cubiceps gracilis, Lowe,

Proc. Zool. Soc. 1843, p. 82; Cat. Fishes Brit. Mus. ii. 389.

Navarchus sulcatus, Filippi e Verany, Mem. Acad. Torino, ser. 2. tom. xviii. p. 187.

D. 11. $\frac{1}{22}$. A. $\frac{3}{21}$. P. 24. V. 1.5. C. v. 9+8. v. M.B. 6.

Elongate, fusiform, compressed. Dark purplish-grey, nearly black on the back, the belly leaden-grey, the fins grey. Clothed with moderately large cycloid scales, of which the exposed part is diamond-shaped. There is a furrow along the side at the middle of the height, and halfway between this and the line of the belly there is another furrow not so long as the upper one. The lateral line is distinct from these, and is placed high up, following the curve of the back, and being straight along the tail. At the sides of the head it is forked, the branches meeting at the suprascapula. In addition to the straight longitudinal furrows already mentioned, the sides of the body are marked with transverse undulating parallel furrows, which at the middle of the height are convex towards the head. Of these, 27 were counted between the opercle and the end of the dorsal fin.

The height compared with the total length is as 1 to $5\frac{2}{3}$; the head compared with the total length is as 1 to $4\frac{1}{5}$. The vertex, opercles, and mandible of the unarmed head are scaly. Between the eyes it is slightly arched, and there is a low ridge along the nape and vertex, extending from the dorsal fin to the neighbourhood of the eyes. The short truncate snout is somewhat swollen at the sides, and there is a triangular depression at each side in the space between the eye, the upper jaw, and the snout. The round *eye* does not reach to the profile, and its diameter compared with the head is as 1 to $4\frac{1}{3}$. It is distant about a diameter from the snout, whilst the thickness of the head from eye to eye is rather more. The *nostrils* are some distance from the eye, and there are two small round openings into each sac. The nasal region is marked by some conspicuous mucus-pores. The *mouth* is small, the rictus being less than the width at the angle of the jaws. The lower jaw shuts inside the upper; the maxillary scarcely reaches back to the vertical from the anterior border of the eye. When the mouth is closed, both the premaxillary and the maxillary are covered by the broad thin bone behind them. The upper side of the mouth is formed entirely of the premaxillary, which, like the lower jaw, carries a single row of minute sharp *teeth*. These are set close together, and are rather longer in front. There is a large oval patch of minute teeth on the roof of the mouth behind the vomer, which is also armed with teeth, but there are none on the edge of the palatines. The fore part of the tongue is thin and dilated, and the hinder part is armed with a patch of teeth. The mouth, as well as the inside of the gill-covers, is black. Pseudobranchiæ are present. The rakers of the first pair of free gills have small spines on their inner sides. There is a sinus at the posterior edge of the opercle; and the edge of the interopercle is minutely denticulate. The lower border of the preopercle is striate, but the edge is simple.

The *dorsal* fin, which commences over the roots of the pectoral fins, has no free spines before it. Its anterior portion consists of twelve spines, but it is so deeply cleft between the eleventh and twelfth spines as to be almost formed into two fins. The spinous portion is triangular, and higher, though shorter, than the rest. The spines are weak; the first very short, half the length of the second. The longest spine is the fourth; the eleventh is very small; and the twelfth is attached to the soft portion of the fin, and almost equal to the ninth. The soft portion is angular, and rather produced behind, the base being scaly. The pointed *pectoral* fins are much longer than the ventral fins, reaching back to the commencement of the anal fin. The *ventral* fins are inserted under the posterior angle of the roots of the pectoral fins, and fold back into an abdominal groove. They reach about halfway from their roots to the vent, which is placed a little before the middle of the total length. The spine is less than half the length of the next ray; the second branched ray is the longest. The *anal* fin commences close to the vent, under the fourth branched ray of the dorsal, the shape of which it copies, and opposite to the end of which it terminates. It is higher anteriorly, and it is angular and somewhat produced behind. Its three spines are short, and the base of the fin is scaly. There are no finlets behind either the dorsal or anal fins. The tail is longer than high, and its fin is deeply furcate, without scales.

The scales of the unarmed *lateral line* are about 60; and there are 20 or 21 scales in the height of the body, of which only four are above the lateral line.

Two specimens of this rare fish have been obtained, both taken in the month of January. There was only a difference of $\frac{3}{4}$ inch between their respective lengths. The larger was an adult female containing ova.

Filippi and Verany have described the species, from Mediterranean examples, under the name of *Navarchus sulcatus*; but they have certainly committed a mistake in stating that there is a furrow on the body above the lateral line, and another below it. That line, as already described, is high up, and has two furrows below it, the upper one of which has obviously been taken by them for the lateral line. This explanation renders it still more probable that there is no specific distinction between *Cubiceps gracilis* and *C. capensis*, Smith, as Dr. Günther has suggested in his Catalogue.

The following are the dimensions of the principal parts of the larger example:—

	inches.
Total length	$7\frac{7}{8}$
Length to base of caudal	$6\frac{1}{2}$
Height in the pectoral region	$1\frac{3}{8}$
Thickness	$\frac{6}{10}$
Head	$1\frac{7}{8}$
Eye	$\frac{7}{16}$
Mouth, width at the angle of the jaws	$\frac{7}{20}$
Dorsal, length of base	$3\frac{1}{2}$
„ „ spinous portion	$1\frac{3}{10}$
„ distance from snout	$2\frac{1}{4}$
„ length of 4th spine	$\frac{8}{10}$
„ height of anterior part of soft portion	$\frac{1}{2}$
Pectorals, length	$2\frac{1}{5}$

	inches.
Pectorals, distance from snout	$1\frac{9}{10}$
" width of base	$\frac{9}{20}$
Ventrals, length	$\frac{7}{10}$
" distance from snout	$2\frac{1}{2}$
Anal, length of base	$1\frac{8}{10}$
" height anteriorly	$\frac{11}{20}$
Tail, length	$\frac{8}{10}$
" height	$\frac{5}{10}$
Caudal, length	$1\frac{3}{8}$

Zeus conchifer, Lowe,

Proc. Zool. Soc. vol. xiii. 1845; Ann. Nat. Hist. ser. 2. vol. x. 49.

Two examples of this rare fish, which have been recently procured, presented certain variations from the descriptions hitherto published; and these differences it may be desirable to mention. The larger specimen had a length of $28\frac{1}{4}$ inches, with a height of $11\frac{1}{8}$ inches; the smaller measured in length $27\frac{1}{2}$ inches, and in height $10\frac{1}{2}$ inches.

The normal number of the branchiostegal rays of the genus appears to be 7; but in one of my specimens there were 5 on one side and 6 on the other, in the second specimen 6 on each side.

As to the bony plates or scutella found at the base of the anal fin, Günther's Catalogue of the Collection at the British Museum (vol. ii. p. 395) speaks of 6 on each side, whereas, in one of my specimens, there were only 5, in the other 7, at each side of that fin. In the former (the larger specimen) the plates did not correspond on the two sides of the fin. On the right side the last plate but two was the largest, and the last was very small; on the left side the last but one was the largest, and the last of moderate size. In the latter specimen the plates corresponded on the two sides of the body, the last but two being the largest, and the last the smallest of each series. Between the ventral and anal fins there was, in the larger specimen, a series of 8 pairs of bony plates; in the smaller the series consisted of 7 pairs only.

The filaments of the anterior spinous rays of the dorsal are stated by Mr. Lowe to be very short; but in my larger specimen the filament of the first spine (itself $5\frac{1}{4}$ inches long) projected $2\frac{1}{8}$ inches beyond the tip of the spine, and those of the succeeding two projected about $1\frac{1}{2}$ inch beyond their respective spines.

The dorsal and anal fin formula is given by Mr. Lowe thus:—D. 9 or 10 + 25 or 26. A. 2 + (1 + 25 or 26). In the larger of my specimens the rays were, D. 9 + 25. A. 3 + 24; in the smaller D. 9 + 27. A. 3 + 26.

In the British Museum Catalogue it is stated, in the diagnosis of the genus, that there are no teeth on the palate. In both of my specimens there was a small patch of minute teeth on each palatine bone.

The "thumb-mark" on the sides of both specimens was nearly obsolete. The colour was a lilac-grey, deeper on the back, with an iridescent lustre in various parts.

Cyttus (*Zeus*) *roseus*, Lowe, sp.

The genus *Cyttus* was established by Dr. Günther, in his 'Catalogue of Fishes in the Collection of the British Museum' (ii. p. 396) for the reception of fishes which are distinguishable from those falling into the genus *Zeus* by the want of bony plates along the base of the dorsal and anal fins, and by the spines of the latter fin being limited to two. The present species had been briefly defined by Mr. Lowe as a member of the genus *Zeus* in the Proc. Zool. Soc. 1843, p. 85. Two examples having lately occurred, taken in the months of February and March, I proceed to give a fuller description of this very rare fish.

D. 7 or 8+28 or 29. A. 1 or 2+29. P. 14. V. 9. B. M. 7.
C. IV. 5+6. IV.

The Dory-like body is compressed, elevated, and coloured a pinky red, without maculæ, the sides, in certain lights, being silvery, washed with red. Very small scales are imbedded in a smooth shining skin, those of the lateral line being about 75 in number. Between the throat and the vent there is a series of five (Dr. Günther says three) oval bony plates, each marked with radiating striæ, and having a median crest which becomes on some of them a short spine directed backwards. In one specimen the third plate is the longest, in the other the fourth.

The height of the body is to the total length, the mouth being closed, as 1 to $2\frac{1}{2}$. The head, when the mouth is closed, is to the total length as 1 to $3\frac{2}{3}$, and is therefore less than the height. The thickness of the body behind the pectoral fins compared with the greatest height varied in the two specimens from 1 to 5 to 1 to $3\frac{1}{2}$, the larger being proportionally much thicker. The vertex is covered with a smooth, transparent, scaleless skin. Behind the eyes the sides of the head are striate, and at the nape there is a broad transverse depression. The large eye is round, or slightly oval, with a diameter which is contained in the length of the head, the mouth being closed, about $2\frac{1}{2}$ times. It is placed high up, and takes part in the profile. The border of the frontal bone above it is toothed. The distance from eye to eye is about equal to the diameter. The openings into each pituitary sac are close together, above the anterior margin of the eye. The outer and posterior one is large, and obliquely oval, In front of each smaller orifice there is a conspicuous mucus-pore. The cheeks are flat, and covered with a smooth skin, in which almost imperceptible scales are buried. The opercular pieces are unarmed, but the border of the preopercle is strongly striate, the striæ parallel with the margin. The mouth is excessively protrusile, the pedicel of the premaxillary being very long; and the lips are furnished with thick skin. The ambit of the open mouth is nearly circular. The maxillary is thin, transparent, and much dilated below. The jaws are roughened with bands of minute *teeth,* that in the upper jaw being very broad at the sides. There is a patch of similar teeth on the vomer, but none on the palatines.

The *branchiostegal membrane* was furnished in both specimens with seven rays on each side; small pseudobranchiæ are present.

The spinous portion of the *dorsal* fin is distinctly connected with the soft portion, the former being shorter but higher than the latter, which is more elevated behind than in front. The stout spines are strongly striate at their sides, and carry short filaments at their apices (Mr. Lowe says, "dorsali haud filamentosa"). The first spine is only half as long as the third, and the last spine is shorter than the first. This fin commences considerably behind the root of the pectoral fin, and a space equal to the diameter of the eye separates its termination from the base of the caudal fin. None of the rays of the soft portion are branched.

The *pectoral* fins are inserted about the middle of the height; they are rounded and much shorter than the ventral fins, reaching back not quite so far as the vertical of the vent.

The rounded *ventral* fins are large, reaching back nearly to the middle of the anal fin, and they are inserted under the roots of the pectorals. The abdomen in front of their roots is flat. The *vent* is placed under the middle of the spinous portion of the dorsal fin.

The *anal* fin, like the soft portion of the dorsal fin, which it resembles in shape, rises out of a deep groove, and has none of the rays branched. It commences under the commencement of the first dorsal, and terminates under or a little posterior to its end. None of the rays are branched. The first spine is short, stout, and subtriangular, with ribbed sides. The rounded *caudal* fin has three short spinous rays at each side.

The *lateral line* is high up, and much arched, following pretty nearly the curve of the back, and being straight on the tail. None of the fins are scaly.

The larger of the two specimens afforded the admeasurements set forth in the following table:—

	inches.
Total length, mouth open	$13\frac{7}{10}$
„ „ mouth closed	12
Height between vent and anal fin	$4\frac{6}{8}$
Head, length, mouth open	5
„ „ mouth closed	$3\frac{3}{10}$
Eye, diameter	$1\frac{3}{10}$
Eyes, distance apart	$1\frac{3}{10}$
Nostrils, distance apart	$\frac{4}{10}$
Mouth, when open, $1\frac{8}{10}$ by	$1\frac{1}{2}$
Premaxillary, length of pedicel	$2\frac{6}{10}$
Dorsal, length of base of spinous portion	2
„ „ „ soft portion	$3\frac{1}{4}$
„ length of third spine	$1\frac{1}{4}$
Pectorals, length	$1\frac{1}{2}$
„ distance behind anterior margin of eye	$2\frac{3}{10}$
Ventrals, length	3
Anal, length	$3\frac{5}{10}$
„ height posteriorly	$1\frac{1}{10}$
Tail, height at middle	$\frac{9}{20}$
Caudal, length	$1\frac{7}{10}$
„ span	$3\frac{1}{10}$

XXVII.—*On* Ephedra. By John Miers, F.R.S., F.L.S. &c.

[Continued from vol. x. p. 140.]

The long interval that has elapsed since the appearance of the former part of this paper demands a word in explanation. When that portion was ready for the press, I was charged by the Government of Brazil with duties arising out of the International Exhibition, which required my undivided attention for many months; and it is only now that I am able to complete the following description of all the South-American species of *Ephedra* known to me.

In the mean time Dr. Hooker's memoir on *Welwitschia* has appeared in the Linnean Transactions, which renders it incumbent on me to reconsider my former views concerning *Ephedra*. That memoir will claim attention from every botanist, not only for the careful description of the structure of this remarkable plant, but for the admirable manner in which the elaborate details of its analyses are illustrated; and it is fortunate for science that Dr. Hooker had at his command ample materials for the investigation. For the present purpose it will be necessary to refer only to such points in that memoir as may relate to *Ephedra*.

In the absence of the smallest information concerning the female flower and the ovary of *Ephedra*, and with the knowledge that in *Gnetum* the male and female flowers are found in distinct whorls on the same node, I had suggested the possibility that in *Ephedra* both sexes might prove to be developed in the same common spikelet, in which the male flowers in the lower whorls had fallen away before the female flowers became developed in the terminal whorl—a supposition rendered more probable by the fact that male and fructiferous spikelets are sometimes found on the same plant. But the changes shown in the gradual development of the ovary and fruit of *Welwitschia* render the above supposition improbable; and by analogy we may now form a tolerable conjecture of the nature of the female flower in *Ephedra*. From these data we may infer that the two ovaria developed in the terminal pair of involucels are deficient of a corolla—a circumstance which sometimes occurs in *Euphorbiaceæ*, where the male flowers are provided with both calyx and corolla, while the ovary is destitute of any floral envelope.

The application of the term "cone" to the flowering heads of *Welwitschia* and *Ephedra* is calculated to mislead many persons in regard to the affinity of the *Gnetaceæ*; for they bear little analogy to the cones of the *Coniferæ*. They are more properly spikelets, because they bear regular petaloid sessile flowers along a common axis, much after the manner of a spike of *Plantago*; and they offer more claims to this category than the spikelets of *Myrica*, the aments of *Betula*, or the spicated inflorescence of many other genera.

The structure of the male flowers and the mode of inflorescence in *Welwitschia* present a striking resemblance to those in *Ephedra*, both showing an advanced state of floral development. Dr. Hooker considers the ovule in the female flower to be deficient of any carpellary covering, and therefore gymnospermous; but the circumstances he has demonstrated tend rather to evince that it is enveloped in a distinct carpel. The important fact of the existence of hermaphrodite or polygamous flowers in this family serves to throw much light on this point. It is shown in pl. 6. fig. 14 that *Welwitschia* (besides its floral envelopes) presents a monadelphous ring of regularly formed stamens surrounding an ovary constituted in the usual manner of angiospermous plants—that is to say, with a simple style and stigma surmounting an oblong 1-celled carpel containing a single erect ovule, thus exhibiting a floral development and pointing to a position in the system far higher than the gymnospermous orders of *Coniferæ* and *Cycadaceæ*. But the ovule of the hermaphrodite flower is always sterile, and it is only in such flowers as are deficient of corolla and stamens that embryo-sacs are formed in the ovule which admit of its fertilization; and here it is seen that the style becomes so far depressed that the stigma remains sessile on the summit of the carpel, leaving the small apical pervious aperture constantly found in the fruits of *Welwitschia* and its congeners. This depression of a pervious stigma I have shown to exist in several other instances. The entire development imparts a truly angiospermous character to the *Gnetaceæ*, notwithstanding the pervious aperture in the carpel, while the peculiar mode of fertilization, as Dr. Hooker seems to indicate, is analogous to some instances in *Santalaceæ* and *Loranthaceæ*. I long ago pointed out the existence of vascular threads in the viscous cap which crowns the seed in *Loranthus* (*Struthanthus*), the nature of which I did not then understand, but which may perhaps be analogous to the development shown in *Welwitschia*.

The involucels in *Ephedra*, even in a young state, resemble those of *Welwitschia* in this particular—that the margins are simply reticulated and petaloid, while the central discoid portion is formed of three easily separable laminæ, the external plates being simply reticulated and epidermoid, while the inner lamina consists of numerous closely disposed spicular fibres shaped like those shown in *Welwitschia*; these are imbedded in parenchyma, as well as two conspicuous distant and parallel nervures which consist of bundles of ordinary spiral vessels.

The bilabiate perigonium in *Ephedra* is quite reticulated and petaloid, and exhibits no trace of any similar fibres or vessels.

Its achenium bears all the usual features resulting from the growth of a regular carpel: it is thick and coriaceous, containing within its somewhat fleshy mesoderm a number of long hair-like threads of pellucid woody fibres, nearly of its entire length; there is no resemblance in this structure to the perianth of the male flowers. Dr. Hooker, however, considers the similar pericarp of *Welwitschia* to be the growth of a perianth surrounding a gymnospermous ovule deficient of any true carpellary covering —a conclusion apparently formed upon hypothetical grounds.

I have to make an essential correction in regard to the tubillus: from recent examinations of the seeds of *Ephedra dumosa* (in which the seminal integuments are somewhat thicker) and of immature seeds of *E. Americana*, lately obtained, it is seen that the tubillus is expanded below, like an inverted funnel, quite free from the apical gland, which it surrounds, and is continuous with the outer integument, of which it is a simple extension. In the cases previously observed, this dilated portion was so extremely delicate, and adhered so closely to the gland, that the tubillus seemed to rise out of it. The fact, as above stated, is now beyond all doubt.

I have again examined carefully the suspensor in *Ephedra*, but can discover no trace of those embryo-sac-bearing filaments which are found in *Gnetum* and *Welwitschia.* The tubillus, as above stated, is a prolongation of the outer integument; the red fleshy gland is attached to and closes the mouth of the inner integument. To a small point in the centre of this gland is attached the white cylindrical and tubular suspensor, hemispherical at its apex, the lower extremity of which descends upon and adheres firmly to the upper part of the albumen, thus forming a kind of white cap upon it for a quarter of its length. This suspensor is capable of considerable extension; and when cut open along one side and examined under the microscope, it is found to consist of a loose mass of condensed and extremely fine flocculent tissue, confusedly huddled together like paper-pulp, without the slightest trace of any of the coiled filaments seen in *Welwitschia* and *Gnetum,* or any vessels whatever. The albuminous mass is just the length of the embryo, and does not extend over the summit of the radicle, which is quite naked within the hollow cylinder, but it disappears gradually, and becomes lost in the flocculent substance of the suspensor, becoming at last so far attenuated as to disappear in the form of separate granular cells. From these facts we may infer that this suspensor is only a portion of the amniotic body which has not been obliterated, or in which albuminous grains have not been deposited—a condition of development clearly indicated by the acute sagacity of the late Mr. Robert Brown*.

We ought not, therefore, to attach much importance either to the mere circumstance of a suspensor as a proof of the close alliance of the *Gnetaceæ* with the *Coniferæ* and *Cycadaceæ,* seeing that it is always diversified in the several genera, and different from that structure in those families—or to the occasional presence of filaments bearing sterile embryo-sacs, for these never occur in *Ephedra,* and not always in *Gnetum*—or to the existence of disciform dotted vessels in the wood, for they are found only in *Gnetum.* These are only partial coincidences, and consequently of little value in comparison with the strong evidence showing a far more advanced perfection of floral structure in the *Gnetaceæ,* and pointing to a much higher position in the system. Other analogies remain to be discovered before this point can be

* "In other cases the albumen is formed by the deposition of granulated matter in the cells of the nucleus. In some of these cases, the membrane of the amnios seems to be persistent, forming, even in the ripe seed, a proper coat for the embryo, the original attachment of whose radicle to the apex of this coat may also continue." (Gen. Rem. p. 57.) This view applies as well to the origin of the vitellus in many seeds as to the peculiar development existing in *Ephedra*; and it is probable that future researches may show the existence of an analogous development in other cases, and may lead to a knowledge of the true affinities of the *Gnetaceæ,* which we have yet to learn.

safely determined. I may here mention that all the details of structure which I have observed will be minutely shown in the drawings of the various analyses intended to illustrate the genus *Ephedra*.

From the circumstances above stated, it is requisite to correct the former diagnosis of *Ephedra*, as far as regards the female plants, in the following manner:—

Flores ♀ ignoti (forsan achlamydei). *Achenia* 2, distincta, rarius abortu solitaria, summo spicæ amentiformis (ei ♂ similis) affixa, involucellis omnino vel semi-obtecta, oblonga, subtrigona, plano-convexa, collateralia, erecta. *Pericarpium* siccum, coriaceum (*mesocarpio* fibrillifero), glaberrimum, indehiscens, apice glandulæformi pro tubilli transitu pervium, uniloculare. *Semen* unicum, basi affixum, loculo paulo brevius, apicem versus attenuatum; *integumenta* 2, simplicia, ab imo usque ad medium coalita, dehinc superne libera et distincta; *exterius* tenuiter membranaceum, apice subito longe contractum et in *tubillum* persistentem tubulosum per foramen pericarpii prolatum et sæpe longe exsertum attenuatum; *interius* crassius, opacum, corrugato-plicatum, apice *glandula* subglobosa majuscula carnosa clausum; *hilum* cum *chalaza* basali confusum, substipitatum; *raphe* nulla; *albumen* oblongum, subcompressum, obpyriforme, carnosulum, embryo æquilongum, apice suspensum; *suspensor* brevis, cylindricus, opacus, flocculosus, ad imum glandulæ integumenti affixus, et ad partem superiorem albuminis arcte adhærens; *embryo* carnosus albumine æquilongus et dimidio angustior; *cotyledones* lineari-oblongæ, semiteretes, parallelim collaterales (commissura spicæ axin spectans), *radicula* iis æquilata et æquilonga, supera, subcompressa, gradatim ad apicem obtusum angustata.

1. *Ephedra Chilensis*, n. sp.;—ramis ramulisque oppositis, validiusculis, pallide viridulis, granuloso-striatellis, internodiis longiusculis vel mediocribus, axillis valde nodosis; foliis rudimentariis, oppositis, crassiusculis, margine tenuibus, imo in vaginam membranaceam serius ruptam connatis, laciniis lineari-acutis; ramis floriferis axillaribus, brevibus vel brevissimis, apice spicellas 1–2–3 sessiles gerentibus; spicellis ovatis vel oblongis, ex involucellis per paria 6, decussatim oppositis et imbricatis; involucellis ovatis, obtusis, per paria imo connatis: floribus ♂ in involucellis solitariis, hinc decussatim oppositis, perigonio incluso; antheris 6, in columna subsessilibus et exsertis: fl. ♀ pedunculo in axillis solitario, elongato, supra medium 2-bracteolato, spicella solitaria terminato, involucellis per paria 5 imo nexis; acheniis 2, termina-

libus, inclusis.—Chile, Prov. Valparaiso, *v. v.* in variis locis; *v. s. in herb. Hook. et Mus. Brit.* (Cuming, n. 372; Bridges).

A low shrub, with numerous virgate constantly dividing branchlets, which are opposite in most of the nodes, more rarely 4, verticillate, from 1 to $1\frac{1}{4}$ line in thickness, the internodes being $1\frac{1}{2}$ to 2 inches apart; the opposite leaflets, 2 to 3 lines long, are at first united for nearly their entire length into a membranaceous vaginant sheath, which afterwards becomes torn, by the swelling of the node, into two acute segments, coriaceous at base. The male inflorescence consists of one to four crowded spikelets upon a very short pedicel, thus forming almost glomerated heads on each side of every node: each spikelet is 3 lines long, $2\frac{1}{2}$ lines broad; the petaloid perigonium in each involucel is turbinately tubular, compressed, delicately membranaceous, of an orange-yellow colour, 1 line long (thus somewhat exceeding the length of its involucel), its border consisting of two rounded concave, erect lobes, which are imbricated in æstivation in the manner before described; the exserted anthers are subglobose, of a bright yellow colour, opening by two pores in the apex. The female peduncle is 10 lines long, bearing spikelets in which the achenia were destroyed by insects*.

2. *Ephedra bracteata*, nob. Trav. ii. 531;—ramis erectis, ramulis ternatim verticillatis aut oppositis, tenuioribus, divaricatis, fusco-viridibus, minutissime granuloso-striatellis, internodiis longiusculis; foliis oppositis, rarius ternis, imo in vaginam submembranaceam connatis, apicibus longissime et anguste linearibus; inflorescentia ♂ et ♀ interdum in eadem planta; spicellis ♂ 2–3 in quaque axilla subsessilibus, imo bracteatis, involucellis 1-floris, per paria 6–8 imo connatis decussatim imbricatis, perigonio involucello paulo longiore, flavido, petaloideo, antheris 6 sessilibus longe exsertis; spicellæ ♀ involucellis imbricatis, majoribus, coriaceis, marginellatis, achenia 2 collateraliter terminalia ultra medium velantibus.—Chile, Prov. Valparaiso et Coquimbo, *v. v.* ad Concon; *v. s. in herb. Hook.*, Viña de la Mar (♂ & ♀ Bridges, No. 178), Viña de la Mar (Anderson, anno 1830), Coquimbo (Harvey ♂).

A shrub growing to the height of 2 to 5 feet, with the habit of the preceding, from which it differs by several marked characters. The branches are more slender, darker, with internodes $1\frac{1}{4}$ inch apart; the leaflets are opposite, sometimes ternate, 3 to 4 lines long, united at base into a vaginant tube 1 line in length, the segments being somewhat erect and linearly setaceous. The

* A drawing of this species, with analytical details, will be given in the 'Contributions to Botany,' vol. ii. Plate 75 A.

male spikelets are $2\frac{1}{2}$ lines long, $1\frac{1}{2}$ line broad, formed of two sets of basal bracts and six or eight pairs of floriferous decussately imbricated involucels, united into as many vaginant sheaths at their bases; the perigonium of each solitary opposite flower is of a yellow colour, 1 line long, with a two-lobed erect border; the staminal tube is $1\frac{1}{2}$ line long, supporting the subsessile subglobose yellow anthers, which open by two pores in the apex. The fructiferous spikelet is 3 lines long, 2 lines broad, formed of four series of imbricated involucels void of flowers; they are coriaceous, $1\frac{1}{2}$ line long, $1\frac{1}{2}$ line broad, each united with the opposite one into a sheath at its base; the two terminal achenia, more than half invested by the superior involucels, are 2 lines long, $1\frac{1}{4}$ line broad, flat on the contiguous faces, and convex externally, of a somewhat glauco-fuscous colour, the summit being terminated by an obtuse perforated gland, through which the shortly exserted slender tubillus passes, which has a unilabiate termination. The pedicel supporting the fructiferous spikelet, which in Bridges's specimen is not fully grown, is 4 lines long, with a pair of bracteoles a short distance below: in Anderson's specimen the pedicel is 10 lines long, the bracteoles being at a distance of 2 lines, and the spikelet is double the size of the former. It should be remarked that, in Bridges's plant, a fructiferous spikelet is found on one of the lower branches of the same specimen the upper branches of which all bear male flowers *.

3. *Ephedra monticola*, n. sp.;—ramis oppositis, substrictis et suberectis, valde ramosis, striatis, brunneis, ramulis junioribus teneribus, imo in vaginam vix nexis; pedunculis axillaribus in flor. ♂ subbrevibus vel brevissimis, spicellam unicam ovatam gerentibus; involucellis in paribus 3–5 decussatim imbricatis, ovatis, obtusis vel mucronulatis, subcoriaceis, margine membranaceo cinctis et floribus totidem includentibus; perigonio petaloideo, vix longiore; columna staminifera 2-plo longiore; antheris 5–7, ovalibus, subsessilibus: spicellis fructiferis solitariis, ovatis, pedunculo ramuliformi 2-bracteolato suffultis; acheniis 2, in involucellis supremis absconditis.—Chile, Cordillera de los Andes, utroque latere; *v. s. in herb. Hook.* (♂ et ♀ Bridges, No. 1210).

A shrub, from its very elevated locality, probably of low growth, with more erect and more slender branches than the preceding species, from which it differs in its general appearance, in its much smaller bractiform leaflets, and in its achenia being hidden by the last pair of involucels. Its branchlets are opposite, but sometimes two superimposed grow out of each axil: these are floriferous, nearly $\frac{1}{2}$ line in diam., with internodes 9 to

* This species will be figured in the same work, Plate 75 B.

11 lines apart. The peduncles are axillary, 1 to 2 lines long, with a pair of bracteoles supporting them at their origin; and they bear a solitary male spikelet, which is ovate, $2\frac{1}{2}$ to 3 lines long, bracteated at base, with four pairs of imbricated involucels briefly conjoined at their base into a sheath, subcoriaceous and 1 line long; perigonium somewhat longer than its own involucel; staminiferous column twice its length, bearing 5–7 sessile yellow anthers opening by two pores in their apex. The fructiferous spikelets are on a distinct specimen: here the peduncle is 1 inch long, 2-bracteolate a little above the middle, bearing a solitary oval spikelet 3 lines long, 2 lines broad; involucels broadly ovate, gradually diminishing towards their summits, coriaceous, with a narrow membranaceous border; two erect achenia $1\frac{1}{2}$ line long, elliptic, plano-convex, perforated at the apex, with no portion of the tubillus exserted*.

4. *Ephedra Andina*, Pöpp.; Meyer, Mem. Acad. Petrop. v. 78;—caulibus plurimis subhumifusis, ramis ramulisque ramosissimis adscendentibus, singulis ad pedem vaginatim foliosis, flexuosis, nodosis, subarticulatis, internodiis subbrevibus, viridiusculis, granuloso-striatellis; foliis minimis, oppositis, coriaceis, acutis, imo vaginatim nexis, lobis in junioribus subulato-acuminatis, mucronulatis, serius distinctis; spicellis ♂ axillaribus, breviter pedunculatis, solitariis vel binis glomeratis, basi 2-bracteolatis; involucellis per paria 6 decussatim oppositis et imbricatis, imo vaginatis, obovatis, primum submembranaceis et flavescentibus, serius subcoriaceis et membranaceo-marginatis; perigonio petaloideo, limbo 2-lobo; columna staminifera longe exserta, antheras 5–6 sessiles apice 2-porosas gerente: spicellis fructiferis axillaribus, solitariis, longe pedunculatis; pedunculo in medio 2-bracteolato; involucellis majoribus, magis coriaceis; acheniis 2, collateralibus, terminalibus, glaucis, striatellis, involucello paulo longioribus, apice perforatis; tubillo breviter exserto, apice inæqualiter fisso aut lacerato.—In Andibus Chilensibus; *v. s. in herb. meo et Hooker.*, ♂ Cordillera de Maule (Germain); *in herb. Hooker.*, ♀ Chile australis (Dr. Philippi).

In the memoir above cited, Meyer has confounded together (but with some doubt) all the Chilean species of *Ephedra*. The above-described plant, from the provinces south of the River Maule, the region visited by Pöppig, has been selected as the type of *E. Andina*, Pöpp. It is a well-marked species. The foregoing diagnosis, drawn wholly from it, should be substituted for the more general character assigned by Meyer. It seems to be a very bushy plant, its lower branches hanging on the ground,

* A figure of this plant will be seen in (*loc. cit.*) Plate 76 A.

and its ramifications rising upwards. In Germain's specimens, a cross section of its branches exhibits three or four distinct annular zones, showing a solid white wood with close medullary rays: these are $2\frac{1}{2}$ lines in diameter, and very flexuose; its bark is thick and of a brownish colour, but in the younger branchlets of the last year's growth it is of a yellowish green, the internodes being $1\frac{1}{2}$ to 2 inches apart. The axillary branchlets or peduncles which bear the ♂ flowering spikelets are generally half a line, seldom 2 lines, in length; these spikelets are $2–2\frac{1}{2}$ lines long, with six pairs of imbricated involucels; the perigonium is $\frac{3}{4}$ line long, and the staminal column, rising above it, becomes $1\frac{1}{2}$ line in length. The fructiferous spikelets, upon a distinct plant, supported by a peduncle 2 to 4 lines long, are 3 to $3\frac{1}{2}$ lines in length, and are formed of three pairs of imbricated involucels, with a pair of bracts upon the peduncle. The two terminal achenia, embraced by the last pair of involucels, which are somewhat shorter than them, and subscarious, are plano-convex, oblong, pointed towards the small perforated apex, where they are marked by a small yellowish glandular ring which I have considered to be the persistent sessile stigma; the exserted portion of the tubillus is barely a line long, and is irregularly lacerated and scarcely 2-lobed*.

5. *Ephedra dumosa*, n. sp.;—ramis arcuato-flexuosis, valde ramosis et intricatis, internodiis subbrevibus aut mediocriter distantibus; ramulis divaricatis, striatellis, granuloso-scabridulis, rufescentibus vel fuscis; foliis oppositis, coriaceis, granuloso-striatulis, fusco-rubescentibus, imo in vaginam amplam brevem connexis, vix marginatis, apicibus breviter mucronato-acutis, vagina demum rupta linearibus: spicellis fructiferis solitariis, brevissime pedicellatis; involucellis per paria imo nexis, imbricatis, ovatis, subcarnosis, rubescentibus, achenia omnino amplectentibus; acheniis nigris, nitidis, tubillo breviter exserto, obsolete 2-lobo.—In Andibus Chilensibus, *v. v.* ad Cortaderas costa orientali; *v. s. in herb. meo et Hook.*, Cuesta del Inca (Gillies).

A low bushy shrub, which I found growing near the Ladera de las Cortaderas, on the eastern side of the Andes, and of which I still preserve the ripe fruits, though my specimen was lost. Dr. Gillies's plant, from the eastern side of the Portillo Pass, is more dwarfish, and is without flower or fruit. The branchlets are opposite, the internodes being only 6 to 12 lines apart; the vaginant portion of the combined opposite leaflets is $\frac{1}{2}$ line long and subcampanulate, the segments being of equal length, and

* A representation of this species, with ample details, will be seen in the work before mentioned, Plate 76 B.

triangular. The fructiferous spikelets are solitary, 3 lines long, 2 lines in diameter; the involucels, broad and very fleshy, of a dull dark ruddy hue, quite conceal the two terminal achenia the latter are ovate, diminishing upwards, plano-convex, shining, unevenly striated, each obtuse at its acumination, where it is perforated and surrounded by an apical annular gland; the tubillus, rising through this, is very little exserted, and very briefly bifid, or rather lacerated into two very short, erect, concave, rounded, unequal lobes*.

6. *Ephedra ochreata*, n. sp.;—suffruticosa, ramis virgatis ramulisque validis adscendentibus, sæpissime fusco-viridibus, striatellis, granuloso-scabridulis, epidermide facile rimosa, internodiis remotiusculis; foliis 3-nis vel 4-nis, rigido-submembranaceis, in vaginam longiusculam striatellam connexis, apicibus subulatis, serius omnino disruptis, tunc liberis et reflexis: spicellis ♂ oppositis, 3-nis vel 4-nis, in axillis sessilibus et subglomeratis, oblongis, ad basin imbricato-bracteatis; involucellis in seriebus ternatis 6–9, imo nexis et decussatim alternantibus, ovatis, subcoriaceis, margine vix membranaceis, perigonio subæquilongis; antheris 5–6, exsertis: spicellis fructiferis 2–4, breviter pedicellatis, subverticillatis; acheniis 2, oblongis, subacutis, ultra medium exsertis.—In Provinciis Argentinis, Travesiá de Mendosa ♀ mihi lecta; *v. s. in herb. Hook. et Mus. Brit.*, ♂ Patagones, Prov. Buenos Ayres (Tweedie), Bahia Blanca (Darwin), Port S. Elena (Capt. King), Bahia San Antonio. Var. *striata* ♂ et ♀ Mendosa (Gillies).

A very distinct species, with long virgated and somewhat curving branches, which are striated, 1 to 2 lin. diam., the internodes being 2 inches apart; the younger ones are somewhat fistulose, with a central pith, but the older branchlets are entirely woody; four branchlets issue from a node, two being superposed in each opposite axil; or there are three verticillate branchlets at a joint; the leaves are 4 lines long, seldom opposite, most frequently ternate, and united together as far as their middle into a sheath which loosely embraces the stem; they are membranaceous, with a subulately acuminate apex terminating in a long cuspidate point proceeding from the excurrent nerve; four sessile male spikelets are placed verticillately round each node within the ruptured sheath, the leaves now becoming reflexed and withered; these spikelets are 2 lin. long, and $1\frac{1}{2}$ lin. broad; each consists of three series of imbricated bracts at base, and nine other floriferous series closely imbricate and alternately

* This plant, with analyses of its carpological structure, will be shown in Pl. 77 A.

decussate, each series consisting of three involucels vaginately united at base; the flowers, from twenty-five to thirty in each spikelet, are therefore ternately verticillate in each series. The perigonium is petaloid, of the usual form, of delicate reticulated texture, the areoles being generally disposed in longitudinal rows sometimes anastomosing with each other, each areole being isolated and replete with a coloured fluid; there is no vestige of any nervure or spicular cells as in *Welwitschia*. The involucels are similarly reticulated, but they finally become thickened, opake, and coriaceous, except round the margins; the coriaceous portion is constituted in the manner described in a preceding page (p. 250). The fructiferous spikelets, upon distinct but similar plants, are two to four in each node, 4 to 4½ lines long, 2 lines broad, verticillately disposed, each upon a separate pedicel; their involucels, in about five gradually decreasing imbricated pairs, are smooth, opake, subcoriaceous, with almost obsoletely membranaceous margins. The two terminal achenia, half invested by the last pair of involucels, are ovate, somewhat attenuating upwards, trigonous, with an obtuse pallid perforated summit, the tubillus, with lacerated apex, being scarcely exserted*.

The variety *striata* of Gillies possesses all the specific features; but the branchlets are less than half the thickness, they are glandularly scabrid, of a pallid colour; the internodes in the male plant scarcely exceed an inch, while those of the fructiferous plants are 1 to 1½ inch apart; the leaves, 2½–3 lines long, are united for above half their length into a 3-fid vaginant tube. There are about six smaller glomerated heads around each node. The fructiferous spikelets are 3 lines long, 2 lines broad, with three pairs of subcoriaceous involucels with scarious margins, the terminal pair enclosing two finely striated, opake, fuscous achenia. It may probably form a distinct species; but there is little that can be characterized.

7. *Ephedra Americana*, H. B. K. ii. 2; Rich. Conif. 31. tab. 29; Meyer, Mem. Acad. Petrop. v. 100;—ramulis graciliusculis, erectis, subflexuosis, striatellis, pallide virentibus, vix scabrellis; foliis oppositis, imo ad nodos in vaginam brevem nexis, lobis liberis longiusculis, linearibus, subulato-acuminatis, erecto-patulis, submembranaceis, glaberrimis, crebre striatellis, serius ruptis et divaricatis, linea transversali tunc nexis: spicellis ♂ axillaribus, sessilibus, subglobosis, oppositis vel 4-verticillatis; involucellis per paria 8–10, floriferis, imbricatis, valde concavis; perigonio paulò longiore, petaloideo; columna

* Ample details of structure, and a figure of the plant, will be given in Plate 77 B.

staminali 7-nervi; antheris 5–7, exsertis: spicellis fructiferis in quaque axilla solitariis vel binis, breviter pedicellatis; involucellis majoribus, glauco-opacis, marginibus anguste membranaceis; acheniis 2, terminalibus, subinclusis, apice calloso perforatis.—In Peruvia; *v. s. in herb. Mus. Brit.*, ♂ et ♀; *in herb. Hook.*, ♀ Chachapoyas (Mathews, 1838).

Kunth describes this as a somewhat erect or repent shrub, very much branched; the branchlets are slender, scarcely ½ line diam., with internodes 1 to 1⅛ inch apart. The leaves are 3 to 5 lines long, 1 line broad, setaceously acute, of a reddish colour, and ultimately subreflexed. According to that botanist, the male and female flowers are found on the same plant, in the proportion of three of the former to one of the latter; but in the instances I have seen, the sexes are on different specimens. The male spikelets are solitary and sessile in each opposite axil; they are 2 lines long, 1½ line broad, with six or eight series of floriferous opposite involucels conjoined at base in alternating pairs, and three series of basal bracts; the involucels are suborbicular, with a fleshy very concave centre and a simply reticulated margin, the central portion being formed of three separable laminæ, as described in page 250. The perigonium is petaloid, simply reticulated, with spotted areolæ, but without vessels of any kind. The fructiferous spikelets are elliptic, 3 lines long, 2 lines broad, supported on pedicels 1 line long. The mesocarp of the pericarp is filled with numerous very long, and apparently solid, filiform woody fibres imbedded in fleshy matter. In a half-ripe state, the tubillus is distinctly seen to be continuous with the outer integument of the seed, a considerable space intervening between it and the gland, and between it and a long portion of the summit of the seed*.

8. *Ephedra rupestris*, Bth. Plant. Hartw. p. 253;—humilis, intricato-ramosissima; ramulis rectiusculis vel arcuatis, fusco-opacis, valde striatis, granuloso-scabrellis, ad axillas paulo nodosis; foliis oppositis, imo in vaginam brevem nexis, superne in lobos triangulares extus subcarinatos mucronatos terminatis, minute granulosis, coriaceis, hæmaticis: spicellis ♂ axillaribus, solitariis vel binis, sessilibus; involucellis oppositis, imo nexis, 3–4-serialibus, imbricatis, carnosulis, fuscis, perigonio brevioribus; antheris circiter 5, sessilibus, longe exsertis: spicellis fructiferis in axillis solitariis, breviter pedicellatis; involucellis per paria 4–5, imbricatis, fuscis, carnosulis, minute granulosis; acheniis 2, terminalibus, inclusis; tubillo exserto, subtruncato, rubello.—Ecuador; *v. s. in herb. Hooker.*, ♂ Monte Pelzhum, altit. 12,000 ped. (Jameson),

* This plant, with full structural details, will be shown in Plate 78 A.

Monte Cotopaxi, altit. 12,000 ped. (Jameson), Monte Antisana ♀ (Hartwegg, No. 1394).

Apparently a shrub of stunted growth, found in the fissures of rocks at a great elevation, the branchlets being $\frac{1}{2}$ to $\frac{3}{4}$ line thick, with internodes 5 to 7 lines apart; opposite leaflets 1 line long, which for half their length are united into a vaginant tube round each node, becoming afterwards more or less torn to their base. The male spikelets are 2 lines long, 1 line broad, with involucels and perigonium $\frac{1}{2}$ line long; staminiferous column yellow, $\frac{3}{4}$ line long, bearing five clustered sessile anthers opening by two pores in the apex. The fructiferous spikelets are $2\frac{1}{4}$ lines long, $1\frac{3}{4}$ line diam.; the involucels are of a dark brassy metallic hue, with a finely granulated surface.

The *Ephedra humilis*, Weddell (Ann. Sc. Nat. sér. 3. xiii. 251), from Puno in Bolivia, does not appear to be specifically distinct from the above plant. The species is much allied to the *Ephedra dumosa* described in a preceding page.

9. *Ephedra Tweediana*, Fisch., Meyer, Mem. Acad. Petrop. v. 99. tab. 9;—ramis ramulisque oppositis, ramosis, erectiusculis, teneribus, subvirgatis, pallidis, striatis, subgranulosis, imo vaginatis, ad axillas nodosas subarticulatis, internodiis subelongatis; foliis oppositis, aut rarius verticillatim ternis, distinctis, imo linea transversali nexis, basi concavis, superne hyalino-membranaceis, acuminatis, et in setam longissimam filiformem terminatis: spicellis ♂ in quaque axilla solitariis, vel 2–3–4 glomeratis, sessilibus, oblongis, acutis, basi 4-bracteatis; involucellis per paria 4–5, imo nexis, decussatim imbricatis, ovalibus, crassiusculis, margine membranaceis, perigonio subæquilongis; antheris sæpius 3, interdum 4–5, sessilibus, oblongis, vix exsertis: spicellis fructiferis similibus, sed 2-plo majoribus, brevissime pedicellatis; involucellis majoribus et paulo crassioribus, pallidis, coriaceis, anguste marginatis; acheniis 2, navicularibus, pallide opacis, oblongis, gradatim angustioribus, apice obtuso perforatis, tubillo exserto, irregulariter lacerato.—In Provinciis Argentinis, *v. v.* Coro Corto (Prov. Mendosa) et Travesia de Mendosa, ♂ et ♀ (mihi lecta, anno 1826); *v. s. in herb. Hooker.*, Travesia de Mendosa (sub *E. Mendocensis*) et in Pampas (sub titulo *E. australis*) (Gillies); Patagones (Carmen, Rio Negro) in Prov. Buenos Ayres, ♂ et ♀ (Tweedie).

This species appears to have a wide range over the extent of the Pampas, in localities which are more or less saline. It has a branching ligneous root, from which numerous slender stemlets ascend, which throw off other occasional branchlets at the nodes, forming a shrub 1 or 2 feet in height, with somewhat longer branches which run along the ground or trail upon others for support. The opposite or verticillately disposed branches are slender, subflexuose, of a pale greenish colour, $\frac{3}{4}$ to 1 line diameter, with internodes 1 to $1\frac{3}{4}$ inch apart; the nodes are somewhat swollen, often articulate, and embraced by the bases of the leaves, which form opposite cup-shaped cartilaginous projections at each node, joined together by a transverse line; the leaflets are 3 lines long, subulate, suberect, with hyaline membranaceous margins, gradually diminishing into a long curved setaceous point. The male spikelets generally abound in the younger branchlets, where two or three are often crowded together in each axil; these are oblong, somewhat tapered, formed of about five pairs of decussately opposite involucels, each pair united at base into a short vaginant tube; the involucels are ovoid, slightly acute or obtuse, glaucescent, subfleshy, with a narrow membranaceous margin, each enclosing a petaloid perigonium of about their own length, which is campanulately tubular, compressed, and expanded into two broad rounded erect lobes, as long as the tube, imbricated in æstivation; the staminiferous column, scarcely exceeding the length of the perigonium, bears on its apex three to five crowded, erect, sessile anthers, which are 2-celled and open by two pores in the apex. In the specimen from Patagones, the number of anthers is constantly three, which number occurs in the other localities, but only occasionally. The fructiferous spikelets are on different specimens, and vary only from those of the male flowers in being generally solitary upon a very short pedicel in each axil, and are about double their size, being 3 lines long, 2 lines broad, gradually narrowing upwards, with about six pairs of involucels, the three upper pairs being the largest, and all barren except the last pair, which embraces $\frac{3}{4}$ of the length of the two terminal achenia; these involucels are greenish, and ultimately brown, 2 lines long, $1\frac{1}{2}$ line broad, and pointed: the achenia are fuscous brown, opake, broadest at base, gradually attenuated upwards, flat inside, with a somewhat sharp margin, rounded and carinated on the opposite face, their section being somewhat trigonous, 3 lines long, $1\frac{1}{2}$ line broad, the small obtuse apex being glandular and perforated; the tubillus is exserted, and irregularly lacerated, not disciform as Meyer has stated, although he figures it as I have described it*.

10. *Ephedra scandens*, n. sp.;—scandens, vage ramosa; ramis strictis, ramulis junioribus floriferis sæpe 4–12 verticillatis ex quoque nodo, gracilibus, subflexuosis, pallidis, striatellis, fere

* A representation of this species, with structural details, will be seen in Plate 78 B.

lævibus, internodiis longiusculis, ad nodos subarticulatis; foliis in axillis oppositis, imo inter se nexis et vaginatis, lobis brevibus, obtusis, membranaceis, serius disruptis et liberis: spicellis ♂ in quaque axilla 1–2–3 glomerulatis, sphæricis, capitulum globosum simulantibus; involucellis rotundatis, concavis, fusco-rubentibus, subcarnosulis; ramulis floriferis demum elongatis: spicellis fructiferis 1 ad 3 ex quaque axilla, longe pedicellatis; acheniis semiinclusis.—In Provincia Uruguay; *v. s. in herb. Hook.*, Banda Oriental (Tweedie, Baird), Parana et Entre Rios (Gibert, Nos. 9 et 75).

Tweedie describes this species as climbing to the tops of the loftiest trees of the forest; and Baird says it is used by the natives for dyeing a fine scarlet colour. The branchlets are slender, of a pallid green, not more than $\frac{1}{2}$ to $\frac{3}{4}$ line diameter, with internodes $1\frac{1}{2}$ to 2 inches apart. The leaves are very small and membranaceous, not exceeding 1 line in length. The male spikelets, generally about six, are crowded together in a capitate form around each node; the spikelets are subglobose, 1 to $1\frac{1}{2}$ line diam., composed of about five pairs of closely imbricated involucels, which are rounded above, and concave, somewhat fleshy, of a dark ruddy colour, and opake; the perigonium, of the same size, is of a reddish hue, beyond which six to eight bright yellow sessile anthers are exserted. The fructiferous spikelets, on distinct specimens, are usually solitary in each axil; each spikelet is supported on a very slender pedicel, 2 to 3 lines in length, which is deflected; it is acutely elliptic, 3 lines long, including the two terminal achenia, which are half-enclosed within the last pair of involucels; the involucels are in three imbricating pairs, with two pairs of bracts at base; they are oblong, rather obtuse, of a greenish-brown colour, becoming somewhat reddish, with a very narrow white margin: the achenia are acuminately oblong, trigonous, 3 lines long, $1\frac{1}{2}$ line broad; granularly striated, of a dark ruddy brown, with a somewhat 3-lobed white gland in the apex, which is perforated for the passage of the tubillus, this being scarcely exserted and lacerated at its apex*.

11. *Ephedra frustillata*, n. sp.;—nana, ramosissima; ramis ramulisque iterum ramosis, brevissimis, oppositis, vel sæpe 4-natim verticillatis, sulcatis, granuloso-asperatis, rufo-aurantiacis, singulis imo vaginatis; foliis axillaribus, oppositis, parvis, ovatis, concavis, rubescentibus, crassiusculis, margine vix marginatis, primum usque ad medium in vaginam 2-dentatam connexis, serius disruptis: spicellis ♂ in apice ramulorum ultimorum solitariis, sessilibus, subovatis; involucellis

* This species will be shown in Plate 79 A.

per paria 4–6, decussatim oppositis, et basi nexis, crebre imbricatis; perigonio 2-labiato, involucello 2-plo longiore, labiis adpressis, rotundatis; antheris 5, globosis, in columnam exsertam crebriter sessilibus.—Patagonia; *v. s. in herb. Hook. et Mus. Brit.*, Port Desire (Darwin).

A stunted shrub, apparently not more than 4 inches in height, with a repent caudex, out of which the somewhat ascendent branches originate, which immediately divide themselves at every half-inch distance into verticillated ramifications round each axil, the ultimate ones being floriferous, with a pair of short vaginant bractiform leaflets round each node, and a similar stipuloid sheath round the base of each ramification. They are all of a dull reddish orange-colour. The male spikelets are ovate, 2 lines long*.

XXVIII.—*On the Raphides of* Isnardia. By Prof. Gulliver.

Having, through the kindness of Mr. W. H. Baxter, of the Oxford Botanic Garden, received a fragment of a few leaves of an old dried specimen of *Isnardia palustris*, I have examined it, and find that, like its congeners *Epilobium*, *Œnothera*, and *Circæa*, it abounds in true raphides. They were easily detected, in the form of bundles, under a magnifying power of about one hundred and sixty, linear admeasurement, in bits of the leaf which had been macerated in water; and the needle-like crystals were also separately diffused through the water in which the leaf had been comminuted. This plant was the only one required to complete the series of observations on British Onagraceæ formerly made by me; and now it is certain that raphides are abundant and of similar shape in all our genera of this order. How well it is thus characterized may at once be seen by comparing a portion of *Epilobium* with a like part of *Lythrum*, when the profusion of raphides in the one plant and their absence in the other will plainly show the difference. This observation, in connexion with others given in the 'Annals' for January last, pp. 13–15, would appear to warrant the following conclusions:—

1. Raphides form a regular part of the healthy, growing, or perfect structure of several plants—from the ovary to mature parts, as stem, leaves, sepals, and testa,—contrary to the statement of Schleiden that "crystals are rarely met with in cells in a full state of vitality."

2. Crystals resulting merely from chemical changes connected

* A representation of this plant will be given in Plate 79 b.

with decay in the stem, bark, and other parts belong to a different category.

3. Numerous species and orders of plants are nearly or quite devoid of raphides as a regular part of the growing and healthy structure.

4. Certain orders may be so readily distinguished from their near allies by raphides alone, and this even in minute fragments of the leaf and other healthy parts, whether in the fresh or dried state, in the absence, too, of the flower and fruit, that the fact should henceforth be comprised in the descriptive characters of our plants of those orders.

5. Onagraceæ and Lemnaceæ have now been proved, as far as regards the British plants, to be such orders.

6. The common and abundant Willow-herbs and Duckweed, being thus very laboratories for the formation and collection of phosphate of lime, should be worthy of attention as valuable manure.

Edenbridge, March 2, 1863.

XXIX.—*On some new Genera and Species of* Umboniidæ *from the Seas of Japan.* By Arthur Adams, F.L.S. &c.

MM. Lesson and Valenciennes have made known *Umbonium giganteum* and *U. costatum* from Japan; and Gould has recently described *U. superbum*, found by Stimpson at Kagosima Bay. One species (*U. moniliferum* of Lamarck) is in estimation among the Japanese for the superior lime it furnishes; and the same species is sold in their shops, under the name of "Aru," for ornamental purposes, such as the manufacture of bracelets. *U. vestiarium*, L., so common in the north of China, is hardly met with in Japan, a few dead examples only having been detected by me at Tsaulian Harbour, which, although in the Sea of Japan, more properly belongs to the Korea.

But although, very naturally, the more conspicuous and brilliant species have been brought by travellers to Europe, yet there remain still unknown many smaller and more obscure forms of the family, some of which I now propose briefly to elucidate.

Genus Umbonium, Link.

1. *Umbonium vestiarium*, Linn.

Trochus vestiarius, Linn. Syst. Nat. ed. 12. p. 1230.
Rotella lineolata, Lamk.; *Rot. rosea*, Lamk.

Hab. Tsaulian.

2. *Umbonium giganteum*, Lesson.

Rotella gigantea, Less. Illust. de Zool. pl. 17.
Globulus giganteus, Phil.
Rotella aucta, Sow.

Hab. O-Sima.

3. *Umbonium costatum*, Valenc.

Rotella costata, Val. Kien. Sp. Conch. viv. pl. 11. f. 5.
Globulus costatus, Phil. Conch. Cab. pl. 7. f. 15.

Hab. Simoda; Hakodadi; Tsu-Sima; Tsaulian.

4. *Umbonium moniliferum*, Lamk.

Rotella monilifera, Lamk. Hist. des Ann. s. Vert. vol. vii. p. 8.
Rotella javanica, Lamk.
Globulus monilifer, Phil.

Hab. Nagasaki; Simoda; Tatiyama; O-Sima; Tago.

5. *Umbonium anguliferum*, Phil.

Globulus anguliferus, Phil. Conch. Cab. pl. 8. f. 3.

Hab. Simoda.

6. *Umbonium superbum*, Gould.

Rotella superba, Gould, Otia Conch. p. 156.

Hab. Kagosima.

Genus Microthyca, A. Adams.

Testa globoso-turbinata, late umbilicata, subporcellana, longitudinaliter rugoso-plicata; suturis canaliculatis; anfractibus ad suturas crenulatis. Apertura semicircularis, peritremate continuo; labio incrassato, arcuato; labro margine incrassato; umbilico crenulato.

1. *Microthyca crenellifera*, A. Adams.

Isanda crenellifera, A. Adams, Ann. & Mag. Nat. Hist. 1862.

Hab. Gotto Islands, 71 fathoms; Seto-Uchi, 17 fathoms.

In this curious little form, which I referred to *Isanda* (not having the type of that genus to compare with it), the peritreme is continuous, and the outer lip thickened—characters which prevent its being referred to any existing genus.

Genus Umbonella, A. Adams.

Testa globoso-conoidea, solida, porcellana, polita, anguste umbilicata. Apertura subquadrata; labio rectiusculo, antice dilatato; umbilico angusto, margine crenulato-rugoso.

1. *Umbonella murrea*, Reeve.

Turbo murreus, Reeve, Conch. Icon. sp. 54.
Isanda maculosa, A. Adams, Ann. & Mag. Nat. Hist. 1862.

Hab. Gotto Islands; 71 fathoms.

This genus is founded on a small, turbinate, porcellanous shell, which I described under the name of *Isanda maculosa*. There is, however, a figure in Reeve's Monograph of *Turbo* which seems to represent the same shell, and is called *T. murreus*. The nearest genus appears to be *Chrysostoma* of Swainson; but in that the aperture is circular, and the axis is imperforate.

Genus Ethalia, H. & A. Adams.

1. *Ethalia perspicua*, A. Adams.

Ann. & Mag. Nat. Hist. 1861.

Hab. Kino-O-Sima; Takano-Sima.

2. *Ethalia sobrina*, A. Adams.

Ann. & Mag. Nat. Hist. 1861.

Hab. Akasi, 17 fathoms; Tsu-Sima, 25 fathoms.

3. *Ethalia candida*, A. Adams.

Annals & Mag. Nat. Hist. 1862.

Hab. Gotto Islands, 71 fathoms.

4. *Ethalia polita*, A. Adams.

Ann. & Mag. Nat. Hist. 1862.

Hab. Gotto Islands, 71 fathoms.

5. *Ethalia omphalotropis*, A. Adams.

E. testa ovato-discoidali, alba, lævi, nitida, semidiaphana; spira elatiuscula; anfractibus $3\frac{1}{2}$, convexis, rapide accrescentibus, suturis impressis; anfractu ultimo ad peripheriam rotundato; umbilico aperto, margine valde carinato; apertura subcirculari; labio callo parvo umbilicum partim tegente.

Hab. Yobuko, 17 fathoms.

This species has a peculiar sharp keel surrounding the umbilicus. Like all the other examples of the genus, it is entirely devoid of coloured markings.

6. *Ethalia nitida*, A. Adams.

E. testa helicoidea, tenui, semiopaca, lævi, nitida, sordide alba; anfractibus $2\frac{1}{2}$, convexis, ultimo antice subdilatato, ad peripheriam rotundato; apertura subcirculari; labio in medio indentato, subcalloso, peritremate in angulo postico producto.

Hab. Yobuko, 14 fathoms.

A thin helicoid species, with the whorls smooth and polished, and the inner lip callous and indented, but not emitting a callus sufficiently large to cover or conceal the umbilicus. The peristome is produced into an angle, which ascends on the last whorl.

Genus Teinostoma, A. Adams.

1. *Teinostoma concentricum*, A. Adams.

T. testa orbiculato-ovata, superne convexa, alba, solida, semiopaca, sulcis concentricis confertis concinne insculpta, lineisque incrementi radiantibus subtilissime decussata; anfractibus rapide crescentibus, ultimo dilatato, ascendente, alios involvente vix usque ad apicem, peripheria rotundata, basi convexo; umbilico callo convexo lævi omnino obtecto; apertura subcirculari, antice vix producta.

Hab. O-Sima; Takano-Sima.

A solid, convex species, with the surface finely concentrically grooved—a peculiarity which distinguishes it from any of the species already known.

2. *Teinostoma radiatum*, A. Adams.

T. testa orbiculata, depressa, superne convexiuscula, basi subplana, semiopaca, alba, lineis incrementi radiantibus conspicue ornata; umbilico callo excavato angulato obtecto; anfractibus subito crescentibus, ultimo alios involvente usque ad apicem; apertura depressa, antice producta.

Hab. O-Sima.

This species is distinguished by its depressed form and the conspicuous radiating lines which proceed from the axis towards the periphery. The callus covering the umbilicus presents a sharp angular excavated edge near the inner lip.

3. *Teinostoma lucidum*, A. Adams.

T. testa oblique ovata, depressa, superne convexa, inferne planiuscula, alba, lævi, pellucida, striolis incrementi obsolete radiata; umbilico callo plano subcirculari opaco obtecto; anfractibus rapide crescentibus, ultimo ascendente, alios involvente usque ad apicem; apertura subhorizontali, depressa, antice producta.

Hab. Simoda.

This species differs from the others already described in being smooth and pellucid; the last whorl is also considerably more dilated anteriorly.

Genus Calceolina, A. Adams.

Testa neritiniformis, oblonga, depressa; spira parva; anfractibus rapide accrescentibus; regione umbilicali callosa. Apertura semicircularis, intus non margaritacea; labio callo magno-lato obtecto, postice umbilicum tegente; margine antico recto, simplici.

This little genus is established on a shell I found at Tanabe, and which I believe to be the same as the *Neritina pusilla* of

C. B. Adams. It seems to be most nearly allied to *Teinostoma*, with which my brother and myself have placed it in our 'Genera.'

Calceolina pusilla, C. B. Adams.

Neritina pusilla, C. B. Adams, Conch. Contrib. p. 112.
Teinostoma anomalum, H. & A. Adams, 'Genera of Recent Mollusca,' vol. i. p. 123. *Teinost. pusillum*, Append. p. 615.

C. testa albida, subopaca, superficie rugulis incrementi confertissimis striata; sutura valde impressa; anfractu ultimo depresso, magno, ad peripheriam compresso.

Hab. Tanabe, in shell-sand.

XXX.—*Notice of the Occurrence of a rare Cetacean* (Lagenorhynchus albirostris, *Gray*) *at the Mouth of the Dee.* By Thomas J. Moore.

On the 29th of December last, at daybreak, a fresh wind blowing from W.S.W., and the tide being about quarter-ebb, a large Cetacean was discovered stranded at Little Hilbre, one of two closely contiguous islands at the mouth of the Dee. It was observed by Mr. Barnett, Inspector of Buoys, who resides on the larger island, and who had noticed others off the shore a few days previously. I had urged Mr. Barnett, on the occurrence of such creatures, to endeavour to secure examples for this Museum; and he was, in consequence, kind enough immediately to proceed to the mainland for a suitable conveyance, into which it was carefully removed and brought to Birkenhead Ferry, and thence across the Mersey to this building. The creature was still living, spasmodically breathing at irregular intervals; the body was warm to the hand; and tear-like moisture oozed from its eyes as it lay quiescent in the cart.

I was desirous of giving it a fresh chance of life, and my first anxiety was to obtain a vessel large enough to form a bath for it. This I succeeded, after some delay, in securing; but, to my great mortification, the creature gave up the ghost (with considerable violence, too) at the very moment when we were prepared to remove him into it. It was then getting dark, and the poor animal had thus lived about eight hours out of water.

It was a male; and upon endeavouring to make out the species, I was agreeably surprised to find it approximate most nearly to the description of the White-beaked Bottle-nose (*Lagenorhynchus albirostris*), as given in Dr. Gray's 'Catalogue of Cetacea in the British Museum,' p. 99, and in the 'Zoology of the Voyage of the Erebus and Terror,' p. 35, the skull agreeing well with the figures in the latter work, pl. 11.

I subsequently sent the skull to Dr. Gray for comparison; and he confirmed my supposition of its being an individual of the species above named, namely, *L. albirostris*, which was founded upon a specimen taken at Great Yarmouth in October 1845, and recorded by Mr. Brightwell in the 'Annals' for 1846 (vol. xvii. p. 21, pl. 2), under the name of *Delphinus tursio.*

This addition to our local fauna is a matter of considerable interest, as its place of capture comes within the range taken by Mr. Byerley in his "Fauna of Liverpool," published in the 'Transactions of the Literary and Philosophical Society of Liverpool,' in 1854, and in which only two Cetaceans are recorded, namely, *Phocæna communis* and *Hyperoodon Butzkopf.*

The general colour is a rich black. A long and narrow greyish streak extends on either side diagonally across the ribs; and a similar greyish hue occurs on each side of the dorsal ridge, extending nearly from the fluke to the tail. The beak white, irregularly blotched with blackish, the white extending slightly above the constriction of the beak. The under jaw and throat milk-white, which colour extends along the belly, but becomes less clear as it approaches the vent. Its dimensions were as follows:—

	feet.	inches.
Total length from snout to cleft of tail	9	0
Length of gape	0	$10\frac{1}{2}$
,, of beak	0	$2\frac{1}{4}$
,, of under jaw beyond the upper ..	0	$\frac{1}{2}$
,, from snout to eye..............	1	$1\frac{1}{2}$
,, ,, to blow-hole	1	3
,, ,, to commencement of dorsal fluke	3	11
,, ,, to end of ditto	5	6
,, ,, to pectoral fin	1	9
Breadth of tail	2	5
Deflection of cleft of tail from a line drawn between its tips	0	$6\frac{1}{2}$
Girth in front of pectoral fin............	3	11
,, ,, dorsal fluke	5	0
,, behind dorsal fluke	4	3

The body becomes much attenuated towards the tail. Immediately in front of the dorsal fluke, the vertical and transverse diameters are nearly identical, the former being $31\frac{1}{2}$ inches, and the latter $30\frac{1}{2}$. Halfway between the end of the fluke and the commencement of the tail, the vertical diameter is 13 inches, and the transverse $6\frac{3}{4}$; and immediately before the commencement of it, the vertical diameter is $4\frac{1}{2}$ inches, and the transverse $2\frac{1}{4}$, or exactly one-half.

The dorsal fluke measures 24 inches along its convexity, and is 11 inches high. The pectoral fin, at its junction with the trunk, is 7 inches across, and its greatest length (diagonal) is 19 inches; measured round the curve, it is 21.

The eye is $\frac{7}{8}$ inch long by $\frac{1}{2}$ an inch. The orifice of the ear is $2\frac{1}{2}$ inches behind the eye in a slightly diagonal direction, and is less in diameter than a puncture by an ordinary pin. The transverse diameter of the blow-hole is $1\frac{3}{4}$ inch, and the longitudinal 1 inch, the points being directed forwards.

The skin has been stuffed, though with much difficulty, owing to its want of tenacity; and the contrast of colour is now almost imperceptible.

The skeleton is in maceration, and will shortly be mounted.

The dimensions of the skull are as follows:—

	inches.
Total length	$19\frac{1}{2}$
Length of nose	9
Width at orbit	10
„ notches	$5\frac{3}{4}$
„ middle of nose	$4\frac{1}{2}$
Length of lower jaw	$15\frac{1}{2}$
Width at condyles	9

Teeth $\frac{25}{23}$ $\frac{24}{23}$; curved, and acute where not slightly worn.

Free Public and Derby Museum,
Liverpool, Feb. 17, 1863.

XXXI.—*On the Geographical Distribution and Varieties of the Honey-Bee, with Remarks upon the Exotic Honey-Bees of the Old World.* By Dr. A. Gerstäcker*.

After a few observations upon domestic animals in general, and the difficulty attending their identification with any existing wild species, the author remarks that the mutual relation of the various races of Honey-Bees is less subject to doubt, since, notwithstanding that they have been described as distinct species by various authors, they really present no distinctive specific characters. Nevertheless, as with the other domestic animals, the native country of the Honey-Bee is unknown, as may be seen from the opinions expressed by the various entomologists who have written upon this subject. Latreille says of the supposed species of Honey-Bees, "One (viz. *Apis mellifica*, Linn.), which is predominant and most generally cultivated, probably originated in the north, also found in Barbary, &c."†, and therefore

* Abstract of a paper read to the eleventh 'Wander-Versammlung Deutscher Bienenwirthe,' Potsdam, 1862.

† Humboldt, Recueil d'Observations en Zoologie, p. 299.

believes that our northern Bee, from which he distinguishes the Italian Bee (*A. Ligustica,* Spin.), is probably indigenous to the North of Europe. This view is supported by Brun in his article on "Exotic Races of Bees"*, who regards the North of Africa as the southern limit of the Honey-Bee, and the centre of Europe as the centre of its existence. An opposite opinion was held by Lepelletier de Saint-Fargeau†, who says, "A native probably of Greece, and perhaps also of Anatolia, it has been transported over the whole of Europe, Northern Africa, &c." Kaden‡ thinks "that the native country of our Honey-Bees is to be sought under the hot zones, and that they have been introduced into Europe with some trouble;" and the latest writer on Bees, Von Berlepsch, regards this opinion as firmly established, saying §, "Our Bee is *demonstrably* indigenous in the hot southern countries of the Old World, where an almost perpetually serene sky enables it to bustle about in balmy airs through the whole year, with very little interruption. But at a very early period human civilization carried it into northern localities; and here, in consequence of the roughness and coldness of the climate, it is often compelled to remain for from three to six months in its dwelling,—contrary to its nature; for that so long a period of confinement is contrary to the mode of life originally impressed upon the Bee, opposed to its innate nature, is at once shown by the fact that it has no winter-sleep, like other allied insects indigenous to this country."

The grounds of these various opinions are easily discovered. Latreille, regarding the different races of Bees as distinct species, was evidently of opinion that each of these supposed species was indigenous in the country where it occurred; and Brun, following Latreille in considering the African Bees (*Apis fasciata,* Latr., from Egypt, *Apis Adansonii,* Latr., from Senegal, &c.) as distinct from *Apis mellifica,* Linn., erroneously placed the southern limit of the latter on the north coast of Africa. Lepelletier's opinion is evidently derived from the direction of European civilization; Kaden abstains from all evidence in support of his similar view; whilst Von Berlepsch endeavours to maintain it only by analogies which will not bear examination. Because the Wasps and Hornets, of which only females survive the winter, pass this season in a torpid state, there is no reason that Bees should do the same. The Bee must pass the winter in society, because the continuance of its existence depends upon this; hence it is impelled to lay up a supply of food against this

* Bienenzeitung, 1858, p. 37.
† Hist. Nat. des Hyménoptères, i. p. 401.
‡ Bienenzeitung, 1857, p. 214.
§ Die Bienen und die Bienenzucht: Mühlhausen, 1860, p. 461.

period, and is also endowed with the physical property of overcoming the cold by the close approximatien of numerous individuals. What countries are particularly meant by Von Berlepsch under the term "hot southern lands of the Old World" does not appear: if Italy be one of them, we have the evidence of Pliny* that in his time the Bees of Italy were quite inactive for sixty days, that they became more lively after the rising of Arcturus, but still fed for some time on their stores. Even if the expression be intended to refer to the tropical regions of Africa, the activity of the Bees would even here be interrupted, or at least much hindered, for several weeks, by the rainy season, which occurs twice in the year; so that the difference between their existence in southern and northern latitudes would consist solely in the different duration of the interruption of their activity. That such climatal or local differences in the mode of life of one and the same species are not necessarily to be ascribed to its artificial dispersion is shown by many insects of all orders.

But although the long interruption to the activity of the Bees in northern regions can furnish no sufficient reason for their not being indigenous there, on the other hand it is difficult to prove that they existed among us before the spread of civilization, however probable this may be; at any rate, the expression that the Bee has "demonstrably" been introduced here is certainly not justified. The author considers that we are still to regard this question of the origin of the Honey-Bee as in a state of complete uncertainty.

The solution of this question must be effected, if effected at all, by the examination of historical data, coupled with the investigation of the geographical distribution of the different varieties of the Bee, the latter acquiring increased value when the historical investigation leads only to negative results. If we cannot prove historically the transportation of the Bee from one country to another, neither have we the least certainty that no such transportation took place; and we can by no means rest contented with the assumption that the ancients never thought of the transportation of such an animal as the Bee; for we know that honey and wax were, among the ancients, indispensable articles, and also that in Egypt, Attica, and Italy the hives were carried from place to place, with the view of increasing their weight. That the common Bee was the animal described by the Greek and Roman authors under the names of *μέλισσα* and *Apis* cannot be doubted, as (with the exception of the *Bombi*) this is the only social honey-gathering Bee found in the parts of the Eastern hemisphere known to the ancients, the

* Hist. Nat. lib. xi. cap. 15; see also lib. xi. cap. 5.

Bees found in Italy and Egypt, in Greece and Asia Minor, being specifically identical with the *Apis mellifica*.

The intimate connexion of the Bee with the mythology of the ancients, and especially with that of the Greeks, furnishes a certain proof of the high value put upon this insect by them, and at the same time demonstrates that it must have existed amongst them from time immemorial. Of all those natural products which the Greeks represented their deities as making use of in Olympus, or regarded as direct presents from the deities to mankind, we may be sure that they were not introduced from without at any determinable historical period. The origin of the Bee is carried back by Nicander of Colophon to the age of Saturn, in which, as is well known, the earth "flowed with milk and honey." By others it is brought into immediate connexion with the youngest dynasty of deities, as especially in the narrative of Euhemerus of Alexandria, according to whom, at the birth of Jupiter, the Curetes performed an armed dance, by the noise of which the Bees produced on the Island of Ceos by the hornets and the sun were attracted into Crete, and induced to feed the new-born god with honey, which they collected as the dew of heaven. In gratitude for this, according to Diodorus, Jupiter afterwards gave them a bronze or golden-bronze colour; that is, he gave them the colour of the noblest metal. Ovid applies a somewhat similar myth to Bacchus*.

Whatever value these myths may possess as historical documents, the customs founded upon them and continued for centuries and perhaps thousands of years, and the representations (such as sculptures and coins) which have come down to us, may be taken as evidence of them. Thus we have, in historical times, the Nephalia, in which honey was offered as one of the costliest sacrifices; and figures of the Bee occur upon the coins of several Greek cities, and, amongst others, upon those of the Island of Ceos. From Homer we learn that the Bee, by its production of honey, was closely connected with daily life from a period of high antiquity; and, from the fact that Homer enters into such full details upon everything which appears somewhat out of the ordinary way, we may be sure that he would not have referred to honey so briefly as he does†, if both it and the insect producing it had not been of every-day occurrence, but introduced shortly before his time. Against such an introduction, which could only have taken place from Asia Minor or Egypt, we have also Cicero's statement that, in the time of Xerxes, the Attic honey of Mount Hymettus was celebrated even in Asia; and Xenophon's narrative‡ of the poisoning of his soldiers by

* Fasti, lib. iii. vv. 739–744.

† See Iliad, xi. v. 630.

‡ Anabasis, lib. iv. cap. 8.

honey "at Trebizond, where the people also had many bee-hives," seems to show that the Greek general was astonished at finding Bees kept by the barbarians. The antiquity of the culture of the Bee amongst the Greeks is shown not only by the laws of Solon, but also by an indirect reference in Hesiod, who, in verses 594, 595 of his Theogony, speaks of the "evil-doers," the drones, which the bees nourish in their "well-covered baskets," thus showing most clearly his acquaintance with the culture of the Bee.

Passing to Egypt, it is very remarkable that the Bee was either altogether omitted from the animal-worship of that country, or, at least, played a subordinate part in it. The Bee is not mentioned in Prichard's 'Analysis of the Egyptian Mythology.' Nevertheless some antiquaries, amongst others, Keferstein*, are of opinion that in the name *Apis*, given to the sacred Bull of the Egyptians, the sacredness of the Bee is indirectly indicated. However this may be, we know from the Old Testament that honey was used in the heathen sacrifices of Egypt—a custom which probably arose from the notion that it was necessary to offer to the sacred Bull what came from the Bull, it being a wide-spread superstition amongst the ancients that Bees were produced from the decomposing carcases of oxen. The domestication of the Honey-Bee in Egypt appears, at any rate, to be as old as this sacrifice of honey; so that its introduction into that country appears less probable than into Greece. The employment of the Nile by the Egyptians for obtaining an abundant harvest, which extends, as regards corn, to the most ancient periods, must have led to a similar proceeding in connexion with the cultivation of Bees. De Maillet† states, with regard to the latter, that Bees are very numerous in Egypt, and that a custom introduced by the ancients of sowing saintfoin as soon as the waters of the Nile leave the land uncovered, and sending the Bees from all parts of Egypt into Upper Egypt at the commencement of the season of flowering of the saintfoin, is still practised. The hives are packed in a pyramidal form upon boats specially adapted for their reception; in these they are conveyed up the river to the part where the flowers are earliest, and then gradually brought down the stream, stopping every two or three miles. As Greek civilization is generally supposed to have been influenced by the older civilization of Egypt, we may suppose that the custom prevalent in Attica in the time of Solon, of sending the Bees into favourable localities, was derived from Egypt; and upon this we may even found a second assumption, namely, that the Bees themselves may have been transported

* Oken's Isis, 1837, pp. 866 *et seq.*

† Descr. de l'Egypte, ed. Le Mascrier: La Haye, 1740, p. 117.

from Egypt into Greece in prehistoric times. These suppositions can neither be confirmed nor refuted absolutely; but, independently of the high antiquity of the Bee in Greece, the difference between the Egyptian and Greek races of Bees is such that the one could hardly have been derived from the other.

Among the Romans, according to Magerstedt*, the business of Bee-keeping occurs only at a comparatively late period; so that those who maintain the gradual transmission of the Honey-Bee from the south and east might here assume a transportal from Greece. This supposition may be supported by the fact that the Roman poets, such as Ovid and Virgil, in their myths place the origin of the Honey-Bee, not in Italy, but in Greece, which it might be concluded would not have been the case if the Bee had existed as long in Italy as in Greece. But such a conclusion is not admissible; for, just as the worship of the Romans accommodated itself to Greek views, and, indeed, based itself upon the Greek worship, so the myths and poetry of the Romans approached most closely to those of the Greeks. Nor does the late occurrence of Bee-keeping among the Romans furnish any support to the introduction of the Bee from Greece; for the constant wars of the Romans must have kept back all civilization even in Italy itself. It is, however, possible that the management of Bees, like many other occupations, may have been taught to the Romans by the Greeks, and perhaps practised chiefly by the latter. If, as Magerstedt's investigations prove, there was no Bee-keeping in Italy before the end of the second Punic war, and its considerable extension only dates from the time of Varro (B. C. 116), it seems very probable that it was introduced amongst the Romans by the Greeks, as the subjugation of Greece occurred between these two dates. In favour of this is Pliny's statement (lib. xi. cap. 9) that two Greeks, Aristomachus Solensis and Philiscus Thasius, busied themselves for a long time with observations upon Bees, and that the former did nothing for fifty-eight years but manage Bees.

The occurrence of Bees simultaneously in the South of Europe, Western Asia, and Egypt may not appear improbable to those who are inclined to ascribe to the Bee a southern origin. The comparatively slight diversity of climate in the above-mentioned countries certainly renders possible its original existence in all of them; and the opinions of authors differ essentially only on the one point, whether the Bee is indigenous to northern latitudes, or has been acclimatized under them. This question cannot be historically decided with absolute certainty; but it would

* Die Bienenzucht der Völker des Alterthums, insbesondere der Römer: 1851.

almost appear that the Bee existed in Northern Germany either originally or at least before any known direct intercourse of that region with Rome. Unfortunately, nothing is to be learnt upon this subject from Cæsar or Tacitus; but honey is mentioned by Diodorus Siculus*, a contemporary of Cæsar and Augustus, as being employed among the Gauls in the preparation of a beverage. Shortly after the time of Diodorus, we find in Pliny statements which, as they indicate with some degree of certainty the existence of wild Bees in Germany, are of more consequence in the present investigation. Pliny mentions† a swarm of Bees which settled in the camp of Drusus just before the successful battle near Arbalo; and in another place ‡, when speaking of the goodness of honey from different districts, he describes a remarkably large honeycomb from Germany, which was 8 feet in length. That the Bees producing this swarm and honeycomb could have been introduced by the Romans is negatived by the shortness of the time elapsed since their access to Germany, and still more by the habits of the Romans themselves; nor is any such introduction of Bees mentioned by Pliny, whilst his statements and those of Diodorus involuntarily show that the Romans, on their first acquaintance with Gaul and Germany, found the Bee already there. From the statements of Pytheas, quoted by Strabo §, indeed, it would appear that honey was known in Northern Germany (Thule) at a much earlier period, namely, in the time of Alexander the Great (B.C. 300). The position of Thule is doubtful; but Pytheas probably derived his information from merchants of Marseilles, who visited the shores of the Baltic in search of amber. The introduction of the Bee into these northern regions by voyagers, whether Phœnician or Massilian, although not impossible, is very improbable, from the character of those people and the difficulty of transport. Hence, weighing all the historical evidence, it seems more probable that the Bee is indigenous in Germany than that it has been introduced by civilization; and this view is supported by a still more important circumstance, namely, the difference of our northern race of Bees from those of the southern and south-eastern parts of Europe and the bordering parts of Asia and Africa. Since the introduction of the Italian Bee into Germany, it has been sufficiently proved that, when it does not mix with the dark-coloured northern Bees, it remains perfectly constant in its characters: consequently it would be quite impossible that, even after the lapse of many years, the unicolorous northern Bee should have been developed from the variegated Italian form.

* Bibliothecæ Historicæ lib. v. cap. 26.
† Lib. xi. cap. 18. ‡ Lib. xi. cap. 14.
§ Rerum Geographicarum lib. iv. § 5.

The necessity of such a development cannot be denied if the Bee was introduced, in accordance with the spread of civilization, into Germany from Italy. It is true that the dark-coloured German form of Bee occurs in some parts of Italy, especially on the east coast of central Italy opposite to Dalmatia; but as these Bees are far less widely distributed in Italy, and even in ancient times were much less valued than the variegated Bees, and as the latter, being diffused over Liguria and Lombardy, would have been most likely to be transported into Germany, there seems to be the very smallest amount of probability that the dark variety which occurs only sporadically in Italy should have been selected for transmission. The remarkable circumstance that, before the introduction of the variegated Italian race into North Germany, the two races were in contact in the region of the Alps, may furnish the best proof against the derivation of the dark from the light variety. Almost everywhere in Southern Europe, the Bees either (as in the south of Spain) exhibit a nearly complete agreement in colour with the German form or (as in Dalmatia, Greece, and Asia Minor) the most gradual transitions from the German to the Italian race; on the other hand, exactly where a transference might most readily be supposed, the differences of colour are most distinctly preserved. Hence the introduction of the Bee into Germany might rather be supposed to have taken place from Greece or the south of Spain than from Italy; but we have no proof of any traffic between those countries in ancient times.

Amongst the reasons which might be adduced in favour of the opinion that the Bee is not indigenous in Northern Europe, but introduced from the south, the first to be noticed is the great power of adaptation to external circumstances exhibited by the Honey-Bee where it is known to have been introduced, as in America, which renders the possibility of its southern origin and northern acclimatization indisputable; and had the Bee confined itself within the limits of the warmer parts of America, this would have been evidence in favour of that view. But, from the statements of Barton, Josselyn, and others, it appears that the parts of America which have proved most favourable to the spread of the Bee, and in which it has even become wild, are those under *the same isothermal lines* as Northern Europe (Germany and Sweden), namely, the central and northern States, up to 47° N. lat., showing that it cannot be regarded as peculiarly a native of the south.

As a second reason for the southern origin of our Bees, it may be said that, in our northern regions, they are rarely, and in many places never, met with in a wild state, whilst this is commonly the case in Southern Europe and also in Asia and Africa.

This argument would be of force if our northern countries were still in the same condition of cultivation as the more southern parts of the Continent; and we know from the Roman authors that, in ancient times, wild Bees occurred in the forests of Germany. As late as the year 1783, according to Krünitz*, the pursuit of the wild Bees was still followed in Neumark, Pomerania, Prussia, Lithuania, Courland, Livonia, Poland, &c., evidently because favourable localities still existed in those countries. If it be urged that, notwithstanding the change produced by cultivation, the Bees, if really indigenous to the north, might still easily, like the Humble Bees and Wasps, find a sufficiency of suitable localities for their hives, as well as of nourishment, it may be replied, in the first place, that they do become wild, although not frequently, under favourable circumstances; and in the second, that they are with us far more completely domesticated than in southern regions. Hence there seems to be no evidence, either historical or from the present distribution of the varieties of Bees in the temperate parts of Europe, in favour of their introduction into the latter from warmer regions.

The author next proceeds to the investigation of the geographical distribution of the Honey-Bee beyond the boundaries of Europe. From the want of special knowledge on the part of travellers, it is often impossible to determine from their writings whether, in mentioning Bees, our Honey-Bee is intended; so that an examination of specimens frequently becomes necessary.

It appears that our Honey-Bee does not occur, or, at least, has not been discovered as yet, in India and the Sunda Islands, but that over the whole of the rest of Asia, from the coast of Asia Minor to China, no other species except the *Apis mellifica* is found. The Honey-Bees mentioned in books of travels in India, Ceylon, &c., belong to species differing from the European Bee.

In Africa, on the contrary, *Apis mellifica* occurs in all parts, but no other species which can be confounded with it; a few small black species of *Melipona* from the Guinea coast, which also collect honey, differ so much from our Bee, both in size and colour, that an uninformed traveller would hardly regard them as Bees at all.

For the full elucidation of the geographical distribution of the Honey-Bee in Asia the materials are but scanty. According to Loew's personal observations, the Bee is everywhere domesticated, and at the same time very frequently found wild in trees, on the islands and continent of Asia Minor. Eight workers collected by him in Rhodes, and one from Ephesus, exhibit various

* Oekonomische Encyklopädie, 4. Theil, p. 418.

colorations, directly uniting our northern Bee with the Italian race, and partly even show (by the pale scutellum) a tendency towards the Egyptian race. Of two specimens collected by Thirk, near Brussa in Asia Minor, one is dark-coloured and approaches the Greek form; the other, again, which is considerably smaller and lighter in colour, resembles the Egyptian; and it is evidently to Bees resembling this that the statement of Aristotle (Hist. Anim. v. 19) refers: "In Pontus there are very light-coloured Bees, which make honey twice in the month." This statement is repeated in nearly the same words by Pliny (Hist. Nat. xi. cap. 19). With the last-mentioned specimen, one collected by Pallas in the Caucasus also agrees.

The occurrence of the Honey-Bee in Arabia and Syria is proved by five specimens collected in Syria and one in Arabia Felix by Ehrenberg; the latter agrees exactly with the Egyptian form; and the others approach it very nearly, only differing in being a little larger. The Bee described by Brun (Bienenzeitung, 1858, p. 38) as occurring domesticated in Circassia and Persia is probably identical with ours, although, from want of specimens, this cannot be stated with certainty, as the light-coloured race of Bees occurs under a corresponding degree of latitude, but much further to the east, namely on the Himalaya; this is proved by a specimen taken there by Hoffmeister, which agrees in all essential characters with those from Syria. Lastly, the extension of the Honey-Bee to the coasts of the Pacific is proved by a specimen from China, which cannot be distinguished from the Egyptian form except by the dark colour of all the hair on the vertex. This is the *Apis cerana*, Fabr.

With regard to the northern extension of the Honey-Bee in Asia, the author cites an oral statement of Ehrenberg's, that, during his journey through Siberia, he found Bees kept in hives near Riddersk, in the Altaï Mountains, lat. 51° N., long. 86° E. The northern limit is still to be ascertained: it seems probable that the Bee does not exist in the high northern latitudes of Siberia, as it is not mentioned in Erichson's catalogue of the Hymenoptera collected by Middendorf on the Boganida*.

Admitting the difficulty of determining on historical grounds whether the Honey-Bee is indigenous in those parts of Asia where it is found, or whether it has been introduced from the west, the author indicates that the forms of Bees there occurring do not, at least, contradict the notion that they may have been artificially dispersed. With the exception of Asia Minor, where the Bees are evidently of a mixed race, we find, over an extent of more than five thousand miles from west to

* Reise in den äussersten Norden und Osten Sibiriens, Zoologie, i. pp. 60 *et seq.*

east, only one and the same form of Bee, showing in particular places only extremely slight and probably accidental variations, and resembling the Egyptian form so closely that it may without difficulty be regarded as originating therefrom. Nevertheless this resemblance does not necessarily indicate genealogical affinity, as many other European insects (and, indeed, many Mammalia and birds) occur with a remarkably wide geographical range in Asia.

In Africa very different conditions prevail with regard to the races of Bees. Some districts lying under nearly the same latitudes exhibit very different forms; whilst, on the other hand, different varieties as to colour occur intermixed in the same localities. Thus in Algiers and Tangier, situated only about three hundred miles to the north of Egypt, there occurs a Bee perfectly identical in colour, hair, and size with that inhabiting North Germany; whilst in Egypt the form which is most distinguished from all others (*Apis fasciata*, Latr.) by its smaller size and light colour occurs, and apparently remains very constant in its characters. A form agreeing with the Egyptian in size and body-colouring, but differing in its darker hair, appears to be spread over the greater part of Central and Southern Africa, extending on the east coast from Abyssinia, through Mozambique and Caffraria, to the Cape of Good Hope, and occurring also on the west coast at the Senegal (*Apis Adansonii*, Lat.). It is very remarkable that at the Cape, together with this variegated form, all transitions to a nearly uniform dark one occur: the latter differ from the North German Bees only in smaller size—a peculiarity appertaining more or less to all the African Bees, with the exception of the Algerian. This uniformly dark form also occurs in Guinea together with a variety with light colour only on the anterior third of the abdomen, described by Lepelletier as *Apis nigritarum*, and, lastly, in the Mauritius and Madagascar, where, according to Latreille, it is constant in its dark colour (*Apis unicolor*, Lat.).

With regard to the diffusion of the Honey-Bee in Africa, the author cites the following statements from the writings of various travellers. In Algiers, according to Lucas *, the form agreeing with the northern one is everywhere abundantly distributed; it is kept in hives by the natives, and especially by the Kabyles. With respect to Egypt, the statement of De Maillet has been already quoted (p. 274) with regard to the sending the hives on boats along the Nile in search of a good store of nourishment. Niebuhr describes the proceedings of the Egyptian bee-keepers in precisely similar terms; whilst neither Ehrenberg nor Dr. Hartmann saw anything of the kind during their

* Explor. Scient. de l'Algérie, Zool. iii. p. 141.

travels in Egypt. The two latter agree in stating that in the countries situated to the south of Egypt, namely Nubia, Abyssinia, Sennaar, and Dongola, the keeping of Bees is certainly not extensively carried on, but that the honey and wax are taken when wanted from the wild Bees which build everywhere in abundance in clefts of rocks and hollow trees. On the other hand, Barth* mentions that he repeatedly met at least with a wild-bee keeping in the districts of Africa traversed by him. The first passage, relating to the neighbourhood of Kussada (between 12° and 13° N. lat., long. 8° E.), runs as follows:—"Vast *Adansoniæ* rose on every side with their immense naked branches, and also gave evidence of the industry of the inhabitants; for beehives, consisting of hollowed branches, were fixed in the summits of the Kuka. For bee-keeping this region appeared to be peculiarly adapted; for the pasture-ground, spreading far around, was adorned with sweet-smelling shrubs, which furnished nourishing food for the industrious Bees." In the second passage, describing the Mussgu-lands lying south-west of Lake Tchad, Barth mentions the same practice as prevailing in that district. Our information upon the occurrence of the Bee upon the west coast of Africa relates chiefly to Senegambia. Webb and Berthelot, indeed, mention the Honey-Bee as inhabiting the Canary Islands †; and as they call it *Apis mellifica,* without any further statement, it may be concluded that it agrees with the northern variety. Of the light-coloured variety found in Senegambia, which he regarded as a distinct species, named *Apis Adansonii,* Latreille says:—"Adanson found this insect on the Senegal, in the trunks of trees;" and Adanson himself (Voyage au Sénégal) reports as follows upon it:—"In the neighbourhood of Podor, I fully expected, every day about noon, to be visited by one, two, or more swarms of Bees, which made their way into the cabin and compelled me to leave the ship. This occurred from October to December at Podor; probably in these three months the Bees quit the old hives in order to construct new ones: hives are then found of great size. Once I saw the roof of a negro hut, measuring sixteen square feet, which was entirely covered more than four fingers thick with inhabited combs. This is, it seems to me, a sufficient proof of the incredible quantity of such insects in this country. They build everywhere, but chiefly in the hollow trunks of old trees. This year they had built three large hives in our dwelling at Podor—one between the window-shutter and

* Reisen und Entdeckungen in Nord- und Central-Afrika, ii. p. 105, and iii. p. 214.

† Hist. Nat. des îles Canaries, ii. 2; Entom. p. 84.

the window, and two upon the flat floors of small closets." Adanson adds that the honey of these Bees is peculiar, being always fluid, and resembling a brown syrup.

Olivier * gives, from the MS. notes of Geoffroy de Villeneuve, son of the author of the 'Histoire Naturelle des Insectes de Paris,' the following account of the Bees of Senegambia. In descending from Guisguis, according to that traveller, numerous trees are seen bearing beehives, which are well made with straw, and have only a very small opening. The negroes of this district collect the honey twice in the year. The first harvest is about the end of May, and is the richest; the second takes place at the beginning of December.

The occurrence of the Honey-Bee in the interior of South Africa is proved by Andersson and Livingstone. The former says †—"Wild Bees very frequently build their nests in the gigantic edifices of the White Ants; in many years they are very numerous. The temper of these insects seems to be unusually peaceable and patient; for I have never observed that the people, when robbing their nests, were stung by them. These nests are usually smoked first of all; but I have often convinced myself that the naked savages approach them without fear, and remove them without any precautions." Livingstone's account‡ runs as follows:—"Bee-keeping is practised in Londa; beehives are there found set upon trees in the most solitary woods. We often met waggons with large pieces of wax weighing from 80 to 100 pounds, and in every village such were offered to us for sale; but here (namely, on the Zambesi, 16° S. lat.) we never saw even a single beehive; the Bees were met with everywhere in natural cavities in the Mopané-trees. In many parts of the Batoka country, Bees exist in great abundance; and Sekeletu's tribute was often paid in large vessels of honey. I also saw a little wax in Quillimane, which was brought by the natives of this district."

The latter place is situated in Mozambique, which has already been indicated by the author as inhabited by Bees, from some specimens obtained there by Peters§. At the Cape of Good Hope "our Honey-Bee" was observed by Frauenfeld (Verhandl. der Zool.-bot. Gesellsch. zu Wien, 1860, p. 85); and there is no doubt that it is this species which is referred to in the following statement of Lichtenstein's, although he regards the Bee mentioned by him as belonging to a distinct species. He says—

* Enc. Méth., Insectes i., art. Abeille, p. 49.

† Lake N'Gami, or Explorations and Discoveries, &c., p. 132.

‡ Missionary Travels and Researches in South Africa, p. 614.

§ Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, V., Insecten, p. 439.

"A peculiar species of Bee which inhabits these heights [near Lange Kloof] prepares the most beautiful honey from the flowers of the *Brunia*, and stores it in hollow trunks of trees and the clefts of the rocks. The honey is perfectly white; and the waxen cells are so thin that during their collection they melt up with the honey, which may then be conveniently poured into a bottle. Its taste is so fine that I cannot imagine that of Hymettus to have been better. It is often collected and used instead of sugar by the colonists of Lange Kloof"*. Lastly, with regard to the dark Bee occurring in the eastern islands of Africa, namely Madagascar and the Mauritius, Latreille, who describes it as *A. unicolor*, speaks as follows †:—"The honey of this species has a greenish tinge when it is contained in the combs; its colour and excellence depend upon the diversity of the plants of those regions, and upon the temperature. The inhabitants of Madagascar have understood how to avail themselves of the industry of these insects; for we possess a memoir by M. de la Nux upon the form of the beehives which are in use there." Lepelletier's statement (Hist. Nat. Hyménoptères, i. p. 403), that this Bee has been introduced into the Mauritius, is contradicted by Grant's assertion (Hist. of Mauritius, 1801, p. 67), that the Mauritian Bee, which produces very fine honey, is indigenous to the island.

[To be continued.]

XXXII.—*On some Species of Tree-Snakes* (Ahætulla). By Dr. Albert Günther.

A. *The Subgeneric Division* Philothamnus, *A. Smith.*

The whole of Tropical Africa is inhabited by a group of Tree-Snakes which are distinguished by a habit which is not excessively slender; by a normally shaped head; by smooth scales; by posterior longer teeth, not separated from the others by an interval, and not grooved; by a round pupil of the eye; and by a green coloration, almost always varied by the black skin between the scales, and by white dots placed at the base of each scale. Species of this group have been named by Sir Andrew Smith *Philothamnus*, and three different kinds were distinguished by him—*Ph. semivariegatus*, *Ph. albovariatus*, *Ph. natalensis*. There can be no doubt that the second of these species is identical with *Dendrophis Chenonii*, Reinhardt, or with *Coluber irregularis*, Leach, of which we have the typical specimens.

At a later period, a similar Snake was described by Hallowell as *Chlorophis heterodermus*.

* Reisen in südlichen Afrika in den Jahren 1803 bis 1806, I. Band, p. 355.
† Annales du Muséum, v. p. 168.

The species named were evidently most closely allied to one another, and from the descriptions and figures alone it was almost impossible to find out which of the differences were of a really specific value; hence, although, in the 'Catalogue of Colubrine Snakes' (p. 152), I could not hesitate to refer *Ph. albovariatus* to its proper place as a synonym of *A. irregularis*, I withheld my opinion as to *Ph. semivariegatus* and *Chlorophis heterodermus*, of which I had seen no specimens, mistaking altogether the *Ph. natalensis*, which I have since recognized.

M. A. Duméril was in a still more difficult position than myself when he published his paper, "Reptiles et Poissons de l'Afrique Occidentale" (Archiv. Mus. t. x.), having for examination only the *A. irregularis* in the collection of the Paris Museum. Therefore we can hardly be surprised to find that, in his opinion, the three species of Smith would be distinct from *A. irregularis*, whilst *Chlorophis heterodermus* would be only a synonym.

In order to terminate this state of uncertainty, the attention of travellers and collectors has been directed to these Snakes; and having brought together nearly 100 specimens, with the localities whence they were obtained well marked, I have come to the following conclusions:—

1. *Coluber irregularis, Dendrophis Chenonii*, and *Philothamnus albovariatus* are synonyms of the same species, which is the most common of all.

2. *Philothamnus semivariegatus, Ph. natalensis*, and *Chlorophis heterodermus* are distinct species.

3. *Ahætulla hoplogaster* and *A. heterolepidota* are two new species.

4. All these species are distinguished from one another by at least two characters, which are constantly combined with each other; the number and shape of the temporal shields is subject to some variation, not only within the limits of the same species, but also on the two sides of the same individual.

Synopsis of the Species.

I. Ventral shields laterally keeled.
- A. Upper labials nine, three entering the orbit.
  - *a.* Anal bifid; ventral shields 164–177.... *A. irregularis.*
  - *b.* Anal entire; ventral shields 150–157 .. *A. heteroderma.*
  - *c.* Ventral shields 207; trunk with black cross-bands anteriorly.............. *A. semivariegata.*
- B. Upper labials eight (seven).
  - *a.* Two labials enter the orbit; ventral shields 151–168 .... *A. natalensis.*
  - *b.* Three labials enter the orbit; ventral shields 187 .... *A. heterolepidota.*

II. Ventral shields without a trace of lateral keels. Anal bifid.............................. *A. hoplogaster.*

Ahætulla irregularis.

Coluber irregularis, Leach, in Bowdich, Ashantee, App. p. 494.
Dendrophis Chenonii, Reinh., in Dansk. Vid. Selsk. Afh. x. 1843, p. 246, tab. 1. fig. 13, 14.
Dendrophis (*Philothamnus*) *albovariata*, Smith, Illustr. Zool. South Afr., Rept. pl. 65, and pl. 64. fig. 3.

Ventral shields with lateral keels; upper labials nine, three of which enter the orbit; temporal shields generally 1+2; frequently one or two are broken up into two, or the two hinder ones are united; in this case the temporal shields are generally not symmetrical on both sides. Anal bifid; ventral shields 164–167; subcaudals 108–126. Scales smooth, in fifteen rows, apparently with one apical groove. Teeth longest behind, in a continuous series. Green, skin between the scales black, each scale with a white spot on the basal half of its outer margin.

Western coasts of Africa (Fantee, Gambia, MacCarthie Island); Cape Colony. Two young specimens, which we refer to this species, were sent by Consul J. Petherick from Central Africa, 500 miles south of Chartoum.

Ahætulla heteroderma.

Chlorophis heterodermus, Hallowell, Proc. Ac. Nat. Sc. Philad. 1857, p. 52; Cope, *ibid.* 1860, p. 559.

Ventral shields with lateral keels; upper labials nine, three of which enter the orbit; temporal shields 2+2+2. Anal entire; ventral shields 150–157, subcaudals 83–92. Scales smooth, in fifteen rows, some with two apical grooves. Teeth longest behind, in a continuous series. Green, skin between the scales black; each scale with a white spot on the basal half of its outer margin.

We have received several specimens of this Snake from the Gold-coast.

Ahætulla semivariegata.

Dendrophis (*Philothamnus*) *semivariegata*, Smith, Illustr. Zool. South Afr. pl. 59, 60, and pl. 64. fig. 1.

Ventral shields with lateral keels; upper labials nine, three of which enter the orbit; temporal shields in two rather irregular longitudinal series. Ventral shields 207; subcaudals 112. Scales smooth, in fifteen rows. Green anteriorly, yellowish posteriorly; anterior part of the trunk with irregular, narrow, black transverse bars. Cape Colony (Bushman Flat).

Ahætulla natalensis.

Dendrophis (*Philothamnus*) *natalensis*, Smith, Illustr. Zool. South Africa, pl. 64.

Ventral shields with lateral keels; upper labials eight*, the

* Eight specimens, examined by myself, have eight upper labials; and

fourth and fifth entering the orbit; temporal shields 2+2+2; two are sometimes united into one. Anal bifid; ventral shields 151–168; subcaudals 114–126. Scales smooth, in fifteen rows, without apical groove. Teeth longest behind, in a continuous series. Green, skin between the scales black, each scale with a white spot on the basal half of its outer margin. Port Natal, and probably Cape Colony.

Ahætulla heterolepidota.

Ventral shields with very faint lateral keels; upper labials seven or eight, the third, fourth, and fifth, or the fourth, fifth, and sixth, entering the orbit; one anteocular, two postoculars; six of the lower labials are in contact with the chin-shields; temporal shields 1+1. Ventral shields 187; anal bifid; subcaudals 125. The scales are smooth, without groove, and with minute longitudinal striæ (these striæ are lost when the epidermis has gone off); they are arranged in fifteen series in the anterior half of the trunk, and in eleven in the posterior. The posterior maxillary teeth longest, in a subcontinuous series with the others. Head small; neck very slender; body and tail slender. Uniform greenish-olive.

A single specimen, marked "Africa," has been purchased; it is 26 inches long, the head measuring $\frac{1}{2}$ in., the tail $8\frac{1}{2}$ in.

Ahætulla hoplogaster.

Ventral shields without any trace of lateral keels; upper labials eight, the fourth and fifth entering the orbit; one anteocular, two postoculars; six of the lower labials are in contact with the chin-shields; temporal shields 1+1. Ventral shields 150–156; anal bifid; subcaudals 94–105. The scales are smooth, without groove, arranged in fifteen series anteriorly, and in eleven posteriorly. The posterior maxillary teeth longest, in a continuous series with the others. Head rather small, body and tail moderately slender. Green, skin between the scales black, each scale with a white spot on the basal half of its outer margin.

This Snake appears to be more common at Port Natal than *A. natalensis*. An adult specimen is 26 inches long, the head measuring $\frac{5}{8}$ in., the tail 9 in.

B. *On a new South American Species of* Ahætulla.

Ahætulla nitida.

Scales in fifteen rows, smooth, minutely striated, without

this also is the number shown in the figure of the entire Snake contained in Sir A. Smith's work. On the same plate, however, a separate drawing is given of the same specimen, showing nine upper labials: we cannot help thinking that this was an accidental variation of the normal number, that specimen having had eight labials on one side, and nine on the other.

apical groove. Head small, depressed, with the snout of moderate length, subtruncated in front; rostral shield rather broader than high; loreal not quite twice as long as high; præorbital reaching to, or nearly reaching to, the vertical; two postorbitals; nine upper labials, the fourth, fifth, and sixth of which enter the orbit; temporals 1+2+2; occipitals rounded, each with a larger rounded scale behind; six lower labials are in contact with the chin-shields. Eye rather large, with round pupil. Body very slender, compressed; tail very long, angular. Ventral shields 165, angularly bent on each side, the central portion being not much broader than long; anal bifid; subcaudals 153. The posterior maxillary tooth is the longest, not grooved, and is separated from the others by a short interspace. Above uniform metallic brownish-green, below greenish; scales on the back narrowly edged with black; one of the specimens has blackish dots on the crown of the head. No band either on the side of the head or of the body.

This species would enter the subgenus *Uromacer* of Duméril and Bibron.

The British Museum possesses two examples of this species, one from Demerara; the origin of the other is not known. The latter is 32 inches long, the head measuring 7 lines, and the tail 13½ inches.

XXXIII.—*On an undescribed Indigenous Form of* Amœba. By G. C. Wallich, M.D., F.L.S., &c. &c.

[Plate VIII.]

The occurrence of an undescribed variety of *Amœba* in the immediate vicinity of the metropolis is of interest both on its own account and from the indication it affords that the study of our indigenous Rhizopodal fauna is still unexhausted. The variety in question was recently obtained, in considerable abundance, from the ponds on Hampstead Heath; and inasmuch as every specimen examined by me has presented the very singular characters to which I am now about to draw attention, there is every reason to believe that these are normal, although perhaps not permanent in their nature.

According to the descriptions of the commoner forms—as, for example, *A. princeps*, *A. diffluens*, or *A. radiosa**—it would appear that the sarcode substance is uniformly differentiated into "endosarc" and "ectosarc." In other words, setting aside the elementary organs which may be said to be shadowed forth by the contractile vesicle, the nucleus, and the protoplasmic granular

* It will, I think, eventually be found that all these are mere transitory phases of one and the same species.

bodies, neither the outer layer of sarcode, nor the more viscid mass within, is endowed with a more advanced degree of development at one point than at another. And, in addition to this, the creature possesses the power of moving with equal facility in every direction, by means of pseudopodia projected indiscriminately from any portion of its surface.

In the variety under notice (see Plate VIII.) this is not the case, inasmuch as one portion of the ectosarc exhibits a structure differing permanently from the remainder—being densely studded with minute papillæ which, in the quiescent state of the creature, are of nearly uniform aspect and size, and cause the surface upon which they occur to resemble the villous structure of mucous membrane in outward appearance. When the animal moves, these papillæ or villi vary in length, and now and then several coalesce so as to form processes more nearly approaching the ordinary pseudopodial character, although still of minute proportions. The villous patch, which occupies probably from $\frac{1}{50}$th to $\frac{1}{70}$th of the entire superficies, appears frequently to be employed as a prehensile organ, the creature being enabled through its agency to secure for itself a continuous *point d'appui* from which the rest of the body is pushed or flows onwards, almost invariably in an opposite direction to that in which the villous patch is itself situated. The true pseudopodia would seem never to be projected from this area; but should a retrograde movement be about to take place, they are either thrown out from the adjacent portion of the ectosarc, or the main mass of the organism flows altogether in a backward course, the villous patch remaining fixed until it once more assumes its position at the posterior part of the advancing mass.

So powerful is the prehensile power referred to, that some of the papillæ at times become stretched beyond their endurance and are torn asunder; minute shreds being left adherent to the foreign bodies in the neighbourhood. Should the animal be subjected to pressure between the slide and glass cover, the papillæ may occasionally be seen to adhere to the polished surfaces, some relaxing their hold and taking up a position in advance, whilst those described as being stretched till they detach or break asunder are, in turn, moved onwards until they once more secure an attachment for themselves.

On the other hand, the pseudopodial processes and the rest of the ectosarc generally seem to exercise no prehensile power. In the one case the marginal layer is broken up into a delicate villous coat, the hyaline transparency of which is destroyed and replaced by a pale cream-coloured opacity; in the other it is perfectly hyaline, clearly defined, and unbroken. I have only in a very few instances been enabled to trace an influx of granular particles of endosarc within such of the coalesced villi as, from their size, rendered observation practicable.

As a general rule, the contractile vesicle and nucleus maintain a position close to the villous patch, even whilst the animal is moving—the former organ being in close proximity to it, and sometimes appearing to discharge itself, by the usual systolic action, at a spot within the villous surface. But now and then both nucleus and contractile vesicle move slowly round with the mass of circulating particles. The villous area, however, retains its position in relation to the rest of the body.

In some specimens the contractile vesicle presents an appearance of the most delicate reticulation, resembling that described as occurring on the external surface of *Actinophrys*, and depending probably on a similar cause, namely, the occurrence of a number of minute vacuoles. The contractile vesicles occasionally subdivide into several smaller cavities, as constantly happens in other forms; and these either coalesce prior to collapse, or they collapse separately. But no sinuses of the kind described by Carter in *Paramecium aurelia* and other Infusoria are discernible. Vacuoles are frequent, and in some cases of sufficient size to contain large diatoms.

The nucleus consists of a pale grey-coloured spherical mass of granules, towards the centre of which may occasionally be detected a minute clear nucleolus. It is contained within a hyaline and somewhat elongated vesicular cavity, but never occupies the entire area of the latter.

Dilute alkaline and acid solutions cause the body at once to assume a more or less spherical shape, and the granular contents to close up into a central mass, leaving a broad hyaline border around the entire surface, as described by Auerbach in *Amœba bilimbosa*. But these reagents fail to render apparent anything like the double outline, indicative of a definite membranous envelope, alluded to by that author. It is worthy of note, however, that, under imperfect adjustment of focus or want of due care in illumination, the *semblance* of a double outline can be evoked.

Some of the specimens of the Hampstead *Amœba* are of extraordinary dimensions, the largest attaining a diameter of no less than $\frac{1}{50}$th of an inch. The villi, in their quiescent state, seem to be about $\frac{1}{15000}$th of an inch in average length.

In a solitary example, the villous patch constituted a nearly circular brush-like tuft at the extremity of a cylindrical pedicle of hyaline sarcode; and at its centre was a minute vacuole-like space. I kept my eye on this specimen for nearly a quarter of an hour without perceiving this structure alter in anywise,—the prehensile power of the villi seeming to be either suspended or destroyed, and both brush-like tuft and pedicle being dragged behind the *Amœba* during the entire period. Unfortunately the drying-up of the water on the slide put a stop to my observation at this point.

With regard to the specific value of the characters of this form, I think it unadvisable at present to express a decided opinion. Several circumstances render it probable that it may be a transient phase in the life-history of the common *Amœba*. Amongst the principal of these I may mention having detected traces of a like villous structure in specimens obtained from other localities. But, whether the Hampstead form eventually proves to be a distinct permanent type or otherwise, the characters referred to are of high interest as evincing a nearer approach, than any heretofore noted amongst the Rhizopods, to the structure of the ciliary legs of certain Infusoria, as, for example, of *Plœsconia* or *Kerona**. They also tend to confirm the view put forward by MM. Claparède and Lachmann with reference to the "reptant" nature of the motion of *Amœba*, and the consequent suggestion of Dr. Carpenter regarding the probable differentiation of the ectosarc into a ventral and dorsal portion. According to present experience, "reptation" takes place in forms endowed with this more highly developed state of a portion of the ectosarc, whilst the motion is of a simple "rolling" or flowing kind in those forms in which the ectosarc is uniformly developed at all points.

The Hampstead form corresponds in every important particular with one found by me in Lower Bengal in 1856, in which the villous portion of the ectosarc constitutes a means of permanent attachment to foreign bodies such as Confervæ or the like; and the animal appears to be normally sessile in its habits†.

In conclusion, I may mention that a week has passed since the supply of these *Amœbæ* was obtained at Hampstead, and that they retain the characters above described in an unimpaired degree to the hour at which I write.

EXPLANATION OF PLATE VIII.

[Figures 1 to 5 magnified about 400 diameters.]

Fig. 1. *Amœba* in quiescent or nearly quiescent state: *a*, villous patch; *n*, nucleus; *c*, contractile vesicle; *v*, vacuoles‡.

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* See Carter's observations on these forms in the 'Annals and Magazine of Natural History, 3rd series, vol. iii. p. 241 *et seq*.

† This variety is figured in Part I. of my 'North Atlantic Sea-Bed,' pl. 4. figs. 13 & 14.

‡ Each letter applies to the same portions of the structure in the several figures. The arrows indicate the direction in which the animal is supposed to be advancing.

Fig. 2. Showing the appearance of the *Amœba* when moving slowly, the villi being employed as organs of prehension.
Fig. 3. The same, when advancing energetically, the villous patch being aggregated into a subspherical tuft, and the contractile vesicle and nucleus now sharing in the general protoplasmic circulation.
Fig. 4. A specimen with two large *Pinnulariæ* in its interior, the upper of the two frustules being enclosed within a large vacuole.
Fig. 5. A specimen in which the villous patch has assumed a brush-like shape, and is supported on an elongated pedicle of sarcode; 5 *x*, an enlarged view of this tuft and its supporting pedicle.
Fig. 6. Enlarged view of granular nucleus, nucleolus, and the nuclear vesicle or cavity.
Fig. 7. Contractile vesicle, showing appearance of reticulation.

BIBLIOGRAPHICAL NOTICES.

The Land and Freshwater Mollusks indigenous to, or naturalized in, the British Isles. By Lovell Reeve, F.L.S. Reeve & Co., 1863.

Only a few months have elapsed since we had occasion to notice the publication of the first volume of a new work by Mr. Jeffreys, on British Conchology, which treats of the Inland Mollusca; and already another handbook on the same subject lies upon our table.

The valuable illustrated works on 'Conchology' by Mr. Reeve are well known, and more especially his splendid 'Conchologia Iconica;' but, until we read the announcement of the intended publication of the work which we are about to review, we were not aware that the author had paid any special attention to the Mollusca of our Islands. We cannot therefore expect to find in this volume the same mass of interesting detail which long years of patient and special study have enabled Mr. Jeffreys to condense in the pages of 'British Conchology.' On the other hand, however, 'The Land and Freshwater Mollusks' is more fully illustrated, and the woodcuts of all the species offer an attraction which Mr. Jeffreys's volume does not possess.

The animals are engraved by Mr. O. Jewett, some from original drawings, while others are reproductions of previously published figures. The original drawings from the life, which may be recognized by Mr. Jewett's autograph, are admirable. We were not previously acquainted with this artist's name as a natural-history draughtsman; but such life-like and characteristic figures as those of *Limax Sowerbyi, flavus,* and *cinereus, Helix aspersa, Planorbis corneus, Paludina contecta, Dreissena polymorpha, Anodonta cygnea,* and *Unio tumidus* raise him to a high position among delineators of Mollusca. Unfortunately the same praise cannot be bestowed on Mr. Sowerby's figures of the shells; for while the woodcuts of the larger species are generally good, no trouble appears to have been bestowed upon the smaller and closely allied species; and thus in those very instances where accurate illustrations were most desirable and would have been of most value, we meet with engravings which are not only worthless, but calculated to mislead.

We may mention, as examples of this carelessness, all the *Zonitæ*, but especially *crystallinus, Helix pulchella, rupestris, pygmæa, rotundata*, &c.

It is with much regret that we notice the numerous changes in nomenclature which Mr. Reeve seeks to introduce, changes in almost every instance uncalled for, in many cases actually wrong. Obsolete names, originally appended to descriptions of Mollusca so loosely and inaccurately defined as to apply with equal truth to many species, are here dragged forward from their merited oblivion, and made to supersede names which have been familiar to European conchologists for the last half-century. It is impossible to criticise all the changes thus made; but let us examine those that are introduced into a single genus: let it be *Planorbis*.

Planorbis imbricatus is changed to *Planorbis crista*, on the authority of the following synonymy:—

Nautilus crista, Linnæus (1758), Syst. Nat. 10th edit. p. 709.
Turbo nautileus, Linnæus (1767), Syst. Nat. 12th edit. p. 1241.

And the author remarks—"It may be observed on reference to the synonymy, that Linnæus made two species of this." But Linnæus did not make two species out of *Planorbis nautileus*. The facts are that he described *Nautilus crista* in the tenth edition of the 'Systema Naturæ;' and in the twelfth edition changed the name of the species to *Turbo nautileus*, and referred to his *Nautilus crista* of the tenth edition as a synonym. We can only account for Mr. Reeve's mistake by supposing that he has never consulted the twelfth edition—a supposition which is confirmed by the fact that throughout his volume the tenth edition is almost invariably referred to. It is the twelfth, however, which embodies the most matured views of the great naturalist, and has therefore always been justly held to be the standard edition of his works; and it is for this reason that the name *nautileus* has universally been adopted. Few of Linnæus's species are identified moreover with the same degree of certainty as this little shell; for specimens are still to be seen in the Linnæan cabinet enclosed in a small paper envelope on which the name is written at full length.

Planorbis marginatus (Drap.) is changed to *P. complanatus* (L.). Yet no one, from Linnæus's time to our own, has been able to say to what species the brief description of *Helix complanata* was intended to apply. Müller, in his description of *Planorbis umbilicatus* (*P. marginatus*, Drap.), wrote in 1773 (only six years after the publication of 'Syst. Nat.' 12th edit.), "Satis diu hæsito an hic *Planorbis* Linnæi, an *complanatus* auctorum dicatur, et descriptiones me dubium adhuc relinquunt; quid quod, hunc et *Planorbem* confudisse videntur, et sequens forte erit eorum *complanatus*. In tantis difficultatibus has tricas solvendi, ipso Linnæo litteris frustra consulto. Planorbem et complanatam, nomina generi toti propria, oblivioni dandos, descriptiones et nomina aptiora magisque significantia effingenda reor." And again, in the description of *Planorbis nitidus*, the same author observes, "An *H. complanata* Linnæi, haud liquet." Mr. Hanley, in his 'Ipsa Linnæi Conchylia,' expresses his belief that Linnæus included both *Planorbis carinatus* and *marginatus* under the name *Helix planorbis*, and that *Helix complanatus* is synonymous with *Planorbis nitidus*, Müller. "'Deorsum carinata,'" he observes, "is equally applicable to *nitidus*" as to *marginatus*; "whilst 'supra convexa—subdiaphana—apertura semicordata' (Fauna Suecica) is much more critically correct when affirmed of that little shell than of its larger rival; and as 'parva admodum' is applied to it in the 'Fauna Suecica,' in the contrast of its features with those of the preceding species, I feel no hesitation in asserting the identity of *nitidus* with the Linnæan *Helix*." Surely Müller was right, when he said of such names (impossible to be identified with the species they were intended to represent), "oblivioni dandos reor."

The chief confusion, however, which Mr. Reeve introduces into the genus *Planorbis* is by his adoption of the views of Moquin-Tandon respecting the *Planorbis nitidus* of Müller. That name is here applied to *Planorbis* (*Segmentina*) *lineata* (Walker); while the shell which has hitherto been known to British conchologists as *Planorbis nitidus* is called *P. fontanus* (Lightfoot). Now, on what grounds is this change made? Müller's description of the species in his 'Historia Vermium' is very full, and agrees most accurately with *P. fontanus* until we reach, at the end, this sentence, "Ultra quinquaginta examini subjeci, quorum quidam strigis duabus ligamentorum instar in superna parte extimæ spiræ, forte ex restauratione fractæ testæ, notantur." Now what does this sentence prove, but that the *majority* of the shells he examined were *Planorbis fontanus*? to which species therefore his name should be applied. It is quite possible, though far from certain, that the author confused the two species, and that "quidam strigis duabus ligamentorum instar" has reference to specimens of *P. lineatus*; but such specimens were described as the variety, while *P. fontanus* is clearly the type of the species. And this becomes more evident when we find all allusion to the variety omitted in the subsequently published 'Zoologiæ Danicæ Prodromus,' the description in which work applies only to the type.

Mr. Reeve describes 128 species. His estimate of our land and freshwater Mollusca differs from that of Forbes and Hanley in the omission of *Helix aperta*, and the addition of *Testacella Maugei*, *Vertigo Moulinsiana*, *Conovulus Myosotis*, *Cyclas pisidioïdes* and *C. ovalis*. And as compared with the species described in Jeffreys's work, we find *Anodonta anatina* and *Pisidium roseum* omitted, and *Testacella Maugei*, *Pisidium obtusale*, *Casertanum* (*cinereum*) and *Henslowianum*, and *Cyclas pisidioïdes* added. Moreover Jeffreys considers that *Hydrobia ventrosa* has a claim to be inserted as a freshwater shell. But Reeve denies the species a place; while, on the other hand, he admits the *Conovuli* and *Assiminia Grayana*, which are rejected by the former author.

Mr. Reeve gives a map, in which, by a deeper or lighter tint of colour, it is intended to show the boundary of the Caucasian province of Mollusca, over which the British species range, and to indicate the part in which the most characteristic of the genera and species congregate. Two tables also show the distribution, in Great Britain and abroad, of the several genera and species; and a short chapter on the "Distribution and Origin of Species" concludes the volume.

Geological Observations in South Australia; principally in the District south-east of Adelaide. By the Rev. JULIAN EDMUND WOODS, F.G.S., &c. 8vo. Longman, 1862.

"EVERY country has its history, not alone the history of what its inhabitants said and did, nor how its people lived, conspired, quarrelled, fought, and died, but a history which stretches further back and is buried in more remote antiquity. If it had not been so, Australia might indeed be counted the youngest as well as the least interesting of continents. She has had no people that could describe her vicissitudes, and there are no monuments left to chronicle her changes; but yet her history is written in an imperishable record. Of old, when the first explorers came upon the coast of a newly discovered territory, the rocks, the trees, the soil, and the verdure only spoke to them of one thing, namely, of fertility, or richness, or special adaptation to the wants of man. But now the very coast-line tells much more. Not only is the fertility or barrenness of the place itself told by the rocks, but the explorer is able to guess how far these appearances extend, and whether the country is likely to be fitted for human requirements in the present state of civilization."

These are our author's preliminary observations in his Chapter II.; and he follows them up, 1stly, by pointing out the evidences of former and different physical conditions presented by the existing geographical features of Australia generally; 2ndly, by giving in detail an account of the limestone-beds that form the plains of a great part of Southern Australia, and perhaps of Tasmania, describing their probable origin in a sea occupied by reefs of Bryozoa, as some seas now are by corals; 3rdly, by treating of the extinct volcanos of Mount Gambier and its vicinity, and of their individual and general history; 4thly, by describing the caverns in the limestone of the district under notice, and the undergound drainage in connexion therewith.

The conclusions that the author draws from his observations on the geology of the colony are as follows:—

"I. There has been in Australia an immense area of subsidence during the Pliocene period, at a time when Rome, parts of Italy, Vienna, and parts of Austria, Piedmont, and Asia Minor were under the sea. II. This subsidence was accompanied by a [moss-] coral formation, very similar to the subsiding area of the Pacific at the present time; and although all the appearances are those of a reef of true zoophyte corals, the predominent fossil is a massive *Cellepora,* while true corals are rare. III. This gives rise to the suspicion that *Bryozoa* may build reefs and atolls, as well as true Corals. IV. That the subsidence ceased; and probably about that time volcanic disturbance commenced, and gave rise to submarine craters. V. That, after the cooling of the lava from these submarine craters, a deposit of small fragments of shells was thrown down from an ocean-current. VI.

That this became hardened into stone, and was then upheaved from the sea; during which process large portions of it became washed away. VII. That the latter part of the upheaval was separated by a long lapse of time from the subsidence, because the latter strata show some difference in their fauna. VIII. That while upheaval was going on, until very recently, extensive volcanic disturbance took place, giving rise to craters which are now all extinct. IX. That the upheaved [Bryozoan] rock, when decomposed, has given rise to a very different sort of soil, of a sandy character, which causes large tracts of arid, useless country in this part of Australia. X. That the same rock, being of a loose texture, easily allowed water to percolate through, forming caves and underground passages, besides honeycombing the ground in all directions. XI. That, while these operations proceeded, the animal life was of a slightly different character from what is found in the same locality now, though probably the land-animals were not specially different from individuals in other parts of the Australian continent." Lastly, that "these numerous changes seem to have taken place without any vast convulsion of nature, or phenomena different from what happen in the world now."

In discussing the many geological and natural-history points of interest that occur in his work, the author, himself an amateur, often freely explains the elementary basis of his several lines of argument, quoting Lyell, Darwin, Jukes, and others, for the information of his readers as to geological systems, the theories of coral-formations, the nature of coral-reefs, &c.; and his book, thus popularly written, is rendered more readable for the general public than if written with strict technicality; but at the same time we miss a requisite scientific accuracy, especially as to zoological nomenclature and classification, without which no geological work can have a high scientific value,—though certainly a hard-working amateur in so distant and isolated a position as Penola must surely be excused for this short-coming.

Some observations by Mr. Woods on extensive recent accumulations of minute organisms, such as *Cypridæ*, *Diatomaceæ*, and *Charæ*, and of mammalian bones and of lake-shells in South Australia, are to be found in Chapter III., and must prove highly suggestive to geologists. The notes on the bone-breccia and accumulations of bones in caves, in Chapter XI., will also attract attention. The author's explanation of the origin of the limestone "Biscuits" of the "Honeysuckle flats" (pp. 43–45) is very ingenious; and his other numerous observations on the physical features of the district, which have been "the occupation of many a passing hour in the bush, where amusements are otherwise few," are full of interest and value.

In his Introductory Chapter and elsewhere, the author has taken care to point out what others have already done in explaining the geological features of Southern Australia; but he has overlooked the little work 'On the Geology and Mineralogy of South Australia,' by Mr. T. Burr, published at Adelaide in 1846.

Transactions of the Linnean Society of London, Vol. xxiv. Part 1. 1863.

Thanks to the exertions of its late excellent President (Prof. T. Bell) and his successor (Mr. G. Bentham), the Linnean Society appears quite restored to its pristine activity. In addition to the usual annual publication of the quarto 'Transactions' in the autumn of 1862, and the ordinary quarterly 'Journal,' it has lately issued another part of the 'Transactions,' in order to bring as quickly as possible to the knowledge of botanists the exceedingly valuable paper by Dr. Joseph D. Hooker "On *Welwitschia,* a new Genus of Gnetaceæ." This paper occupies the whole of the part, extends to 48 pages, and is illustrated by 14 plates. We think this proceeding in the highest degree creditable to the Society. When such a paper is brought before it, it does well to deviate from its usual course. The present essay has attracted the utmost attention from botanists. Probably nothing of equal botanical interest has appeared since the publication of Robert Brown's papers on *Rafflesia,* in the thirteenth and nineteenth volumes of the same 'Transactions.'

The first notice of *Welwitschia* was sent to Sir W. J. Hooker by Dr. Fred. Welwitsch, its discoverer, in a letter from Loanda in South Africa, dated Aug. 16, 1860, which was soon followed by the dispatch of specimens to Kew. This singular plant never possesses more than the same two leaves, although it seems to be very long-lived. These leaves appear to be the cotyledons, which, instead of fading, as is usual, and giving place to ordinary leaves, are permanent, and attain to a length of six feet and a breadth of two. They are hard and leathery, and in the course of time split into longitudinal strips. They spring from a groove situated between the crown and stock of the plant, and lie flat, or nearly so, upon the ground.

This is the only example of a "perennial flowering plant which at no period has other vegetative organs than those proper to the embryo itself, the main axis being represented by the radicle, which becomes a gigantic caulicle, and developes a root from its base and inflorescences from its plumulary end, and the leaves being the two cotyledons in a very highly developed and specialized condition." The venation of the leaves is "parallel and free, like that of Monocotyledons in general appearance; but there is a total absence of lateral vascular communications between the bundles," as in many Coniferæ.

Its male flowers are structurally hermaphrodite, but their naked ovule is always abortive. It seems therefore probable that the plant is truly diœcious. Dr. Hooker considers its female flowers as gymnospermous, but that the plant is rather intermediate in character between gymnospermous and angiospermous plants.

We feel sure that many of our botanical readers will hasten to peruse this remarkable essay, which is a permanent monument of the high attainments of its author, such as it seldom can fall to the lot of even a Hooker to obtain.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Feb. 5, 1863.—Major-General Sabine, President, in the Chair.

"On the Embryogeny of *Comatula rosacea* (Linck)." By Prof. Wyville Thomson, LL.D., F.R.S.E. &c.

After briefly abstracting Dr. W. Busch's description of the early stages in the growth of the young of *Comatula*, the author details his own observations, carried on during the last four years, on the development and subsequent changes of the larva. After complete segmentation of the yelk, a more consistent nucleus appears within the mulberry mass still contained within the vitelline membrane. The external more transparent flocculent portion of the yelk liquefies and is absorbed into this nucleus, which gradually assumes the form of the embryo larva, a granular cylinder contracted at either end and girded with four transverse bands of cilia. This cylinder increases in size till it nearly fills the vitelline sac, gradually increasing in transparency, and ultimately consisting of delicately vacuolated sarcode, the external surface transparent and studded with pyriform oil-cells, the inner portion semifluid and slightly granular.

The vitelline membrane now gives way, and, usually shortly after the escape of the larva into the water, the third ciliated band from the anterior extremity arches forwards at one point; and in the space thus left between it and the fourth band, a large pyriform depression indicates the position of the larval mouth. At the same time a small round aperture, merely separated from the posterior margin of the mouth by the last ciliated band, becomes connected with the mouth by a short loop-like canal passing under the band, and fulfils the function of an excreting orifice. A tuft of long cilia, which have a peculiar undulatory motion, is developed at the posterior extremity of the body. The larva now increases rapidly in size, assuming somewhat the form of a kidney bean, the mouth answering in position to the *hilum*. It swims freely in the water, with a swinging semi-rotatory motion, by means of its ciliated bands and posterior tuft of cilia.

Shortly after the larva has attained its definite independent form, ten minute calcareous spicula make their appearance, imbedded within the external sarcode-layer of the expanded anterior portion of the larva. The ten spicula are arranged in two transverse rings of five, the spicula of the anterior row symmetrically superposed on those of the posterior. By the extension of calcareous network, these spicula rapidly expand into ten plates, which at length form a trellis enclosing a dodecahedral space, open above and below, within the anterior portion of the zooid. Simultaneously with the appearance of these plates, a series of from seven to ten calcareous rings form a chain passing from the base of the posterior row of plates backwards, curving slightly to the left of the larval mouth, and ending by abutting against the centre of a large cribriform plate, which is rapidly developed close to the posterior extremity of the larva. Delicate sheaves of anastomosing calcareous trabeculæ shortly arise within these rings, and the series declares itself as the jointed stem of the pentacrinoid stage, the basal and first interradial plates of the calyx being represented by the already formed casket of calcareous network. The skeleton of the Crinoid is thus completely mapped out within the body of the larva, while the latter still retains its independent form and special organs.

Within the plates of the calyx of the nascent Crinoid two hemispherical or reniform masses may now be detected,—one superior, of a yellowish, subsequently of a chocolate colour; the other inferior, colourless and transparent. The lower hemisphere indicates the permanent alimentary canal of the Crinoid, with its glandular follicle; the upper mass originates the central ring of the ambulacral system, with its cæca passing to the arms. The body of the Crinoid is, however, at this stage entirely closed in by a dome of sarcode, forming the anterior extremity of the larva. After swimming about freely for a time averaging from eight hours to a week, and increasing rapidly in size till it has attained a length of from 1 to 2 millims., the larva becomes sluggish, and its form is distorted by the growing Crinoid. The mouth and alimentary canal of the larva disappear, and the external sarcode-layer subsides round the calcareous framework of the included embryo, forming for it a transparent perisome. The stem now lengthens by additions of trabeculæ to the ends of the joints. The posterior extremity dilates into a disk of attachment. The anterior extremity becomes expanded, then slightly cupped; the lip of the cup is divided into five crescentic lobes corresponding to the plates of the upper ring; and finally five delicate tubes, cæca from the ambulacral circular canal, are protruded from the centre of the cup, the rudiments of the arms of the Pentacrinoid. At some stage during the progress of these later changes the embryo adheres, and at length becomes firmly cemented to some permanent point of attachment.

The author states his views as to the morphological and physiological relations of the larval zooid. He believes that all the peculiar independently organized zooids developed from the whole or from a part of the segmented yelk in the Echinoderms, and which form no stage in the development of the perfect form of the species, must be regarded as assimilative extensions of sarcode, analogous in function to the embryonic absorbent appendages in the higher animals. For such an organism the term "pseudembryo" is proposed. In the Echinoderm subkingdom, although constructed apparently upon a common plan, these pseudembryos present considerable range of organization, from a somewhat complex zooid provided with elaborate natatory fringes, with a system of vessels which are ultimately connected with the ambulacral vascular system of the embryo, with a well-developed digestive tract, and in some instances with special nervous ganglia, to a simple layer of absorbent and irritable sarcode which invests the nascent embryo. The pseudembryo of *Comatula* holds an intermediate position. It resembles very closely in external form and in subsequent metamorphosis the "pupa stage" of the

Holothuridæ, the great distinction between them being that in the Holothuridæ the pupa has already passed through the more active "Auricularian" stage, while the analogous form in *Comatula* has been developed directly from the egg.

ZOOLOGICAL SOCIETY.

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

Descriptions of Two Corals from Madeira, belonging to the genera Primnoa and Mopsea. By James Yate Johnson, Corr. Mem. Z.S.

Fam. GORGONIIDÆ, M.-Edw.

Subfam. Gorgoniinæ, M.-Edw.

Sect. Primnoaceæ, M.-Edw.

Primnoa imbricata, sp. n.

White, having a tendency to branch dichotomously in one plane; the branches slender, flexible, not plume-like, and not anastomosing. Axis pale brownish yellow, spineless, obscurely striated, effervescing in hydrochloric acid, coated with small white scales composed of carbonate of lime. Over the lower coating of scales there is another coating of larger scales, with a wide space between the two. The outer coat, which is easily removed, appears to be attached to the peduncles of the cells. These peduncles are in closely-set whorls of three or four, each of which expands into a cup-like cell, having its mouth closed in the dead coral with eight scales that have their apices in contact. The peduncles project at right angles from the stem, and are also clothed with scales.

This is a much more delicate form than *Primnoa lepadifera*, in which species the pedunculated cells appear to be arranged spirally on the branch.

Two specimens of this elegant *Primnoa* have been obtained, the larger of which has a height of 8½ inches, with a width of 11 inches. It was attached to a piece of *Lophohelia* (*Oculina*) *prolifera*. The whorls of the pedunculated cells are about three-twentieths of an inch apart, and the peduncles about the same in height. The principal branch, near the base, has a diameter of one-fifth of an inch. The smaller example has been deposited in the British Museum.

Subfam. Isidinæ, M.-Edw.

Mopsea arbusculum, sp. n.

The whole coral is coated with a thin brown skin. When this skin has been removed from the lower calcareous joints, they are found to be stony, white, subcylindrical, but rather narrower at the middle than at either end. They are finely striate longitudinally, and the striæ are parallel and straight. The interjoints do not nearly equal the joints in length, being little more than discs, and are somewhat less in diameter. They are striate, and from them spring the branches. These branches are very numerous, diverging in all directions subdichotomously, and making a tolerably thick bush. They are much thinner than the main stem, and they become gradually more slender upwards, the calcareous joints at the same time becoming longer. Occasionally two of the ultimate branchlets come into contact and are soldered together. Each branchlet bears at its apex a cell of a shape between campanulate and infundibuliform, the margin of which bears eight pairs of long, upright, spine-like spicula. There are also sessile cells at the sides of the ultimate branchlets, one at each interjoint. All the cells are of a pale brown colour. The pellicle covering the branchlets contains long spicula, which are for the most part large and fusiform, whilst the smaller ones are cylindrical, and all are brown and minutely tuberculated.

A single example of this Coral was obtained from a fisherman at Cama de Lobos, Madeira, and it is now in the British Museum. Its length, without the base, which is wanting, is 13 inches, and it is 7 inches across. The lower part of the main stem has a diameter of three-tenths of an inch, and its calcareous joints are about three-eighths of an inch in length. The branches are broken away from this part of the stem; but there are remains to show that some of the interjoints bore four branches, others only one. A cell, with its marginal spines, measures the fifth of an inch.

This coral seems to be nearly related to *Mopsea dichotoma*; but M. Milne-Edwards gives the Indian Ocean (with a mark of doubt) as the habitat of that species. Strange to say, that writer, in his work on Corals ('Histoire Naturelle des Coralliaires,' forming one of the 'Nouvelles Suites à Buffon'), is altogether silent as to the cells of *Mopsea*. Lamouroux says that the polypi (? cells) of *M. dichotoma* are mammiform on the higher, tuberculous on the middle, and superficial on the lower branches. This would ill accord with the Madeiran specimen. Little agreement can be made out between that specimen and the figures of Esper, "Pflanzenthiere," Isis, pl. 5, figs. 1–5.

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

Mr. W. K. Parker read the following abstract of a Memoir on the Osteology of the genera *Pterocles, Syrrhaptes, Hemipodius,* and *Tinamus,* intended for publication in the Society's 'Transactions:'—

"The classification of the gallinaceous birds would be easy enough if it were not for certain outliers, which refuse to conform to that particular plan of structure with which we are all so familiar in that very convenient and natural type of the group, the Common Fowl.

"Agreeing with this bird in all essential respects are the genera *Phasianus, Polyplectron, Lophophorus, Tragopan, Pavo, Meleagris, Numida,* and many others, the species of which are in many instances creatures of unsurpassed beauty. This properly typical group has, amongst other characteristics, its species provided with a robust body, short rounded wings, and very strong legs; whilst the tarsi are naked, provided with one or two spurs, and having the generally small heel elevated above the anterior toes.

"Notwithstanding the more subdued style of colouring, and the rudimentary condition of the spur, the Red Partridge (*Perdix rubra*) ought to be placed with the Francolins in the typical group.

"Still further, if we are to be guided by the structure of the skeleton, and especially by that of the skull, the dwarfs of the family, the Quails (*Coturnix*), ought to stand in the same inner circle as the gigantic species, the Turkey and the Peacock.

"In a subtypical group all those forms ought to be placed, in which, besides the quiet style of colouring, we find feebler legs, often with the tarsi feathered, a more depressed pigeon-like form of the body, and a skull with thinner and more fibrous walls, combined with a much enlarged tympanic cavity. The spur is also obsolete.

"The Grey Partridge (*Perdix cinerea*) should be classed with this subfamily—the *Tetraonidæ*.

"This beautiful and valuable bird is, as is especially shown in the structure of its skull, much more nearly related to the Ptarmigans (*Lagopus*) than to *Perdix rubra*, with its very thick-walled cellular skull, small tympanic cavities, and rudimentary spur.

"There is a group of very majestic birds inhabiting the warmer parts of the New World, which differs so much from the *Gallinæ* proper and from the *Tetraonidæ*, that it must be considered to belong to an outer or aberrant place in the great gallinaceous family. I allude to the *Cracidæ*.

"These birds, less ornate indeed than their normal relatives, are nevertheless creatures of great interest, and of no little beauty, whether we consider their form or their mode of colouring.

"In this outer circle we place the Guans (*Penelope*), the Curassows (*Crax*), the genera *Ortalida*, *Opisthocomus*, and others.

"The mode in which the *Cracidæ* differ from their terrestrial typical congeners is highly interesting; but as the present paper is only intended to be an introductory outline, I shall not 'bestow all my tediousness' upon the Society by going into details now: suffice it to say that they appear to me to connect the *Gallinaceæ* quite as much with the Plantain-eaters (*Musophagidæ*) as with the Pigeons.

"The habit, which has given the family-name *Rasores* to the Fowl tribe, curiously enough, does not attain its highest degree in the typical species, but is developed in certain subtypical genera which are found ranging from the Philippines through the islands of the Indian Archipelago to Australia: these birds are the Megapodes*.

"In the 'Mound-maker' we have a bird which, whilst marvellously like the Common Hen in gentleness of expression and neatness of contour, has also a most striking isomorphic resemblance to certain members of a very distantly related family, viz. the Gallinules.

"My acquaintance with the structure of *Talegalla* was made sixteen or seventeen years ago; for at that time I met with and made drawings of a precious skeleton of this bird in one of the drawers of the Museum of the Royal College of Surgeons; it has not, however, been noticed in the Catalogue.

"Being therefore well and safely possessed of the fact that the Brush Turkey (*Talegalla*) does not, in any *essential point of struc-*

* Gould (see Penny Cyclop., art. "Talegalla").

ture, differ from the Common and Ocellated Turkeys (*Meleagris Gallo-pavo* and *M. ocellata*), I was indeed surprised to find that, as late as last spring, Professor Owen had classed them with Cuvier's *Macrodactyli*.

"In the report in the 'Medical Times and Gazette' of the fourth of Professor Owen's Jermyn Street Lectures for this year, delivered on the 23rd of May, I find the classification which he has adopted, and in which the mound-making birds are placed between the Rail and the Screamer.

"As there are in the same system of classification several other instances of what appear to me, to say the least, very odd and confusing misplacements, I shall crave the liberty to point them out, and to make my own remarks upon them, especially as the position in nature of these birds is exactly what I have set myself to try and find out. It is in Professor Owen's Second, Third, and Fourth Orders, viz. the 'Grallatores,' 'Cursores,' and 'Rasores,' that I find most to surprise and confuse me.

"The family *Macrodactyli*, of the Second Order, 'Grallatores,' according to this eminent author contains the 'Coot, Crane, Rail, Megapode, Screamer,' and 'Jacana.'

"The next family, or the 'Cultrirostres,' contains, we are told, the 'Boat-bill, Adjutant, Heron, Ibis, Stork, Tantalus,' and 'Spoonbill.'

"The third family, or 'Longirostres,' is said to be composed of such forms as the 'Gambet, Avocet, Snipe, Ruff, Turnstone, Curlew, Sandpiper,' and 'Godwit.'

"And the fourth, or the 'Pressirostres,' the 'Oyster-catcher, Thick-knee, Plover, Lapwing, Bustard,' and 'Courser.'

"Then in his Third Order, the Cursores, Professor Owen places these genera, and in this succession, viz.:—

'*Apteryx*.
Didus, *Pezophaps*.
Ostrich, Emeu, Nandú.
Cassowary.
Notornis.
Dinornis, *Palapteryx*.'

"In the Order 4, 'Rasores,' he gives us two families, viz. the *Gallinacei* or *Clamatores*, and the *Columbacei* or *Gemitores*.

"The first of these is exemplified by the 'Pea-fowl, Partridge, Quail, Pheasant, Ganga, Grouse, Pintado, Tinamú, Turkey, Curassow,' and 'Guan.'

"The second is made to contain the 'Dove, Goura,' and 'Vinago.'

"First, as to the Macrodactylous *Grallæ*, the Porphyriine *Notornis* is wanting; and, besides the Megapode, the Crane certainly has no business there, being (as its embryology reveals) a gigantic specialized aberrant of the Pressirostral family.

"As to the *Cultrirostres*, I feel pretty certain that the Spoonbill and the Ibis will have to be placed in the next family, the *Longirostres*, a group less specialized from the Plover type than the Cranes. If this should turn out to be the truth, the 'Pressirostres' and the

'Longirostres' must receive accessions at the expense of the 'Cultrirostres,' which family, however, possesses the *Balæniceps*, the Umbre, and the *Eurypyga*.

"With regard to the 'Cursores,' it seems to me much better to use the simple term *Struthionidæ*, and to let *Didus* and *Pezophaps* abide where Messrs. Strickland and Melville most appropriately placed them, viz. amongst the Ground-Pigeons; the *Notornis* being marched back again to its proper place, between *Tribonyx* and *Porphyrio* *.

"I hope to console the lover of the struthious tribe by compensating him for the loss of the Dodo and the *Notornis* with the gain of what has hitherto been considered as a true gallinaceous genus: I refer to the Tinamou.

"The examples given of the gallinaceous genera in Professor Owen's classification are principally remarkable for want of order, as the Ganga is not intermediate between the Pheasant and the Grouse, but between the Grouse and the Pigeon, and the Tinamou certainly has no place between the Pintado and the Turkey.

"The Gemitores might stand as they are, as to the examples given; but they are not *Rasores*.

"In the same lecture in which the 'classification' is given, the *Notornis* is said to be 'allied to the Coots,' and the Cassowaries 'still more modified Coots.'

"This seems to me to be an inversion of the natural order of things; for the Cassowary, every one knows, is in all respects typically struthious in its whole skeleton, but is most decisively seen to be so in its cranium and facial bones; and all the *Struthiones* are low, embryonic, unspecialized forms.

"That there is a near relationship between the Rail-tribe and the Ostriches I feel certain; but the former seem to me to stand on the same level typically (or in relation to the highest style of bird) as the Rasorial group, and in some respects on a higher one; but I would not press this too far, as the skulking habits of these birds seem to point to a lower brain-development than even the Fowl possesses, and to place them in near contiguity to the Ostriches: moreover *Brachypteryx* is, in respect of its wings and sternum, but little in advance of the great '*Brevipennes*.' Cranially, however, it is in advance; and it seems to be a more philosophical way of putting the matter to say that a Coot is a modified Cassowary, than that a Cassowary is a modified Coot. Whether Mr. Darwin is right in all respects or not, yet we all believe with him that nature does not retrograde, but ascends from the simpler to the more highly specialized forms.

"I shall not take up either the Society's time or my own in merely arguing about these puzzling affinities, but hope soon to be able to

* Dr. Mantell (Petrifactions and their Teachings, page 125) says that "the general form of the skull" of *Notornis Mantelli* "approaches nearest that of *Brachypteryx*;" whereas that of *Tribonyx Mortieri* (Osteol. Catal. Mus. Coll. Chir. vol. i. p. 239, No. 1281) comes nearer. In the sternum, however, *Notornis* is most like *Brachypteryx*.

bring forward some simple drawings and descriptions, such as shall enable any one to judge for himself to what type these birds really do belong.

"I intend moreover in my larger paper to consider the relationships of *Oreophasis Derbianus*.

"But the birds hitherto mentioned are all easily referred to their proper zoological position; those, however, of which it is my principal business to speak stand just above the *Struthionidæ*, in such a doubtful position that it is at first hard to say whether they have declared for any one of the families by which they are surrounded.

"The Sand-Grouse, the Hemipodes, and the Tinamous have in their composition such a mixture of characters, that they seem to be the very birds which might in the lapse of ages, through climatal change, a different diet, 'the struggle for existence,' and 'natural selection,' give rise to such divaricating and dissimilar types as the Pigeons, the Gallinaceous birds, and the Plovers.

"These last-mentioned families are those the characters of which the osculant forms under consideration most affect, with, let it be remembered, a more or less broad struthious basis.

"There are other genera, however, the osteology of which I long to know, viz. *Thinocorus*, *Attagis*, and *Chionis*.

"Speaking of these birds, Mr. Darwin, in his most pleasant 'Journal' (ch. 5. p. 94), makes the following remarks:—

"'This small family of birds is one of those which, from its varied relations to other families, although at present offering only difficulties to the systematic naturalist, ultimately may assist in revealing the grand scheme, common to the present and past ages, on which organized beings have been created.'

"*Thinocorus rumicivorus* partakes, according to this excellent author, 'of the characters, different as they are, of the Quail and the Snipe' (ibid. p. 94).

"As to the *Attagis*, Mr. Darwin says (p. 94), 'The two species of this genus are in almost every respect Ptarmigans in their habits;' and of *Chionis alba*, that it 'is an inhabitant of the Antarctic regions,' that 'it feeds on sea-weed and shells on the tidal rocks,' and that, 'although not web-footed, from some unaccountable habit, it is frequently met with far out at sea' (ibid. p. 94).

"Will some lover of ornithology be on the look-out to procure something more than the *skins* of the birds of these three genera?*

"It would tend towards our knowledge of the meaning of these birds of mixed character and osculant relationship, if we knew how long each type has been on the planet; for if our Fowls and Peacocks, Doves and Gouras, are really comparatively new importations to the 'green earth,' then there would be some colour and life in 'Darwinism,' and the Ostriches, Tinamous, and Sand-Grouse might be looked upon as a remnant of the 'flint-folk' of the bird-class.

"It is, however, almost impossible for the most devout believer in separate creations to keep this idea of 'ancestral relationship' alto-

* There is a skeleton of *Chionis*, I find, in the British Museum.

gether out of his mind when considering such birds as those we are speaking of: at any rate, dogmatism on either side, on a subject so far beyond the reach of our feeble faculties and limited knowledge, has in it something of profanity. I have, up to this time, only been able to get a sight of the skeletons of *Pterocles arenarius* (see Osteol. Cat. Mus. Coll. Chir. vol. i. p. 273, No. 1421), of *Hemipodius varius* (ibid. p. 274, No. 1423), of a specimen of an undetermined species of *Hemipodius* (which died soon after its arrival at the Gardens, and was lent to me by Mr. Gerrard), and of a *Syrrhaptes paradoxus* and a *Tinamus robustus*, for which I am indebted to the Council of this Society.

"I shall now merely indicate the curious composition, so to speak, of these birds, and begin with that of the Sand-Grouse.

"These beautiful and gentle birds are seen at once to have in them something both of the Ptarmigan and the Pigeon; but there is in their physiognomy a marked inferiority of expression, quite in contrast with the sharp, intelligent look of the typical Fowls, and very much below what we see in the Pigeon-tribe.

"This is exactly in harmony with what the skeleton reveals; for whilst the characters of both these types are almost inextricably interwoven, yet there is in many points a marked inferiority of character—a less degree of elevation above the Struthious style of structure. What there is of the Bustard (*Otis*) in them (which Professor Owen, 'Osteol. Catal.' p. 274, points out) is only part of their general relationship to the Pluvialine type.

"It is in those parts of the skull and face which are first mapped out in thickened blastema, and then differentiated into clear cartilage, at some considerable period of the early embryonic life anterior to the deposit of bone, that we find the most instructive modifications of structure.

"I allude especially to the basis cranii and to the upper part of the first facial arch, that is, to the occipital and sphenoidal regions, and to the pterygoids, palatine bones, and vomer. Not only do these bones (with the exception of the vomer, which is absent as in the Pigeons) show a marked 'struthious' inferiority in the *Syrrhaptes* (the culmination of the Pterocline type of structure), but the sternum, which literally unites that of the Ptarmigan with its counterpart in the Pigeon, is inferior in one important point, not only to this, but also to that of the whole Pluvialine group.

"The heel, which is a mere rudiment in *Pterocles* proper, is absent in the *Syrrhaptes*; and the whole pelvic extremity is almost the counterpart of that of the Swifts (*Cypselus*) in deficient growth. I believe that it would take a very clever anatomist to detect any difference between the wing-bones of the '*Pteroclinæ*' and those of a typical Pigeon.

"The elongated feathers of the tail and wings of *Syrrhaptes* give it one of its peculiarities of character: the two middle tail-feathers have already become elongated in *Pterocles setarius* (the Pin-tailed Sand-Grouse of Temminck), its nearest ally.

"I cannot conclude this rough outline of what I wish to say about the Sand-Grouse, without referring to what Dr. Andrew Smith tells us of *Pterocles gutturalis*, Sm., in his 'Illustrations of the Zoology of South Africa.'

"First, what must be considered a 'Pluvialine' character, the eggs are of a 'dirty-white or cream-colour, marked with irregular streaks and blotches of a pale-rusty and pale-grey or ash-colour;' and the second point is the careless habit of laying them upon the bare ground*. This habit, so untypical ornithically, so unlike the almost *human* family tenderness of their relatives, the Pigeons, is, however, much like the conduct of the unthinking 'giants' that come next below them in the zoological scale.

"So that not only the Ostrich, but also the Sand-Grouse 'leaveth her eggs in the earth, and warmeth them in the dust, and forgetteth that the foot may crush them, or that the wild beast may break them.'

"If birds were intelligent in the *human* sense of the word, their relationship to the reptiles would be as humiliating as our affinity to the *Simiæ*; but the fact is certain that these low types not merely have in themselves obscure anatomical resemblances, but their instincts and habits are plain, out-spoken evidences of their nearness in nature to 'the creeping things after their kind.'

"I now leave *Syrrhaptes* (which, at first sight, seems to run in some mysterious way without the help of feet) to speak of the stilted *Hemipodius*, an aberrant gallinaceous bird, which has escaped from its more steady *walking* allies to join the true coursing birds. Without heel, with not only naked tarsi, but with the lower half of the tibiæ bare; what can these birds be but true essential '*Grallæ*.'

"They may be in a sense grallatorial, but are not really so, as we shall see, if we work out their mixed affinities.

"The *Hemipodii* (some of which are very small, and, like some other small creatures, very pugnacious) stand pretty exactly between the Tinamous and the Quails; but not quite so, for the Pigeon comes in again, even here, with a touch of kinship, the connecting links being the *Didunculus* and the dwarf Ground-Pigeons (*Chamæpelia*).

"The characters of head are almost equally divided between those of the Ground-Pigeon and the Quail; the sternum, between the Quail and Tinamou; yet the legs are those of a little Sand-Plover, although they are hinged upon a pelvis which would require but little altering to suit a Quail.

"I must ask for more time and space, if not to settle this difficulty, yet to put it into a proper form for some fuller mind to explain; for it seems to me that my position of 'interpreter' is in this case more perplexing than that of the purblind patriarch, who found the hands of his hairy son Esau combined with the vocal organs of the smooth-limbed Jacob.

"I have now merely to speak of the Tinamous; and in their case also I must merely indicate the kind of task they present to him who would fairly work them out.

* Penny Cyclop., art. *Tetraonidæ*.

"In the first place, let me at once say that they have no right to the dignity of the gallinaceous title; they are little struthious birds, looking upwards from that simple rudimentary beginning of the beautiful ornithic type.

"Nearly all the specialization of this bird, by which it rises above the *Struthionidæ*, is in the direction of the true or typical gallinaceous bird, and not towards the Ptarmigans, as is the case of the Sand-Grouse.

"The *Hemipodius* runs upwards towards the little flat-bodied typical Quails; but there is no bird better for comparison with the Tinamou than the common Hen. Nine-tenths of the characters of the bony structures of the head in this bird are truly struthious: the residuum belonging half to the Plover and half to the Fowl.

"It is not a little curious, however, that it outdoes the Plover in one thing, viz. the structure of the supraorbital region; for whilst the nasal or supraorbital glands in the *Pluvialinæ* are protected by a continuous beam of bone, the Tinamou has the unique character of a series of those bones. In the young Ring-Dottrel I find a series of square denticles growing out from the margin of the frontal below, and external to the large gland; these exogenous processes fuse together in the adult.

"I had racked my memory to find an instance of multiplied supraorbitals in a vertebrate skull, but in vain, when one turned up to me on examining the Reptilian skeletons in the Museum of the College of Surgeons, a few months ago: this example is the skull of the Trigonal Cayman.

"There are three on each side in this latter creature, united by a triradiate suture; in the Tinamou, however, there are six or seven larger and several smaller ossicles on each side. At first sight it seems as though half the sclerotic ring had been attached there by accident; these supraorbitals are, however, much stronger than the sclerotals.

"The sternum of the Tinamou is greatly differentiated when compared with that of a Rhea or Emeu; but all the improvement is gallinaceous. It is absolutely the most unique and wonderful of all the sternums I have seen, the variations of which in the bird-class, as is well known, are very great and very exquisite.

"The presence of a somewhat deep keel, so seemingly fatal to the struthious theory of this bird's relationship, strange to say, turns out a good proof of its validity and truth. Every one who has watched the larger-winged Ostriches must have noticed their habit of lifting their wings—a motion performed by the middle pectoral muscles or *levatores* of the humerus: to these muscles nearly all the keel of the Tinamou's sternum is devoted, a most narrow, small corner being left for the thin abortive *depressores*—muscles which, not only in typical birds, but also in the heavy Gallinaceæ, are of very large size. The small 'furculum' is Pluvialine; but the coracoids and scapulæ come very near to those of the common Fowl.

"The blending of the last cervical with three out of four of the dorsal vertebræ is gallinaceous; but the absence of costal appendages, except a small one on the second true rib and a trace on the third, is struthious enough. The pelvis looks, at first sight, but a few removes from that of the Hen; and in so much as it differs from the pelvis of the Emeu or the Apteryx (which have very compressed pelves, whilst this is broad and gently arched), in the same degree does it approach that of the Fowl. The preacetabular spur of the ilium is there; but the postfemoral part of that bone looks as if it had been pared away, leaving an enormous ischiadic *notch*, which is a *foramen* in typical birds. The tail is a mere pretence (as Wagler's term *Nothura* well expresses); the caudal vertebræ are therefore but little better than those of an Ostrich. The strong legs leave us the choice, at first sight, of referring them to either the Fowl or the Ostrich; and the heel, small and high up, is gallinaceous. But the tarso-metatarsus, covered with transverse plates in front, has the posterior two-thirds invested by an intensely strong imbrication of horny scales; thus adapting the leg of the bird to that odd sitting position (about as elegant as that of the Ass in the first stage of the erect posture) in which the *Struthionidæ* delight."

MISCELLANEOUS.

On Chlamyphorus. By Dr. Burmeister.

Dr. Burmeister has sent from Buenos Ayres the description of a second species of *Chlamyphorus*. He defines them thus:—

1. *Chlamyphorus truncatus*. Minor, chlamyde dorsali lateribus libere dependente, subtus cum artubus vellere molli recto subsericeo indutus; cauda thecaque anali perfecte cataphractæ.
   Hab. Mendoza.

2. *Chlamyphorus retusus*. Major, chlamyde dorsali lateralibus corporis adnata, subtus cum artubus intus vellere undulato, sat lanuginoso indutus; cauda thecaque anali imperfecte cataphractæ.
   Hab. Circa oppidum Stæ. Crucis de la Sierra Bolivia.

He gives three figures of the species.

On the Action of Magenta upon Vegetable Tissue. By J. G. Lynde, F.G.S., M. Inst. C.E.

The author describes a series of experiments upon cuttings of *Vallisneria* immersed in a solution of magenta in cells under the microscope, and its effect upon the circulation in the plant. He found that so long as the vital action continued, the cell-walls and the moving chlorophyll retained their green colour, but the injured cells were immediately deeply reddened, and their contents gradually acquired the same colour, the intensity of which was in proportion to the thickness or density of the tissue. Between the cell-walls it would appear that there exists an intercellular membrane, devoid of vital action, which becomes rapidly coloured whilst the circulation continues active. On the inner surface of the cell-wall, whilst rotation is going on, the author observed a luminous stratum suggesting the action of cilia, but in every observation, as the dye permeated the tissue and the circulation ceased, the true cell-wall became covered with irregular markings, either corrugated or having raised excrescences, scarcely alike in any two cells; in no case were the markings visible until the rotation had ceased, and they had the appearance which would be produced by cilia falling against the cell-wall in all positions upon the suspension of vital action.

The chlorophyll-vesicles appear in three forms—in a gelatinous sac or mass rotating altogether in the cells, as independent vesicles apparently homogeneous in their structure, rendered opake by colouring matter, and, lastly, as independent vesicles somewhat increased in size, of a pale green colour, almost transparent, containing nuclei, one, two, or three in number, which in reality appear to be immature vesicles within the parent, similar to *Volvox globator*, without rotatory motion. The chlorophyll-vesicles appear to resist the action of the magenta for some time after their rotation has ceased, indicating a vitality, at least to a certain extent, independent of that of the cell. In some of the experiments a few of the cells assumed a purplish colour, whilst in the adjoining cells the circulation was active and the chlorophyll green; in those the chlorophyll appeared to be decomposed, and the cell to be nearly full of very minute dots, swarming like the granules in *Closterium lunula*. Upon this subject the author offered no opinion. The observations were made with $\frac{1}{5}$th and $\frac{1}{8}$th objectives; and the paper contained minutiæ of several experiments, with the hours of observation, temperature of the room, and other particulars.—*Proceedings of the Literary and Philosophical Society of Manchester*, March 1863.

The Ringed Seal (Phoca fœtida).

A specimen of this animal was caught at Aberystwith during last month, and has been exhibited alive in London. It is now in the Collection of the British Museum.—J. E. Gray.

On the Nature of the Gas produced from the Decomposition of Carbonic Acid by Leaves exposed to the Light. By M. Boussingault.

In an interesting paper in the 'Ann. Sc. Nat.' (Bot.) sér. 4, vol. xvi. pp. 1–27, 1862, referring to the history of discovery in respect to the relations of plants to the atmosphere, Boussingault remarks that Bonnet first took notice of the emission of air from the surface of leaves. Priestley recognized this air to be oxygen; Ingenhous showed the presence of light to be necessary; and Senebier proved that the oxygen gas eliminated by leaves under the light of the sun came from the decomposition of carbonic acid gas. Théodore de Saussure, nearly at the beginning of the present century, ascertained the fact (which has since been often overlooked) that the volume of oxygen gas produced was not quite equal to that of the carbonic acid decomposed; and also that nitrogen gas was always evolved, to an amount about equal to that of the oxygen gas which had somehow disappeared. He supposed that this nitrogen came from the substance of the plant—not considering, what is now obvious, that the substance of the plant did not contain, and therefore could not have furnished, anything like this quantity of nitrogen.

In more recent times, Daubeny was unable to obtain from leaves oxygen gas free from nitrogen; and Draper states that he found the astonishing amount of from 22 to 49 per cent. of the gas emitted from the leaves of *Pinus tæda* and *Poa annua* to be nitrogen. The first step towards the elucidation of the matter was made by Cloëz and Gratiolet, who, exposing the leaves of a common Pond-weed (*Potamogeton perfoliatus*) in water slightly impregnated with carbonic acid, found that the first day 15·70 per cent. of the gas eliminated was nitrogen; the second, 13·79; the third, 12·00; the fourth, 10·26; the fifth, 9·53; the sixth, 8·15; the seventh, 4·34; the eighth, 2·90: that is, the oxygen gas grew purer and purer, exactly as if the nitrogen retained in the tissues of the plant, or in the water, was gradually expelled by the oxygen. Similar experiments were made by Boussingault in 1844, confirming these results, and also later a set of comparative experiments, with and without leaves, which confirmed the truth of the conjecture as to the source of most of the nitrogen. But, after all, he could not obtain any oxygen gas free from nitrogen.

Boussingault now devised a new method of proceeding, by which he avoided the difficulty about extraneous nitrogen, &c. The mean results of 25 experiments (which are detailed particularly in the memoir), made with a variety of plants, are, that 100 measures of carbonic acid gas, decomposed by foliage under the light, gave 97·2 of oxygen gas; and that 1·11 of nitrogen had appeared, which, from the plan of the experiments, could not have come from the water, nor have been contained in the plant.

At this point, Boussingault raised the question whether this gas, which remained after the absorption of the oxygen by the pyrogallate and the carbonic acid by potassa, was necessarily and really nitrogen. A series of experiments, devised and executed with this view, brought out the interesting result, that the supposed nitrogen (which, moreover, corresponded very nearly with the amount of oxygen gas that had disappeared) was oxide of carbon, *i. e.* carbonic oxide! There is also a little protocarburet of hydrogen. So "foliage, during the decomposition of carbonic acid, does not really emit nitrogen gas, but, with the oxygen gas, emits some oxide of carbon and some protocarburet of hydrogen; and these combustible gases, like the oxygen, are produced only under the light of the sun. . . . In other terms, to keep strictly within the conditions of the experiments, these gases constantly accompany the oxygen of which the sun determines the production when it acts upon a vegetable submerged in water impregnated with carbonic acid." Is this also the case when carbonic acid is decomposed by foliage in the air?

Boussingault concludes his paper with the remark that the earlier observers looked at their discoveries rather from the hygienic than the physiological point of view; that, while Priestley announced his brilliant discovery by the statement that plants purify the air vitiated by combustion or by the respiration of animals, it is curious enough that, a century afterwards, it should come to be demonstrated before the Academy of Sciences, that probably the leaves of all plants, and certainly those of aquatic plants, while emitting oxygen gas, which ameliorates the atmosphere, also emit one of the most deleterious of known gases—carbonic oxide! He closes with the pregnant and natural query, whether the unhealthiness of marshy districts is not attributable, at least in part, to the disengagement of this pernicious gas by plants?

[We add, that what strikes us with most surprise is to learn that, if these results are true, the vegetable machinery would seem to work at a loss, and with a real, though it be a small, waste of material. When any carbonic acid taken into the leaves passes off unchanged, so much work is not done, but there is no waste or loss in the process of manufacture. But, looking at the food of plants and their products—comparing the raw material with the manufactured article—it seems apparent that any carbonic acid which is reduced to carbonic oxide, and given off as such, is so much loss or waste. We may avoid this unwelcome conclusion by the supposition that the carbonic oxide and carburet of hydrogen are products of the decomposition of some of the vegetable matter coëtaneous with vegetable assimilation, but no part of that process itself. This is the more probable, since it cannot reasonably be supposed that carbonic acid supplied to the foliage is resolved into oxygen and carbonic oxide, and both set free, which seems to be the alternative.—Asa Gray.]—*Silliman's Journal* for January 1863.

On a new Species of Ophiura (O. Normani) *found on the Coast of Northumberland and Durham.* By George Hodge.

During the summer of 1861, whilst dredging at Seaham, upon a sandy bottom, in water varying from 6 to 25 fathoms, a number of small Sand-stars were brought up, associated with *Ophiura texturata* and *Ophiura albida*. Their actions were so singular as to claim a more than ordinary examination, when it was noticed that, although resembling in some respects young forms of *O. texturata* and *O. albida*, they presented features that at once distinguished them from those species, the most striking of which were the longer and more attenuated character of the rays, as compared with the size of the disk, their excessively lively movements, and the wonderful pliability of the rays. These several circumstances caused them to be regarded as distinct from the two well-known species above named: a careful examination under more favourable circumstances confirmed this opinion.

The surface of the disk is beautifully rosulated, a large plate being in the centre, around which, at a little distance, are arranged five other plates; beyond these, other five plates, and so on, the interspaces being filled in with circlets of little scales, producing an appearance not unlike that seen in *Ophiocoma bellis*.

At the base of the rays, close to the disk (upon the upper surface), is a crescent of short spines, the concave side of the crescent being outwards.

These are features entirely different from what we find in either *Ophiura texturata* or *O. albida*; in both instances the upper surfaces of the disks present no trace of the beautiful and *distinct* rosulated character here seen, neither do we find the crescentic arrangement of spines upon the basal portion of the rays.

The characters of the species under consideration may be thus defined:—

Disk either pentangular or round, the former pertaining to well-grown individuals, the latter to young; upper surface of disk rosulated; under surface corresponding with the other members of the genus. Two clasping scales at the origin of each ray, each bearing above ten short spines. A crescent of eight or ten short blunt spines on upper surface of rays, close to the disk. Lateral ray-plates bearing five moderately long spines. Upper ray-scales nearly square, slightly tapering towards the disk. Rays about four times as long as the diameter of disk, which, in well-grown individuals, measures about a quarter of an inch. Colour reddish-yellow, occasionally of a pale sandy tint.

These features being so constant and distinct, there can be no doubt of the species under consideration being new to our fauna; and as such, it affords me much pleasure to name it after my friend the Rev. A. M. Norman, who is, in fact, the original discoverer, having taken a single specimen some years ago in the Frith of Clyde; and at Shetland, during 1861, he also took three or four specimens. In both instances, however, they only received a glance, and were assumed to be the young of *O. texturata*, for which they may easily be mistaken unless subjected to microscopical examination.

This species would appear to be generally distributed, having been found at three widely different parts of our coasts. It is common here, between sixty and seventy specimens having been dredged in a few hours; owing, however, to their excessive fragility, few were obtained perfect.—*Trans. Tynes. Nat. Field Club*, 1863, vol. v. p. 296.

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[THIRD SERIES.]

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XXXIV.—*A Novel Instance of the Production of Fermentation by the Presence of Infusoria capable of existing without free Oxygen and deprived of all Access of Atmospheric Air.* By M. L. Pasteur.

Such is the subject of a short paper addressed by M. Pasteur to the French Academy of Sciences, and published in the 'Comptes Rendus' for March 1863.

About two years previously, he communicated a note to the same learned body respecting the existence of infusory animalcules possessing the two properties of living without free oxygen, and of acting as ferments*. "These were," he says, "the first known examples of an animal ferment, as well as of animals capable of living and of indefinite self-multiplication, without contact with atmospheric air, whether in the gaseous state or held in solution.

"The infusory animalcules in question constitute the ferment in butyric fermentation, which has hitherto been explained to take place by the agency of plastic azotized matters, more or less changed by contact with the air, upon sugar or lactic acid, and by the supervention of an internal molecular action giving rise to the phenomena of fermentation.

"I believe I have proved that such a theory, which is applied indeed in explanation of all kinds of fermentation, properly so-called, is inadmissible, and that an albuminoid matter never constitutes a ferment, but that the true ferment (as in butyric fermentation, for example) is an organized being belonging to the Vibrios, derived from the air and present in the fermentable substance.

"I am now able to add another example—viz. the fermentation of tartrate of lime, determined in precisely the same way

* See Annals, April, 1861, p. 343.

by the presence of an infusory animalcule, existing without free oxygen, belonging also to the genus *Vibrio*, though very different, at least in external aspect, from the animalcule of butyric fermentation.

"To be brief, I will at once adduce a decisive experiment in proof of this statement. I place in an aqueous solution of tartrate of lime a minute portion (some millièmes) of phosphate of ammonia or of alkaline and earthy phosphates, either artificially prepared, or derived from the ashes of the yeast of beer or the ashes of infusory organisms. (I prefer the ashes obtained by the combustion of organisms analogous to those whose development is sought, in order to be more certain that no useful principle, known or unknown, is omitted. It is probably as well to add some traces of sulphate of lime and of ammonia.)

"The vessel used is a glass phial, flat at the bottom, and having a curved glass tube fitted in its narrow neck. The tartrate of lime is introduced, the phial filled up with pure water, and then placed in a chloride-of-calcium bath with the end of the curved tube immersed in a vessel of boiling water. Its contents are made to boil, in order to expel all the air held in solution; and when this is effected, the surface of the water under which the end of the curved tube opens is covered by a thick layer of oil. The whole apparatus is then left to cool for some hours. Under these conditions, the tartrate shows no sign of fermentation; but if a small quantity of the Infusoria obtained from a spontaneously fermenting portion of tartrate of lime be quickly introduced within the phial, and the little water displaced in this process be as quickly replaced by some of the water deprived of its air by boiling, then it is found that the introduced Infusoria rapidly multiply, and the tartrate progressively disappears until entirely removed, all air having been in the meanwhile excluded by the curved tube of the phial being kept under the water, or, better still, under the surface of a mercury bath.

"The tartrate was replaced by a deposit consisting solely of the bodies of Vibrios, of about $\frac{1}{1000}$ millimètre in diameter, but so variable in length that some measured $\frac{1}{20}$ millimètre. Like all Vibrios, they are reproduced by fission; and during the act of fermentation, the minutest quantity of the deposit formed by them showed them in more or less rapid and writhing movement.

"The fermentation of tartrate of lime, therefore, whatever its intimate cause may be, is set up by the presence of Infusoria having the property of living without free oxygen and without contact with atmospheric air.

"It may undoubtedly be objected that, at the moment when the ferment has been added, I have failed to prevent the contact of the air with the solution experimented upon. But I will now demonstrate that the very strict precautions I have taken to obviate the contact of oxygen or of air are really uncalled for. The following observations will also afford a reply to the question why the germs of Infusoria which not only live without air, but are actually destroyed by it (as happens also with the butyric Infusoria), may spontaneously originate in liquids which under the circumstances of ordinary fermentation are exposed to the atmosphere.

"Resuming the phial filled with water, and containing the tartrate of lime and the phosphates, and having the bent tube luted in its neck also filled with water (which I will suppose to be ordinary distilled water undeprived of its air by boiling), and with its free extremity plunged under mercury, it will be found by experiment that, without adding any ferment, fermentation of the tartrate of lime takes place at the end of a few days, and that a multitude of animalcules are found living in the phial, though deprived of oxygen.

"How this happens it is easy to conceive; for in all such cases the smallest Infusoria, such as *Monas, Bacterium termo,* &c., develope themselves in the aërated distilled water, which contains in solution traces of ammonia, of phosphate and carbonate of lime, together with oxygen gas; this last they appropriate to themselves with incredible rapidity, until it is ultimately used up, replacing it by carbonic acid in somewhat larger volume. This result is accomplished in from twenty-four to thirty-six hours at most, at a temperature of 25° to 30° Cent.; and it is not till then that the Infusoria of fermentation make their appearance, which have no need of oxygen for their existence. The question, therefore, why animalcules which do not require oxygen to carry on life, and to which air is destructive, should arise under the conditions assumed, is thus at once and naturally answered. They originate in sequence to a former generation of organisms which quickly abstract the relatively considerable quantity of oxygen in the fluid, and leave it completely destitute of that element.

"I shall shortly revert to this very general fact of the succession of organisms which consume oxygen, and of such as do not, at least in a free state.

"In the instance under consideration, it is easy to comprehend the facility with which spontaneous fermentation of tartrate of lime may be set up, whenever special precautions are not taken to prevent the access of the germs disseminated through the air, or those in the dust deposited from the air on all objects. It is equally easy to understand the fermentation of tartrate of lime in liquids freely exposed to the air, provided the layer of fluid is of sufficient thickness. It may under such circumstances be shown that those Infusoria which consume oxygen gas multiply at the surface; whilst those are developed in the liquid strata beneath which do not require this gas for their existence, and these are at the same time preserved from its injurious contact by the former class of beings.

"In fine, there is no need to resort to any artificial measures to deprive fluids of their oxygen gas. All the precautions I adopted in my experiments for this purpose were wholly superfluous. The abstraction of the oxygen is naturally effected, as a matter of course, before fermentation begins, in every instance of spontaneous fermentation.

"The nature of the experiments above detailed, and the composition of the materials employed in them, deserve particular notice when we come to inquire what may be the primary cause of the fermentation. I have referred to the prevalent theories as requiring, as indispensable for the act of fermentation, the concurrence of albuminoid matter and of a ferment. For my part, I recognize their presence to be not absolutely necessary, but useful, inasmuch as they supply a certain material for the action of the ferment, which is itself an organized being whose germ cannot develope or reproduce itself except in the presence of nitrogen and phosphates. These are especially the kind of suitable materials that the ferment obtains from the presence of albuminoid substances. This theory is so true in its application, that, as before seen, the azotized plastic matter may be entirely dispensed with, and its place supplied by an ammoniacal salt mingled with alkaline and earthy phosphates.

"But it further results from the composition of the fluid just spoken of holding a tartrate in solution, that the sole carbonaceous material for fermentation is the tartaric acid, or the fermenting body itself. Hence this further result follows, that at the least the animalcule derives in the first place all its carbon from the fermentable matter. There is no question, if preconceived notions relative to the cause of fermentation be laid aside, that under the conditions which we have described, the ferment obtains its nutrition at the expense of the fermenting material, and that so long as the life of the infusory organism lasts, so long does a transfer of matter go on from the fermenting substance to that which provokes its transformation. The hypothesis of a purely catalytic action, or of simple contact, consequently cannot be admitted as true, any more than the opinion, to be afterwards combated, that the nature of a ferment is exclusively found in dead albuminoid matter.

"It must be granted that the fact of the nutrition of the ferment advancing at the expense of the fermentable material does not show why the Vibrios must be the ferment. We know, indeed, that the habitual mode of action of animals and plants on the substances from which they directly derive their nourishment is not associated with a process of fermentation, properly so called, of those substances. Yet it must be borne in mind, in making any comparison between organisms previously known and those which I have for the first time described, that animalcular ferments present this peculiar physiological property, heretofore overlooked, that they live and multiply without the presence of free oxygen.

"We are therefore led to associate the fact of nutrition attended by fermentation with that of nutrition without the consumption of free oxygen gas. Herein, no doubt, lies the secret of the mysterious character of all fermentation, rightly so called, and possibly also that of many normal and abnormal actions in the organization of living beings. If any doubts yet remain on these points, I trust to remove them by future researches which I hope to lay before the Academy.

"Henceforward it may be asserted that there are two modes of life among inferior organisms—the one requiring the presence of free oxygen, the other carried on without contact with this gas, and always attended by the phenomena of fermentation.

"As to the number of organisms capable of living deprived of air, and of setting up fermentation, I regard it as considerable, whether we look to those having no inherent power of self-movement, in other words, vegetable beings, or to those which have apparent voluntary motions, or animals.

"I hope, in fact, to demonstrate in a subsequent communication, that infusory animalcules living without the access of free oxygen are the ferments of putrefaction when this act proceeds without contact with air; and that there are other animalcular ferments of putrefaction under exposure to air, which are found associated with Infusoria or Mucors, that consume the free oxygen and fulfil the double purpose of agents of combustion with reference to the organic material, and of agents of preservation for the infusorial ferments, by protecting them from the contact of the oxygen of the air."

The results now described apply exclusively to the case of the simple tartrate of lime; but the author has a series of researches which extend them to the other combinations of lime and tartaric acid, and which he promises shortly to send to the Academy of Sciences.

J. T. Arlidge.

XXXV.—*Characters of new Land-Shells from the Andaman Islands, Burmah, and Ceylon, and of the Animal of* Sophina. By W. H. Benson, Esq.

1. *Helix hemiopta*, B., n. sp.

H. testa anguste umbilicata, depresso-conoidea, vix striatula, læviuscula, minutissime granulata, opaca, albida; anfractu ultimo superne castaneo, versus peripheriam saturatiore; spira convexo-conoidea, apice obtuso, sutura vix impressa; anfractibus $4\frac{1}{2}$, convexiusculis, sensim accrescentibus, ultimo superne prope peripheriam obtuse angulatam concaviusculo, subtus convexiusculo; apertura obliqua, subquadrato-lunata, intus concolore, peristomate expansiusculo, superne antice arcuato, subtus breviter reflexo, marginibus remotis, columellari superne valde dilatato, umbilicum subtegente.

Diam. major 16, minor $13\frac{1}{2}$, axis 10 mill.

Habitat ad Portum Blair Andamanicum.

Two dead specimens of this shell, only one of which has the aperture complete, were collected by Major J. C. Haughton.

A nearly allied shell, with the surface in good condition, obliquely substriated, shining, and sprinkled with minute indentations, may possibly be a variety; but the aperture is in a state too imperfect to allow a satisfactory decision. It is milk-white, with a single dark band above the periphery and running along the edge of the upper whorls, which are slightly more convex, and divided by a more depressed suture. A single specimen from Port Blair was received from Major Haughton.

2. *Helix Aulopis*, B., n. sp.

H. testa perforata, depresso-conoidea, oblique minute striatula, striis confertissimis spiralibus decussata, pallide cornea, nitidula, translucente, versus apicem rubente; spira conoidea, apice acutiusculo, sutura leviter impressa; anfractibus 5, superne subplanulatis, vix convexiusculis, ultimo subtus convexiusculo, ad peripheriam carinato; apertura obliqua, quadrato-lunata, peristomate recto, tenui, acuto, marginibus subremotis, callo tenui junctis, columellari superne breviter dilatato.

Diam. major 12, minor 10, axis 6 mill.

Habitat ad Portum Blair.

A single specimen of this shell, in good condition, was received from Major Haughton. It has some affinity to the Javanese *H. helicinoides*, Mousson.

A perfect example (from the same source) of *Helix Helferi*, m., described in the 'Annals' for September 1860, has a dark corneous epidermis, dull and lustreless, and the scattered hairs are like short dark-coloured prickles. The peristome is liliaceous white and polished. This and other specimens of the shell obtained from Port Blair fully bear out the distinctive characters from *H. asperella*, Pfr., founded on the examination of a single dead specimen.

3. *Helix Scenoma*, B., n. sp.

H. testa anguste infundibuliformi-umbilicata, subgloboso-conoidea, oblique irregulariter striata, striis minutissimis spiralibus decussata, sub epidermide cornea albida, carina interdum fascia rufo-castanea ornata; spira conoidea, apice obtusiusculo, sutura impressa; anfractibus 6, convexiusculis, ultimo antice vix descendente, ad peripheriam obtuse subcompresso-carinato, subtus convexo, circa umbilicum compresso; apertura obliqua, subquadrato-lunata, peristomate expansiusculo, margine columellari reflexiusculo.

Diam. major 16, minor 14, axis 11 mill.

Var. *depressa*: diam. major 17, minor 15, axis $10\frac{1}{2}$ mill.

Habitat prope Moulmein.

A single specimen, slightly worn, of the type was received with *Helix Gordoniæ*. Specimens of the depressed form were collected by Col. Robert Gordon.

4. *Helix brachyplecta*, B., n. sp.

H. testa dextrorsa, late umbilicata, discoidea, obesiuscula, minute arcuato-striata, striis minutissimis spiralibus obsolete decussata, opaca, non nitida, rubescenti-castanea, superne saturatiore, circum apicem succinea; spira planata, apice vix prominente, sutura impressa; anfractibus 6, lente accrescentibus, convexiusculis, ultimo rotundato, superne prope suturam subangulato, antice descendente; apertura obliqua, rotundato-lunari, subauriculata, intus lilacina; peristomate expansiusculo, reflexiusculo, rufo-castaneo, marginibus remote convergentibus, plica arcuata prominente parietali junctis, lamina longiuscula subascendente e medio plicæ intus recedente, plicis 2 parietalibus remotis verticalibus, quarum externa arcuata internaque curvata, laminis 6 remotioribus palatalibus, quarum superiore et basali tenuibus et 4 medianis incrassatis, foveatis; umbilico lato, concavo.

Diam. major 22, minor 18, axis 8 mill.

Habitat ad ripas fluvii Attaran prope Moulmein. Teste Col. R. Gordon.

An obese dextrorse *Plectopylis*, bearing, in some degree, the same relation in form to *H. refuga*, Gould, that *H. Charpentieri*, Pfr., does to *H. Rivolii*, Fér.; but the interior parietal and palatal laminæ and plicæ differ widely from those of the shell from Phye Than, referred to, in the 'Annals' for April 1860, as a dextrorse variety of *H. refuga*, and from all the other species which have come under my inspection, including two new forms discovered by Mr. W. T. Blanford in Ava and Pegu.

5. *Helix Aspides*, B., n. sp.

H. testa obtecte perforata, orbiculato-depressa, vix striatula, lævigata, polita, cornea, subdiaphana; spira convexiuscula, subplanata, apice elevatiuscula, sutura leviter impressa, submarginata; anfractibus 6, vix convexiusculis, lente accrescentibus, ultimo demum latiore; apertura obliqua, late lunata, peristomate breviter patente, intus incrassato albido, subtus latiore, margine superiore prominente valde arcuato, basali arcuatim bisinuato, columellari brevissimo, superne reflexiusculo, pariete tenuissime calloso.
Diam. major 11, minor 9, axis 5 mill.
Habitat —— ?

This shell may at once be distinguished from the Burmese *H. Petasus*, B., and the allied forms, by the white, thickened, and expanded inner edge of the peristome, the sinuate basal margin, and the somewhat wide superior margin of the aperture. A single specimen was sent by Mr. W. Theobald for examination, without any indication of the locality, which may possibly be Burmese.

6. *Helix fritillata*, B., n. sp.

H. testa perspective umbilicata, depresso-subconoidea, arcuatim costulato-striata, subtus læviore polita, superne striis confertis spiralibus impressis decussata, interstitiis conspicue quadrato-granulatis, pallide cornea; spira convexa, subconoidea, apice obtuso, lævigato, sutura profunda; anfractibus 6, angustis, lente accrescentibus, convexis, ultimo demum latiusculo, extus depresso, antice vix descendente, subtus valde convexo, circa umbilicum excavato; apertura obliqua, oblique semiovato-lunata, peristomate superne tenui, valde arcuato, subtus breviter expansiusculo, arcuato, extus marginato, marginibus remotioribus.
Diam. major 13, minor 12, axis 7 mill.
Habitat in regione Peguensi.

A single specimen, belonging to the Museum of the Asiatic Society of Calcutta, was received for examination.

In the 'Annals of Natural History' for September 1860, *Helix consepta*, B., was founded on a single specimen found at Damatha, near Moulmein, by Major Haughton. I have since found a specimen of the same shell in Col. Robert Gordon's collection, made at Moulmein; and a dwarf variety from Pegu belongs to the Museum of the Asiatic Society of Calcutta.

7. *Helix phyllophila*, B., n. sp.

H. testa vix perforata, trochiformi, tenui, superne sericea, oblique striatula, subtus subnitente, utrinque (sub lente) striis confertissimis undulatis minutissime ornata, translucente, pallide cornea; spira conica, apice acutiusculo, sutura impressiuscula; anfractibus $6\frac{1}{2}$, convexiusculis, ultimo carinato; apertura obliqua, subquadrato-

lunari, peristomate simplici, recto, acuto, margine columellari verticali, reflexo, superne latiore, umbilicum subtegente.
Diam. major 5, minor $4\frac{1}{2}$, axis 5 mill.
Habitat ad Badulla, Ceylon. Teste F. Layard.

The fully grown shell was taken at Badulla, on Love-apple leaves; and a depressed form, which appears to me to be the young, on those of Coffee-plants. A small specimen of a variety occurred at Fort M'Donald. The species comes very near *H. Infula*, B., which inhabits the leaves of shrubs in Bengal and Bahar; but the subremote spiral lines, elevated on the upper and sharply impressed on the lower side in that species, are replaced on both sides, in the shell now described, by minute and closely-set undulate striæ.

Helix Barrakporensis, Pfr., a shell which occurs in the Lower Himalaya, from Dehra Dhoon to Sikkim, and which the Messrs. Blanford, in a contribution to the Journal of the Asiatic Society of Calcutta, No. 283, for 1861, notice as found by Mr. R. Bruce Foote in the Kalryen Hills, near Salem, in Southern India, was obtained by Mr. F. Layard at Kandookerre, in Lower Ourah, Ceylon—a distribution equal in extent to that of *Helix Huttoni*, Pfr.

Mr. W. T. Blanford, in page 86 of the 'Annals' for February 1863, under the heading "Ganesella," includes *Helix Capitium*, Bens., from the Rajmahal Hills, and *H. variola*, Bens., from Thayet Mio and Pegu, adding that the distinctness of the two species appears very dubious. On reference to the colouring of the two forms it is evident that "*variola*" is a misprint for "*Hariola*." A comparison of the wide and depressed form of *H. Hariola*, as figured in Pfeiffer's 'Novitates Conchologicæ,' pl. 36. f. 21, 22, with a perfect example of the high conical form of *H. Capitium*, or with the well-drawn figures in Küster's edition of Chemnitz, pl. 125. f. 3, 4, will at once satisfy the inquirer that the two species are perfectly distinct. I feel assured that Mr. W. T. Blanford has not examined a fully-grown example of the Sicrigully shell discovered by Capt. Boys in the low ground intervening between that detached hill and the main range of the Rajmahal Hills.

8. *Clausilia Bulbus*, n. sp.

C. testa sinistrorsa, vix rimata, oblongo-obovata, pupiformi, regulariter oblique striata, rubenti-ferruginea; spira obovata, superne ventricosa, versus apicem obtusum concamerata, sutura impressa; anfractibus $5\frac{1}{2}$, convexiusculis, primis rapide accrescentibus, antepenultimo tumido, penultimo decrescente, ultimo angustiore, pone aperturam impresso, subangulato, infra rotundato; apertura vix obliqua, oblique auriformi, peristomate continuo, margine late expanso, reflexiusculo, albido-rubente, lamella superiore acuta, prominente, longe intus intrante, spirali, infera forti, oblique spiraliter ascendente, subcolumellari immersa; plicis palatalibus 7, superiore valde elongata, late erecta, intus cum lamella superiore rimam angustam efformante, 6 inferioribus brevibus, subparallelibus, lunella nulla.

Diam. anfract. antepenultimi 9, ultimi supra aperturam 5, axis 23 mill.; apert. (oblique) longa 8, lata 7 mill.

Habitat ad ripas fluvii Attaran, non procul ab urbe Moulmein.

This most singular form in the genus was found by Col. Robert Gordon in the same locality as *Opisthoporus Gordoni, Helix brachyplecta,* and *H. Gordoniæ*—shells which escaped the observation of former collectors in that rich district. The bulbous pupiform figure of the shell at once distinguishes it from *Cl. Philippiana,* Pfr., an inhabitant of the Farm Caves, as well as from any other known species. The upper lamella runs spirally up the aperture, forming a narrow slit between it and the upper knife-like plica.

9. *Bulimus Stalix,* B., n. sp.

B. testa rimato-perforata, oblongo-conica, solidiuscula, oblique irregulariter plicatulato-striata, epidermide spiraliter confertissime striatula, castanea, strigis obliquis, sutura, basi apiceque albidis; spira elongato-conica, apice obtusiusculo, sutura impressiuscula, nonnunquam marginata; anfractibus 7, convexiusculis, ultimo ad basin compressiusculo, antice vix ascendente; apertura subobliqua, anguste pyriformi, intus castanea, peristomate sensim dilatato, vix reflexiusculo, albido, marginibus remotis, non conniventibus, columellari lato, callo obliquo superne castaneo junctis.

Long. 20, diam. 7 mill.

Habitat ad Boralande.

Found by Mr. F. Layard in the district of Upper Ourah, in Ceylon. Its nearest ally is *Bulimus proletarius,* Pfr., which was taken by Mr. Layard at Bootelle and Kaluganga.

10. *Opisthoporus Gordoni,* B., n. sp.

O. testa late et concave umbilicata, depressa, discoidea, confertim striata, sub lente striis minutis spiralibus, nonnullis elevatiusculis, decussata, albida, strigis fulguratis castaneis fasciaque fusca dentata ad peripheriam ornata; spira planata, apice non elevato obtuso, sutura profunda, demum canaliculata; anfractibus 5, gradatim accrescentibus, convexis, ultimo rotundato, antice descendente, pone alam breviter soluto, 4 millim. pone aperturam spiraculo suturali brevi retrorsum spectante, nonnunquam subobsoleto, munito; apertura valde obliqua, circulari; peristomate duplici, interno prope anfractum penultimum breviter inciso, exteriore superne et ad dextram angulatim expanso, reflexiusculo, ala intus concava insuper anfractum penultimum antrorsum ascendente munito.

Diam. major 22–23, minor 17–19, axis 5–6 mill.

Habitat non procul ab urbe Moulmein. Invenit Col. R. Gordon.

The last whorl is slightly solute behind the wing, which runs forward up the penultimate whorl, to which it adheres. This is the first species of the genus which has been discovered in Burmah. Two specimens were found on the banks of the Attaran River, near limestone rocks, fifteen miles from its mouth. In one shell the sutural spiracle is worn down to the surface. The operculum was not obtained.

Animal of Sophina.

I am indebted to Col. R. Gordon for observations on the animal of *Sophina*. It proves to be acrommatous, and allied to *Helix*, from which, with reference to the anomalous slit in the columella, it may be separated on grounds as decided as those which suffice for the distinction of the genera *Achatina* and *Streptaxis*.

Sophina.—Animal with four tentacula, two long and two short; the eyes situated on the summits of the larger pair. Colour greyish-blue, with a yellow tint, and a dark spot between the greyish-blue tentacula, the dark colour extending along the neck.

Cheltenham, April 6, 1863.

XXXVI.—*On Natural and Artificial Section in some Chætopod Annelids.* By W. C. Minor*.

The circumstances of spontaneous fission have been observed in so few species of Annelids at present as to make every additional observation of value, even though only confirmatory of what is already known upon that subject. This consideration, and the fact that all views of its nature in the Oligochæta seem to be based upon the observation of one species (*Stylaria proboscidea*), have tempted me to publish the following brief investigations, however they may want any very special novelty to give them value.

It is now nearly one hundred years since the distinguished Danish naturalist, Otto Fr. Müller, studied the phenomena of spontaneous fission in the freshwater Naids†; and his able little

* From Silliman's American Journal for January 1863.

† Trembley had discovered it long before this, as he observes in his 'Mémoires p. s. à l'hist. d'un genre de Polypes d'eau douce,' 1744; and Roesel, in his 'Insektenbelustigungen,' describes the united parent and bud; but the former did no more than observe the fact, and the latter wholly misunderstood what he saw.

work 'von Würmern des süssen und salzigen Wassers,' Kopenhagen, 1771, largely devoted to that subject, shows that he failed only where the imperfect means at his command led him astray. The multiplication by artificial section had been observed before that, both in the Naids and other animals, and had awakened a good deal of general interest; but the multiplication by spontaneous fission seems to have been very nearly, if not wholly disregarded at that time. Nor has its occurrence in the freshwater worms received, since then, the investigation that it seems to demand; for, with the exception of a discussion by Schultze and Leuckart upon some of the particulars, and the significance of this phenomenon in relation to budding, some ten years ago, and a sweeping denial of its occurrence, or, at least, of its vital and systematic nature, by Dr. Williams, about the same time, no one, so far as I am aware, has published any extended observations upon the fissiparity of the freshwater Naids since the time of Müller*. And yet the statements of Dr. Williams, in regard to both artificial and spontaneous fission, are such as to suggest at once the importance of a re-examination of the whole subject; while the great interest given to this question by the remarkable speculations of Steenstrup, together with the interesting varieties of the phenomenon as observed in the marine worms by Quatrefages, Edwards, Frey and Leuckart, and others, seem to demand a more complete knowledge than we as yet possess of its occurrence in the freshwater group.

I may here remark that the European species chiefly studied hitherto, *Stylaria proboscidea*, has not come under my observation, nor am I aware that it has been found in America. Four species of Naids common in this vicinity, *Stylaria* (*Pristina*) *longiseta*, *Nais rivulosa*, and *Dero limosa*, found in fresh water, and a marine *Enchytræus* (*E. triventralopectinatus*) have been the principal subjects of my investigation. In regard to the first of these, it may be questioned whether our species is identical with that described by Ehrenberg ('Symbolæ Physicæ') as *Pristina longiseta*; for his description is too brief to be of specific value. As, however, the characters given by D'Udekem in his "Nouvelle Classification des Annélides Sétigères Abranches" ('Mémoires de l'Acad. Royale de Belgique,' 1859, t. xxxi.) apply equally to the American species, I am compelled to regard it as the same †.

* Gruithuisen remarks, in his "Anatomie der gezüngelten Naide" (Nov. Act. Nat. Cur. t. xi. p. 243), only that it is uncommon to find a Naid without buds of the second generation, and refers to Müller for the details of their formation. Since writing this, I have seen, in Leuckart's valuable yearly report in the Archiv f. Naturgeschichte for 1861, a notice of Claus's observations on fission in *Chætogaster*, which, so far as there given, I can confirm.

† D'Udekem remarks: "Je n'ai pas adopté le genre *Stylaria* admis par

The second species, *Nais rivulosa*, already described by Leidy (Journal Acad. Nat. Sc. Philad. 1850, vol. ii. pt. 1. p. 43) very closely resembles the European *Nais elinguis*, with which D'Udekem regards it as identical. The third species, *Dero limosa*, has also been described by Leidy (Proc. Acad. Philad. 1857, vol. v. p. 226), and, though overlooked by D'Udekem, appears to be distinct from the European form of the same genus. The fourth, *Enchytræus triventralopectinatus*, I have not been able to identify with any species described in works at my command, and have therefore named from the three anterior pairs of ventral combs after which the dorsal combs begin. This character appears to distinguish it from *E. socialis*, if I may judge from the figure given by Leidy (Journ. Acad. Philad.). It has no eyes. The pharynx extends nearly to the fourth ventral or the first dorsal combs, from which a narrow œsophagus continues to a little back of the sixth ventral combs. Here a gradual enlargement of the alimentary canal occurs, ending abruptly just back of the eighth, in a narrow twisted tube; and this last gradually enlarges, at the ninth ventral combs, into a moderate-sized alimentary canal, in which I observed nothing specially marked. The entire length of this Naid was about $\frac{3}{8}$ inch.

The occurrence of spontaneous fission in *Stylaria* (*Nais*) *proboscidea* is described as follows by Müller:—"If a virgin Naid, as I may call it, with 16 or more pairs of hair combs, or 20 or more pairs of hook combs [there are 4 pairs of hook combs anterior to the first hair or dorsal combs as in *Nais* and *Dero*], be carefully observed, it will be seen that its anal ring slowly elongates, and, after some days, appears to be transversely marked within into rudiments of future rings*. In each of these divi-

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Lamarck et Ehrenberg, parce que cette espèce ne diffère des autres Nais que par l'allongement très grand de la lèvre supérieure. Ce caractère n'étant accompagné d'aucune modification importante dans la forme des autres organes, je ne puis le considérer comme assez tranché pour servir à former un genre nouveau." There is, however, a marked difference in the form and position of the cordiform anterior enlargement of the alimentary canal, which even the statements and figures of Müller and Gruithuisen indicate, between the Naids with a long upper lip or proboscis and those with a short one; and the manner of fission differs in these two groups, as will be shown. Lamarck's genus *Stylaria* is therefore a good one. Ehrenberg's division of this genus, however, based upon the absence of eyes, is unfounded; for I have seen *Nais rivulosa* lose them without any other apparent change, and Agassiz has stated that this occurs as a part of the normal development in many Naids.

* Schultze considers Müller in error as to the position at which fission takes place, because he describes it as occurring in a segment, and not between two. The difference of statement, however, is simply verbal, as Müller speaks of "die Zwischenräume der Borsten oder die Gelenke," p. 26, and in many other places shows very plainly that such is his meaning.

sions beneath the skin, germs of hooks and hairs appear; and the pulsations of the artery are evident while the food forces a way through them. The hooks and hairs gradually come through the skin in succession from before backward, while, the rings enlarging, the Naid increases considerably in length. While in this way new segments and their contents are forming within the anal ring, on the other side [anteriorly] of it a strongly marked transverse line, different from those just mentioned, appears, and extends across the whole width of the animal. The angles formed at the sides of the body project, and on the top a slight projection is evident, which gradually becomes a distinct proboscis, while, finally, eyes appear back of this fission. Thus the Naid becomes a mother." . . . " Frequently one may see in the anterior half of the elongated anal ring of the mother Naid a second ring-formation similar to the one just described." . . . " This is not all. Hardly has the second bud acquired the length of one mature ring than a third bud appears before it; and I have even seen a fourth." . . . " Further, not only may a parent and its four offspring thus appear, but the buds themselves may give rise to new buds, their terminal joints forming new buds as they themselves were formed. Hence we may find a parent with its children and grandchildren attached to its body." (*Op. cit.* pp. 34, 36.)

Müller afterwards gives his observations upon a single Naid from the 20th of May to the 9th of June. During this time it gave off the buds observed posterior to the 17th pair of combs, after which a formation of rings began, without any trace of separation, until the body was elongated to over 40 pairs of combs. About this time a fission occurred between the 21st and 22nd pairs of combs. Fission occurring in this way after an elongation of the body I shall speak of as the "renewal of fission." Further observation of individual Naids led him to conclude that each bud is formed one joint anterior to its predecessor, that there is thus a gradual reduction of the parent segments till a certain point; that then a re-formation of rings takes place, and an elongation of the body of the Naid to recommence this circle of fission.

Schultze, in his article "Ueber die Fortpflanzung durch Theilung bei Nais proboscidea" (Archiv f. Naturgeschichte, 1849, t. xv. p. 293) confirms the statements of Müller as to the passage over of one of the parental segments to each bud*, though he was not fortunate enough to observe the recommencement of fission in the elongated Naid. He observes also (p. 301) that, contrary

* Leuckart at first doubted the correctness of this view ("Ueber die ungeschlechtliche Vermehrung bei Nais proboscidea;" Wiegm. Arch. 1857), but has since been convinced of its justice.

to what Steenstrup had supposed from the analogy of marine worms, there is no relation to metagenesis in the phenomena of budding in this Naid; for he had never seen generative organs in the separated buds. He had, however, never been able to keep these buds long alive. He also had seen (p. 304) sexual organs in the parent while budding, though he had never seen well-developed sperm and ripe eggs present during this process.

The phenomena of fission in *Stylaria longiseta,* so far as I have observed them, confirm the statements of Müller and Schultze in substance; for there is nearly always a passage over of one parental ring to each bud; and since fission takes place, as I have seen, while the parent has eggs and sperm, and I have never seen the fullest development of the latter in the buds, I cannot believe that there is any such metagenetic relation in this process as has been observed in *Syllis* and allied genera.

In *Nais rivulosa,* however, the facts are somewhat different; for in several continued observations of individual Naids, extending in one case over twelve weeks, I have known but once or twice of a passage of the parental rings into the bud; while, after an elongation of the parent body, I have very uniformly seen fission recommence in the point at which buds were given off before, or at some point posterior to it, and once anterior; and finally, although I have seen fission taking place between each of the rings from the 15th to the 22nd, I have not been able to discover that it does so in any order. But here, as in *Stylaria longiseta,* I have found no metagenesis in the fission.

The facts obtained in regard to fission in *Dero limosa* are unfortunately meagre, the comparative slowness of the merismatic function making the only two series of observations carried out proportionately unfruitful. In none, however, of the succeeding buds, from Aug. 15th to Oct. 10th, was there any carrying off of parental segments by the separating parts, nor was there anything like metagenesis observed.

My observations upon *Enchytræus triventralopectinatus* are similarly scanty, but are just sufficient to confirm and extend the facts observed in the two other short-lipped Naids. In all the cases observed, the separation was of a part wholly new-formed, without inclusion of the older segments of the parental body.

It is evident, from the above facts, that in *Stylaria longiseta,* as Müller and Schultze have shown is the case in *S. proboscidea,* the point of fission moves regularly forward, ring by ring, and more commonly, in the former Naid, from the 16th to the 12th pairs of hook combs, though the extremes between which I have known it to occur are the 17th and 10th (to judge from Müller's account, it occurs further back in the latter Naid);

further, that in *Nais rivulosa,* and, as far as I know, in *Dero limosa* and in *Enchytræus triventralopectinatus,* all of which have short upper lips, the buds are given off at one point, though that point may vary in different Naids of the same species, or in one and the same Naid at different times. In the latter case, the variation occurs as part of a peculiar form of fission of which I shall speak again. Both "parting" (Theilung) and "budding" (Knospenbildung) occur, then, in the Naids; and it may be added that the former appears to be peculiar to the genus *Stylaria,* or to the proboscis-bearing forms.

I may here remark that the distinction made by Schultze and others between "Theilung" and "Knospenbildung," though convenient, does not seem to me a fundamental one. The mere inclusion of a portion of parental tissue in the bud does not of itself make an essential distinction between this and a wholly new-formed, but otherwise similar, bud; nor have I been able to see any histological or functional differences. The very fact that individuals having the same genetic relations to the parent stock are in one Naid (*N. rivulosa*) always or commonly produced by the so-called "budding," and in another genus (*Stylaria*) by the so-called "parting," leads to this view. Nor, as I think, though observations are largely wanting in that direction, have the two yet been shown to be functionally different in true metagenetic processes. They are two varieties of one process; and it would be interesting in many ways to know exactly how the various species of Naids already known follow distinctly the one or the other plan, or tend to merge them yet more completely as one*.

A little detail will show how closely identical the two forms of bud-formation are. In "parting" ("Theilung"), as has already to a great extent been described by Schultze, we find that, from the parental ring as a fixed point, there is a continuous ring-formation and elongation backward; and that anteriorly to it there is a limited elongation of the general body, also by ring-formation from before backwards. There is, then, unlimited growth backward from the fixed point, and a limited or defined growth backward toward the fixed point from the place of fission. The parental included ring, the most anterior of the series, is here the fixed point. In "budding" ("Knospenbildung"), the most anterior ring of the series also, though a wholly new-formed one, becomes the fixed point, from which, by continuous ring-formation, the Naid elongates backward, and towards which a

* I have known "budding" to intercalate once in a series of fissions in *Stylaria longiseta* (May 31), and I have also known "parting" to interrupt a series of buddings in *Nais rivulosa* (Sept. 25), which leads me to expect that in some Naids both processes may be regularly present.

limited series of ring-formations proceed from the point of fission*. The resemblance between the two is perfect; and as the fixed point is not related to specializations of the alimentary tube as I at first supposed, and is in *Stylaria proboscidea*, where it occurs by "parting," four hook combs back of the mouth, as it is in *Nais* and *Dero*, where it occurs by budding, while in *S. longiseta* it is six hook combs back, the genetic relations of the two processes, in these genera at least, are completely one. But, as I have already said, though the distinction appears unessential in the genera I have examined, the terms are convenient, and, as merely descriptive terms, are used here.

The "commencement of fission" was observed in a large proportion of the buds given off from the individuals of *Stylaria* and *Nais* which were under observation, and the result is given in the following table.

Stylaria.				*Nais.*		
Between	12–13th	combs in none.		Between	17–18th	combs in 3
„	13–14	„ 2		„	18–19	„ 3
„	14–15	„ 12		„	19–20	„ 4
„	15–16	„ 9		„	20–21	„ 3
„	16–17	„ 1		„	21–22	„ 3

It is evident that fission does not begin at a fixed point; nor have I been able to discover any relation between the place of its occurrence and the time of the year, temperature, &c.

Now, while fission may take place by gradual reduction of the Naid *Stylaria*, between the 10th and 11th hook combs, the commencement of fission has not been known forward of the 13th. In *Nais rivulosa*, also, fission has been observed as far forward as the 15–16th, while its commencement has not been noted anterior to the 17th hook combs. This is all the difference between the commencement of fission and continued fission, notwithstanding the fact that, whether the former is introductory to a series of "partings" or of "buddings," its bud resembles that produced by what I shall call the "renewal of fission."

That the "renewal of fission," in a Naid elongated after reduction by fission, is a somewhat peculiar form of fission would hardly have been known from observations on *Stylaria* alone†.

* There is an interesting analogy between this process in the Naids and the embryonic growth of *Terebella*, as described by Milne-Edwards. He has remarked ("Obs. sur le Développement des Annélides," Ann. des Sc. Nat. 1845, sér. 3. t. iii.) that the first defined part is not the cephalic nor the anal, but the œsophageal, and that growth takes place both anterior and posterior to this by succession from before backward. Other speculations and analogies suggest themselves here, but are, in our present knowledge, wholly premature.

† Yet Müller seems to notice these two forms of fission, and says that, "though at first view different, they are fundamentally the same." (*Op. cit.* p. 38.)

The following summary will illustrate this. In *Stylaria longiseta*, one example (April 16) was reduced to 10 rings, grew out but little, and divided between the 12–13th. When again reduced to 10 rings, it grew out much longer, but renewed fission at the same point as before. It was then reduced to 11 rings, and, growing out, again divided between the 12–13th. One of its buds (May 14) began fission between the 15–16th, was reduced to 12 rings, then grew out and recommenced fission between the 14–15th, and was being reduced again when lost. In another case, the Naid was reduced to 12, grew out and renewed fission at the 14–15th, was again reduced to 12, and, growing out again, renewed fission at the same point. It was a third time reduced to 12, and growing out again a third time, renewed fission between the 14–15th hook-combs. It was then reduced to 11, when very unfortunately it was lost. In *Nais rivulosa*, an example that had been giving off buds just back of the 19th ring, increased to something like 33, and then again renewed fission between the 19–20th. Another example, that had given off buds at the 15th, grew out to over 35, and then renewed fission at the 15–16th. After two or three buds had been given off, it again elongated, and then renewed fission between the 20–21st hook combs.

Now, while in *Stylaria* the "renewal of fission" appears to differ from the commencement of fission, with which I believe it is essentially homologous (except by not occurring as far back), which may be owing to the want of fuller observation, and while in this genus it might be supposed to be merely a means of continuing the process of "parting," which must otherwise soon cease, we find that it occurs in *Nais rivulosa* without any change of the point of budding, without any apparent necessity, without performing the very function that we might judge from *Stylaria* was its peculiarity. And what is more, it also occurs in *Nais rivulosa* for the performance of this very function. This fact suggests something more than a physiological meaning in the "renewal of fission." While the phenomena connected with it seem to show that the distinction between this, the "renewal of fission," and other forms of fission is more than a difference of function, I am far from claiming that there is any fundamental difference, like that between metagenetic and monogenetic fissions. I may add that I have not been able to discover that the point of its occurrence bears any relation to the number of buds already given off *.

The sum of the preceding observations tends to show that the "renewal of fission" has some special characters that suggest a

* There are some other differences to be considered in a future paper upon the histological nature of fission.

wider inquiry as to its true nature; that the two forms of fission already known as "parting" and "budding" both occur in the Naids, and occur so as to prove their morphologic and physiologic identity; that "parting" appears to characterize the Naids with a prolonged upper lip (the genus *Stylaria*), while "budding" appears to characterize those with a short one (*Nais, Dero, Enchytræus*, and *Chætogaster*, according to Claus); that the bud produced by both these processes is identical with the parent; that as the buds are here, so far as I know, identical with their parents in function and structure, there is no metagenetic fission; and that therefore fission in these Naids, whether by "parting" or by "budding," is correlative to genesis in the great function of maintenance of the species, and not a mere step in the history of the individual*.

It may be worth while to refer briefly here to the power of reproduction from injuries commonly attributed to these little beings, especially as Dr. Williams, in his "Report on the British Annelida" (Rep. Brit. Ass. Adv. Sc. 1851, p. 247), after quoting a summary of Bonnet's well-known experiments, says, "On the authority of hundreds of observations laboriously repeated at every season, the author of this report can declare with deliberate firmness that there is not one word of truth in the above statement." It may be presumed from this, that Dr. Williams felt the necessity of thorough and very careful investigations before contradicting the statements so often repeated upon this subject; and I cannot doubt that his experiments have uniformly failed. But, from the almost uniform success of my own, I should wonder that they have done so, had not others reported complete or

* "From the analogy of the two species (*Arenicola* and *Nais*) on which the author's observations have been chiefly conducted, the conclusion may be deduced that the 'fission of the body,' in every other species of Annelida in which it occurs, has for object in like manner to protect and incubate the ova.". . . . "It becomes the last act of the parental worm, since the portions into which the body is subdivided by fission *never take food.*" . . . . "It is a catastrophe in which every autumn involves the whole community." (Williams, Rep. Brit. Annel. pp. 249, 250.)

I should be far from wishing to extend the conclusions I have made to all other Annelids by mere analogy; but my observations are, at least, wholly incompatible with a general application of Dr. Williams's statements to the Naids.

The exact circle of life and its duration I have not determined, nor do I feel certain that any of the general statements (see Leidy, 'Flora and Fauna within Living Animals,' 'On *Stylaria fossularis*,' and Williams at large) are absolutely correct; for I have known the process of fission to go on in winter, when the Naids were kept in a warm place, while I have also seen what appeared to be a loss of this power, as shown in badly formed and incomplete buds occurring in the warmer parts of the year.

partial failures in similar experiments. (See Dugès, Ann. des Sc. 1828, sér. 1. t. xv.) It must be remembered, however, that such evidence is wholly negative, and cannot weigh with the positive statements of observers like Müller, Réaumur, and Dugès.

In regard to my own observations, I may state briefly that in *Stylaria, Nais,* and *Dero* I have hardly ever failed to have the head reproduced, and that the anal end has not only been reproduced in these genera, but I have seen it reproduced in *Enchytræus,* in *Lumbricus,* in *Fabricia,* and even in a *Nereis* common on our coast*; that in the vast majority of these cases I have seen food taken again; and in all, I have seen the in-current anal stream, which ceases while either end is closed, recommence. From these and other observations, I am inclined to believe that this power is far more general in the class than is yet supposed.

That this power plays a part in the natural economy of life, the healing fragments of Naids that I have found in our pools is a proof. When saved from the attacks of *Chætogaster,* even the shortest, headless and almost immoveable fragments may go on to as full a recovery as when preserved by the observer. In one instance I found (Aug. 21st) what were apparently five segments of some Naid's trunk, the two ends of which had closed and elongated. This had been preserved for some time; for the sur-œsophageal brain was well-formed anteriorly, and the germs of hook combs were well-defined posteriorly. It went through a rapid growth, developed eyes about the 22nd, opened the newly formed mouth about the 23rd, was supplied with food, and, growing long, divided between the 15–16th hook combs, and then gave off five buds in succession at that point till Oct. 8th, when it was lost.

The thin film with which the Naids line the jars in which they are kept may be seen to serve, there at least, as a protection against the attacks of the prowling carnivorous *Chætogasters;* and once beneath this, a fragment, like the one just referred to, may be preserved till the eyes and mouth are formed—a period usually of a fortnight. And though we should hardly have

* Careless observations, made a number of years ago, led me to think that the Nereids are destitute of the power of recovery from injuries; and Williams states that they always sloughed away, ring after ring, in his experiments. Réaumur remarks, "Les expériences que j'ai fait faire sur des millepieds de mer, d'une toute autre longueur, sur de ces millepieds longs de sept à huit pouces, n'ont pas eu le même succès: mais les essais n'ont peut-être pas été encore assez répétés ni assez suivis." (Mém. pour s. à l'hist. des Insectes, t. vi. p. 59.) Thinking the latter statement very probable, I retried the experiments, during the past year, with more care, and in every case with success.

expected a mere piece of five segments to be preserved as this was, even though endowed with the power of recovery, yet we cannot regard so extended and remarkable a function as this appears to be as useless or inoperative in the natural course of Naid-life.

XXXVII.—*On the Geographical Distribution and Varieties of the Honey-Bee, with Remarks upon the Exotic Honey-Bees of the Old World.* By Dr. A. Gerstäcker.

[Concluded from p. 283.]

After some remarks on the singular fact that, in Africa, which generally exhibits such a remarkable uniformity in its insect-fauna, the geographical distribution and varieties of the Honey-Bee are more complicated than elsewhere, the author proceeds to the consideration of the diffusion of the Bee in America.

The American form is identical with the dark-coloured North-European one. In some American countries, for example, Brazil, the Bee is known to have been introduced from Europe; but it has been questioned whether this applies equally to other regions, such as North America, where the Honey-Bee has existed much longer. With the exception of Olivier (Enc. Méth. Ins. i. p. 49), who doubted the identity of the American Bee with the European species, the best European entomologists have been in favour of the introduction of this insect from Europe into America. Dr. Gerstäcker quotes Latreille*, St. Fargeau†, Westwood‡, and Lacordaire § in support of this statement. Latreille states, on the authority of Bosc, that in North America "the savages know that they are in proximity to the possessions of the Anglo-Americans by the presence of the societies of these insects." Among the native American writers the author quotes Thomas Jefferson, who, in his 'Notes on the State of Virginia' (1787, p. 121), speaks as follows:—"The Honey-Bee is not a native of our continent. The Indians concur with us in the tradition that it was brought from Europe; but when, and by whom, we know not. The Bees have generally extended themselves into the country a little in advance of the white settlers. The Indians therefore call them 'the white man's fly,' and consider their approach as indicating the approach of the settlements of the whites."

Prince Maximilian of Wied (Reise in Nord-Amerika, i. p. 180 & ii. p. 346) speaks in similar terms of the introduction of the

* Humboldt, Obs. Zool. p. 299, and Ann. Mus. p. 167.
† Hist. Nat. Ins. Hymén. i. p. 401.
‡ Introd. ii. p. 285. § Introd. à l'Entom. p. 543.

Honey-Bee into the United States, and adds that "it is now diffused far up the Missouri, and its honey is cut out of the hollow trees by Indians and whites." John Josselyn (Voyage to New England, 1663, p. 120) says, "The Honey-Bees are carried over by the English, and thrive there (in New England) exceedingly;" and Benjamin Smith Barton, in a learned and impartial memoir entitled "An Inquiry into the Question whether the *Apis mellifica*, or true Honey-Bee, is a native of America" (Trans. Amer. Phil. Soc. iii. pp. 251–261, Philadelphia, 1793), expresses himself decidedly in favour of the introduction of the Bee from Europe, and supports his opinion by the most convincing proofs.

Authors have not been wanting, however, especially among the North Americans, who have endeavoured to give their country the credit of the original possession of so valuable an insect as the Bee. The arguments of Van der Heuvel, in his memoir "On American Honey-Bees" (Silliman's Journal, iii. pp. 79–85, 1821), already sufficiently refuted by Brun (Bienenzeitung, 1858, pp. 37–44), are evidently chiefly derived from a treatise by a Dr. Belknap, published in 1792, and entitled 'A Discourse intended to commemorate the discovery of America by Christopher Columbus.' An appendix to this latter memoir contains an argument against the European origin of the North American Honey-Bees, supported on the following facts:—1. Columbus, on his first return from the Antilles, when threatened with destruction in a storm, inclosed a report of his voyage in a capsule of wax which he obtained at Hispaniola. 2. According to Purchas, the Mexicans had to furnish a certain quantity of honey yearly as tribute to their kings, even before the arrival of the Spaniards. 3. Also according to Purchas, when Ferdinand de Soto, in the year 1540, came to Chiaha in Florida, he found amongst the stores of the Indians of that place a pot full of Bees' honey. At this time no Europeans were settled in America, except in Mexico and Peru; whence the author concludes that, before the arrival of Europeans, the Honey-Bee must have existed as far north as Florida. With regard to the first case, as indicated by Barton, the wax used by Columbus might have been obtained from plants, such as *Myrica cerifera*; but indigenous Honey-Bees of the genera *Trigona* and *Melipona* existed in the Antilles before their discovery by Europeans. Clavigero was acquainted with five Mexican species of Honey-Bees, and we now know at least sixteen; so that the Mexicans could have had no want of honey even before the arrival of Cortez. Thus both the first evidences adduced by Belknap come to nothing. An apparently stronger proof of the early existence of the true Honey-Bee in Mexico, which has escaped both Belknap and

Barton, is to be found in the work of Hernandez on New Spain (Franc. Hernandez, Rerum medicarum Novæ Hispaniæ Thesaurus, Romæ, 1648, lib. ix. p. 333. cap. 21). Hernandez says, "Multa mellis genera in Nova Hispania mihi adhuc observare licuit, non loco solum, veluti vetere orbe, verum ipsa materia et apum diversis generibus distantia. Primum est Hispaniensi per omnia simile idemque et quod ab apibus Hispanicis congeneribus sponte in cavitatibus arborum fabricetur, quas Indi sectas in apiaria reponunt ac congerunt." Such evidence as this, from an observer only seventy years later than the conquest of Mexico, would almost seem to be convincing; but it may be urged, on the one hand, that there had been time enough for the introduction of the European Bee into the colony and for its dispersion, and on the other, with more probability, that, as Hernandez had no pretensions to be a practised zoologist, he mistook one of the native species for the true Honey-Bee. This is rendered more probable by the existence in Mexico of a species of *Melipona* (still undescribed) intermediate between *M. rufiventris* and *bicolor*, Lepel., which so closely resembles the European Honey-Bee, at least in form and size, that an unpractised observer of the sixteenth century might easily have confounded them.

With regard to Belknap's third proof, Barton thinks that, on account of the occurrence of indigenous Bees (*Melipona*, *Trigona*), the pot of honey found by Ferdinand de Soto in Florida has no more value as evidence than the Mexican tribute. But this notion is without foundation, as we have no evidence of the existence of such Bees in Florida. It is, however, not improbable; for as only *one* species of *Melipona* (the *Apis atrata*, Fab.) is known from North America, whilst the northern extension of the *Meliponæ* and *Trigonæ* otherwise terminates with the Antilles and Mexico, we may assume with great probability that this single species, which extends beyond the proper district of its group, will exist in the southernmost portion of North America. But however this may be, Purchas's statement can by no means lead to the assumption that the European Bee existed in Florida in the time of Ferdinand de Soto, as is shown by another report, by a Portuguese nobleman who accompanied that general (A Relation of the Invasion and Conquest of Florida by the Spaniards under Fernando de Soto). In this it is stated that "The Indians of Chiaha had a great quantity of butter or, rather, fat, in pots, as fluid as oil; they said it was bear's fat. We also found there walnut-oil, as clear as the fat, and a pot of honey, although neither before nor afterwards did we find either bees or honey in the whole of Florida." Barton also quotes a statement of William Bartram's which directly proves the introduction of the Honey-Bee into Florida. He says, "When Bartram was in

West Florida, in the year 1775, a beehive, the only one in the country far or near, was shown to him as a curiosity; it had been brought there from England when the English, in 1763, took possession of Pensacola. In East Florida the Honey-Bee is certainly now (in 1793) met with in a wild state, and it has been known there for a long time, perhaps a hundred years;" but Bartram's investigations convinced him that it was not indigenous there. Although the date of the introduction of the Honey-Bee into North America cannot be fixed, two circumstances mentioned by Barton indicate clearly that it must have been introduced by the whites. One of these is the name of the "white man's fly," given to the insect by the Indians; the other the fact that when John Elliott was translating the Bible into the language of the Indians, no expression existed in the latter for either wax or honey.

However probable it may appear, from these considerations, that the Honey-Bee was introduced into North America from Europe, we still want the certain historical proof of the introduction, and of the time when it took place; nevertheless the following historical evidence renders the fact of the introduction from Europe not in the least doubtful:—

1. According to Barton (*loc. cit. suprà*, p. 251), Penn, the founder of Pennsylvania, does not mention the Bee in a letter of details to his friends, in the year 1683; had it been a native of Pennsylvania, he would not have omitted so useful an insect from his catalogue of Pennsylvanian animals. The older Swedish writers upon Pennsylvania also do not mention the Bee. 2. Lawson (Voyage to Carolina, 1704) does not notice the Bee amongst the animals indigenous to Carolina. 3. Barton (*loc. cit.* p. 258) says, "The Honey-Bee did not exist in Kentucky when we first became acquainted with the country. But about 1780, a beehive was brought by a Colonel Herrod to the Falls of the Ohio, since when these insects have increased extraordinarily. Not long since a hunter found thirty wild swarms in one day." 4. Barton further states that "Honey-Bees were not found in the Jenessie district of New York either at the time when it was first visited or for a considerable time afterwards. Recently (towards 1793) two beehives were introduced, and these will undoubtedly soon spread over the neighbourhood." 5. D. B. Warden (Statistical, Political, and Historical Account of the United States, 1819, vol. iii. p. 139), quoting from Bradbury, says, "Before the year 1797 the Honey-Bee was not found to the west of the Mississippi; they are now seen as high up as the Maha nation on the Missouri, having proceeded westward 600 miles in fourteen years." 6, 7. Humboldt, speaking of the wax produced in Cuba, says that it is produced chiefly by the European

Bee, which has been much cultivated since the year 1772*. The Bee was introduced from Florida. 8. According to Ramon de la Sagra (Historia de la isla de Cuba, 1831, p. 80) the introduction of the Honey-Bee into Cuba took place from Florida in 1764; and in that author's 'Natural History of Cuba' (ii. 7. p. 327) *Apis mellifica* is mentioned as introduced into Cuba. 9. Ulloa, as quoted by Olivier (Enc. méth. Insectes, i. p. 49), gives the date 1764 for the introduction of the Honey-Bee into Cuba, and describes the extraordinary rapidity with which the insects multiplied and spread themselves over the country. 10. Moreau de Saint-Méry (Desc. de la partie Française de l'île Saint-Domingue, tome ii. p. 112, 1798) gives the date 1781 for the introduction of the Honey-Bee into St. Domingo; he says it was brought from Martinique by the Comte de la Croix.

From these various reports we gather that, in the most different parts of North America, where the Honey-Bee now exists, it was wanting not very long since, and that in some of them (*e.g.* in New York and to the west of the Mississippi) it was only introduced about seventy or even sixty-five years ago. We first find the Bee in West Florida in the year 1763; in 1780, first in Kentucky; a little before 1793, first in New York; since 1797, westward of the Mississippi. (In English North America, according to Josselyn, it existed as early as the seventeenth century, having been introduced there from England.) Thus the diffusion of the Bee has taken place in North America in a north-westerly direction. The introduction into West Florida by the English took place in 1763; in 1764 the Bee was introduced from Florida into Cuba, but from San Augustino in East Florida, where, according to Bartram, the insect existed at the end of the seventeenth century, having probably been introduced by the Spaniards. This joint introduction by the English and Spaniards is borne out by the fact that amongst both these nations we find the dark form of the Honey-Bee, which also is the one occurring in America; whereas the Asiatic form, from which the American Bees would most probably have descended had their migration taken place naturally, is the most light-coloured.

The extraordinary manner in which the Honey-Bee has thriven in America since its introduction is shown most strikingly by the production of wax in Cuba, where the cultivation of Bees has been carried on very extensively since 1772. According to Humboldt (Essai polit. sur Cuba, i. p. 259), the average export of wax, between 1774 and 1779, was only 2700 arrobas (=81,000 pounds); in 1803 it amounted to 42,700 arrobas

* Essai polit. sur la Nouvelle Espagne, 1811, tome ii. p. 455; Essai polit. sur l'île de Cuba, 1826, tome i. p. 259.

(= 1,281,000 pounds). In Ramon de la Sagra's 'Historia Fisica, &c., de la isla de Cuba (i. pp. 283 & 299) we find as the average amount for the first thirty years of the present century, 69,476 arrobas (=2,084,280 pounds) of wax, and 84,044 arrobas (=2,521,320 pounds) of honey. The quantity has probably increased considerably in the last twenty years.

Of the diffusion of the Honey-Bee in America south of the Antilles and Mexico we know very little. It is found in Honduras, according to Squier (Notes on Central America, particularly the States of Honduras and San Salvador, 1855, p. 199), but does not appear to have extended itself southwards from that country, as it is not even mentioned as occurring in Costa Rica by Wagner and Scherzer (Die Republik Costa Rica im Central-Amerika, Leipzig, 1856), although we can hardly suppose that Wagner would have passed it without notice had he seen it there. According to oral communication from Prof. Karsten, the Bee does not occur in New Granada and Venezuela; nor has it been sent from those republics by Moritz. The introduction of the Bee into Brazil (Minas Geraës) took place from Portugal in 1845, according to Reinhardt (Brun, Bienenzeitung, 1858, p. 43); and its great diffusion there is indirectly testified by Burmeister (Reise nach Brasilien, p. 220). The absence of the Bee in the States of La Plata and Chili appears from there being no mention of it in the works of Burmeister and Claude Gay (Reise durch die La Plata Staaten, Halle, 1861; Historia fisica y politica de Chile, Zoologia, tom. iii.–vii.).

On the Australian continent the Honey-Bee does not yet appear to exist; and Australia appears to be peculiarly poor in honey-gathering insects, as we do not yet know even a *Bombus* from that country. Only a small species of *Trigona* has lately been described by Smith (Catal. Hymen. Brit. Mus. ii. p. 414).

With regard to the distinctions existing among the hive-bees of different localities, upon which Latreille and others have founded specific characters, the author remarks that these consist exclusively of differences of colour, and are so variable that no dependence can be placed upon them. The colour of the scutellum, upon which Latreille even based two groups of species, has so little constancy that in three specimens from the same locality as many gradations from light to dark may be detected. The identity of the Italian with the northern Bee is demonstrated by the perfect mutual fertility of the two forms; and the African form approaches much more closely to the Italian than the latter does to the northern Bee. The author describes the following forms of Bees as known to him, arranging them according to the localities in which they occur:—

1. North Germany (Berlin, Neustadt-Eberswalde, Hartz, Erzgebirge).—Numerous specimens: queens, drones, and workers.
   a. Unicolorous dark northern Bee. Seen on the crest of the Erzgebirge, sparingly, at a height of 2800 feet; in larger quantity on the summit of the Brocken, at 3500 feet, in August 1856.
   b. One specimen of a worker, captured by Klug at the beginning of this century, near Berlin, has on the second abdominal segment a reddish-yellow basal band of one-third of its length.
   c. Italian Bee of very recent times (imported).
   d. Crosses of the northern and Italian Bees, of very recent date.
2. South of France.—3 specimens of workers.
   a. (2 sp.) Unicolorous northern Bee.
   b. (1 sp.) of early date (beginning of this century); Italian Bee, with a reddish-brown scutellum.
3. Andalusia (Staudinger, Waltl).—6 specimens of workers.
   a. (5 sp.) Unicolorous northern Bee.
   b. (1 sp.) More densely clothed with yellowish hair than the northern Bee; a very small reddish-yellow point on each side of the base of the second abdominal segment.
4. Portugal (Hoffmannsegg).—3 workers, 1 drone.
   a. (2 sp.) Unicolorous northern Bee.
   b. (1 sp.) A narrow, transverse, yellow spot on each side of the base of the second abdominal segment; scutellum with a yellowish-red apex.
5. Liguria (Spinola).—5 specimens, drones and workers.
   Italian Bee (types of the *Apis ligustica,* Spin.).
6. Sicily (Schultz).—1 worker.
   Italian Bee with the scutellum almost entirely reddish-yellow.
7. Valteline (Italian Switzerland).—1 specimen*, of the year 1858. Italian Bee.
8. Botzen in the Tyrol (Kahr).—2 specimens, 1861.
   Somewhat smaller than the northern Bee; first abdominal segment above, and the second to three-fifths of its length, reddish yellow; scutellum black. (At Trent the Italian Bee only is known. Near Botzen the German form begins to occur.)
9. Dalmatia (Ehrenberg, Stein).—4 specimens.
   a. (3 sp.) from Spalato, 1858. Unicolorous northern Bee.
   b. (1 sp.) of earlier date. Somewhat smaller and more slender than the German, more densely clothed with yellow hair;

* When not otherwise stated, the following descriptions are all of workers.

first abdominal segment above, second to three-fifths of its length, and middle of scutellum reddish yellow.

10. MEHADIA in the Banat (Stein).—1 specimen.
Exactly like *b.* from Dalmatia.

11. RUSSIA (Pallas).—1 specimen.
Unicolorous northern Bee; sent by Pallas as *Apis cerifera*, Pall.

12. GREECE (Krüper).—1 specimen.
Scarcely smaller than the northern Bee; second abdominal segment on each side at the base with a small reddish-yellow point.

13. CRIMEA (Nordmann).—16 specimens.
a. (5 sp.) Unicolorous northern Bee.
b. (5 sp.) Similar, but the second abdominal segment with a small yellow point on each side at the base.
c. (1 sp.) The yellow point extended into a transverse spot.
d. (4 sp.) Instead of the transverse spots, a reddish-yellow band on the second segment, occupying progressively one-fifth, one-third, and one-half of its length.
e. (1 sp.) First abdominal segment and second to two-thirds of its length reddish yellow; scutellum reddish in the middle.

14. RHODES (Loew).—8 specimens.
a. (1 sp.) With a reddish-yellow transverse spot on each side the base of the second segment; scutellum all black.
b. (1 sp.) Similar, but scutellum with a red apex.
c. (1 sp.) With a reddish-yellow transverse band occupying one-third the length of the second segment; scutellum with the apex red.
d. (5 sp.) Reddish-yellow band of second segment one-third to two-thirds of its length; first segment above and the whole or greater part of the scutellum yellowish red. All the specimens of the same size as the northern Bee, but more densely clothed with more intensely yellow hair.

15. EPHESUS (Loew).—1 specimen.
Like the northern Bee, but more densely clothed with paler greyish-yellow hair.

16. BRUSSA (Thirk).—2 specimens.
a. Size of the northern Bee, and similar in colour and clothing, but with a yellow point on each side of the second abdominal segment.
b. A little smaller than the northern Bee; first segment and second to two-thirds of its length, and the entire scutellum reddish yellow.

17. CAUCASUS (Pallas).—1 specimen.
Colouring as in *b.* from Brussa; size a little larger. (This specimen sent by Pallas as his *Apis remipes*).

18. Egypt (Ehrenberg).—5 specimens.
Smaller and more slender than the northern Bee; both the hairy and downy clothing whitish, sometimes yellowish on the thorax; smoky brown only on each side of the vertex, whitish in the middle. Apices of the mandibles and frontal tubercles rusty red; first and second abdominal segments reddish yellow to the margin, third segment to half its length; scutellum almost entirely reddish yellow. (*Apis fasciata*, Lat.)

19. Arabia Felix (Ehrenberg).—1 specimen.
Agreeing with the Egyptian Bee.

20. Syria (Ehrenberg).—5 specimens.
Almost identical with the Egyptian Bee, but the thorax clad all over with yellowish hair, and the yellow band of the second abdominal segment varying between one-half and four-fifths of its length; size a little larger.

21. Himalaya (Hoffmeister).—1 specimen.
Size and colouring of the Syrian specimens, but the scutellum brownish to the yellow apex.

22. China (Colomb).—1 specimen.
Size and colouring of the Egyptian Bee, but the vertex entirely clothed with fuliginous hair. (*A. cerana*, Fabr.)

23. Senegambia (Mion).—1 specimen.
Size and colouring of the Egyptian Bee, but the hair more of a greyish yellow. (*A. Adansonii*, Lat.)

24. Guinea (Isert).—2 specimens.
a. Size intermediate between that of the Egyptian and northern Bees; apices of the mandibles and frontal tubercles rusty red; scutellum nearly all yellowish brown; first abdominal segment, and second as far as the half, yellowish red above. (*Apis nigritarum*, Lep.)
b. Same size; colour uniform light brown.

25. Cape of Good Hope (Krebs).—10 specimens. All somewhat smaller than the northern Bee.
a. (4 sp.) Blackish brown, with only a narrow basal margin of reddish yellow on the second segment; scutellum black.
b. (1 sp.) Similar, but the yellow border of the second segment dilated on each side into a spot.
c. (2 sp.) Similar, but the second segment reddish yellow for almost half its length; scutellum in one specimen reddish brown. (*A. caffra*, Lep.)
d. (2 sp.) First segment to the margin, second to two-thirds, and third to almost half its length yellowish red; scutellum with the whole middle reddish.
e. (1 sp.) Similar, but the whole scutellum reddish yellow.

26. PORT NATAL (Wahlberg).—1 specimen.
Exactly like specimen *e*. from the Cape.
27. MOZAMBIQUE (Peters).—4 specimens.
Exactly like specimen *e*. from the Cape.
28. MAURITIUS (Deyrolle).—1 specimen.
Similar in size to the Cape specimens; colour entirely dark, almost black upon the abdomen; hair scanty.
29. PENNSYLVANIA (Zimmermann, Sommer).—4 workers, 1 drone.
Worker a little more slender than the northern Bee, like this in colour and clothing, with only a narrow reddish-yellow basal border on the second abdominal segment.
30. MEXICO (Deppe).—4 workers, 1 drone.
Exactly like the northern Bee.
31. CUBA (Riehl).—1 worker, 1 drone. As Mexico.
32. PORTO RICO (Moritz).—1 worker. As Mexico.

Of the colour-varieties here described, the most convincing proof of the inconstancy of the colour, and consequently of a probable intermixture of different varieties, is furnished by Nos. 13, 14, and 25, which at the same time prove that not the least dependence can be placed upon the coloration of the scutellum. The variability of the coloration under the different numbers gives transitions from one form to another; and thus it becomes impossible to define clearly limited varieties. Latreille and Lepelletier made 8 species out of the Honey-Bee; with equal justice we might now, from the existing materials, make 20–30. But by referring those specimens which evidently form transitions from one principal race to another to the race with which they have most in common, we may get six principal varieties, with the following geographical distribution:—

1. The unicolorous, dark northern Bee (including the most nearly allied lighter varieties) occurs in Northern Europe, where until very lately it was the only form; in the south of France, Portugal, the south of Spain, and Algiers; likewise in some districts of Italy, in Dalmatia, Greece, the Crimea, and on the islands and coast of Asia Minor; lastly, in Guinea, at the Cape of Good Hope (probably introduced), and in a great part of North America (certainly introduced).
2. The Italian Bee (with a black scutellum) occurs almost exclusively in different districts of Italy, especially in the northern parts, including the Tyrol and the Valteline. Introduced lately into Northern Europe.
3. A variety differing from the Italian Bee in its yellow scutellum occurs in the south of France, in Sicily, Dalmatia,

the Banat, the Crimea, the islands and continent of Asia Minor, and on the Caucasus.

4. The Egyptian Bee is diffused from Egypt, through Syria and Arabia, and passes imperceptibly, through a lighter variety occurring on the Himalaya and in China, into
5. The specific African Bee, which extends over the whole of Africa, from Abyssinia and Senegambia to the Cape.
6. The black Madagascar Bee is limited to Madagascar and the Mauritius.

In the concluding portion of his paper the author treats of the exotic Honey-Bees of the Old World distinct from *Apis mellifica.* He confines his attention to the Old-World forms because, although America possesses numerous species of honey-gathering Bees, these belong to genera (*Melipona* and *Trigona*) which differ greatly from the Hive-Bee both in characters and in value; so that wherever the European Bee has been introduced, they have lost their importance as producers of wax and honey. Some of the East-Indian species, on the contrary, appear to be of great value; and their introduction into other suitable localities might be found useful. These Bees inhabiting the continent and islands of India are also in considerable confusion as regards their specific identity, too much stress having been laid upon variations of colour in them, as in the varieties of the European Bee: instead of thirteen species, described by Fabricius, Latreille, Klug, Guérin, and Smith, the author considers that there are only three, all belonging to the genus *Apis*, but forming the following two groups:—

Group I. Vertex distinctly narrowed by the large compound eyes, so that the posterior ocelli are more distant from each other than from the eyes. Abdomen remarkably elongated, somewhat flattened above; metatarsus of the hind legs with thirteen transverse rows of bristles on the inside. In the anterior wings the recurrent nervure issues very near the apex in the third cubital cell. Here belongs *Apis dorsata*, Fab. (*nigripennis*, Lat.), with its two colour varieties, *Apis zonata*, Guér., and *A. zonata*, Smith.

Group II. Vertex not perceptibly narrowed, so that the hinder ocelli are not more distant from each other than from the compound eyes. Abdomen oval, convex above; metatarsus of the hind legs with nine transverse rows of bristles on the inside. Recurrent nervure issuing far from the apex in the third cubital cell. Here belong, with *Apis mellifica*, the two smaller East-Indian species,—1. *Apis indica*, Fab. (*socialis*, Lat.), with its varieties *A. Peronii*, Lat., *A. Perrottetii*, Guér., and *A. nigro-*

cincta, Smith; 2. *Apis florea,* Fab. (*indica,* Lat.), with its drone, *A. lobata,* Smith.

The first of the three East-Indian species, *Apis dorsata,* Fab., is remarkable for its size, as dry specimens measure $7\frac{1}{2}$ to $8\frac{1}{2}$ lines in length. Freshly developed specimens, sent from Luzon by Jagor, are of a light pitchy-brown colour all over the body and legs, and their clothing of hair everywhere brownish grey; the wings are hyaline, with a distinctly greyish-brown tint. When completely coloured, the head and antennæ are shining pitchy black; vertex clothed with long, erect, deep blackish-brown hair; the border of the upper lip and mandibles has a reddish-brown tint; the two frontal tubercles and the apices of the scapes of the antennæ pale rusty red. Ocelli remarkably large. Thorax above, as far as the scutellum and sides of the breast, with blackish-brown hairs; scutellum and metanotum with tawny-yellow hairs. Anterior wings dark brown along the outer margin, paler brown over the whole disk. Legs pitchy black, fringed with hair of the same colour; the brush on the inside of the posterior tarsi cinnamon-red. The colouring of the abdomen marks three varieties:—

a. Abdomen above clothed with densely adpressed hairs, of a uniform yellow colour, or only a little more dusky, or rather grey, at the apex; beneath pitchy brown, rusty yellow towards the base. Indigenous in Java. Described by Fabricius (Ent. Syst. ii. p. 323. 64), in 1793, as *Apis dorsata*; afterwards (1804) by Latreille (Ann. du Mus. v. p. 170. 4) as *A. nigripennis*).

b. Abdomen with only the back of the first two segments yellow, and the rest blackish brown or nearly black, or with the middle of the third segment also yellowish, and the base of this and the following segment adorned with a transverse band sprinkled with white. Upon this variety, figured by Latreille (*loc. cit.* pl. 13. fig. 7), Klug (Mag. Gesellsch. naturf. Freunde, i. p. 264) founded his *A. bicolor,* and Guérin (Bélanger's Voyage, Insectes, p. 504) his *A. zonata.* It occurs with the preceding in Java, and also in Ceylon (Nietner).

c. Abdomen yellow only on the anterior part of the first segment; the remainder is deep black, with white-besprinkled basal bands on the third, fourth, and fifth segments; these also pass to the lower surface. Examples of this variety from Celebes are the largest, and others from Luzon the smallest of all. Smith described the former under the name of *A. zonata* (Proc. Linn. Soc. iii. p. 8).

This is evidently the species mentioned by Knox, in his work on Ceylon, under the name of *Bamburos.* He says, "Their honey is as clear as water; they place their nests on the highest branches of trees, and take no trouble to conceal them. At a certain season of the year, whole villages go out to collect their honey." The queen and drone of this species are still unknown.

The second species, *A. indica,* Fab., most resembles our European Bee in form and colouring, but is much smaller, dry specimens measuring only $4\frac{1}{2}$ lines. This species is subject to great variation of colour in most parts of the body, and even in the wings. Adopting the coloration of the abdomen as a distinction, the following three chief varieties may be indicated:—

a. Abdomen either light rusty red as far as the last two pitchy-brown segments, or the third and fourth segments from the apex likewise show a slight brownish tinge at the base. The scutellum is always pale reddish yellow, and the hair of the head and thorax greyish yellow. The clypeus and scape are seldom entirely pitchy brown; the former is usually reddish in its lower half, and the latter in the middle. This pale variety appears to be chiefly indigenous to the continent of India; it was first described by Fabricius (Ent. Syst. Suppl. p. 274. 59) as *Apis Indica*; then by Latreille (*loc. cit.* p. 172. 7) as *A. socialis*; by Lepelletier (Hyménopt. i. pp. 404, 405) as *A. socialis* and *dorsata*; and lastly by Guérin (Iconogr. du Règne Anim. p. 461) as *A. Delesserti.*

b. Abdomen with the first two segments and the base of the third reddish yellow, the remainder blackish brown, with bands of light yellow hair. Scutellum generally pale, sometimes blackish; the hair of the thorax brownish yellow, that of the vertex fuliginous. Clypeus generally all black, sometimes reddish at the apex; scape dark. Principally in Java; also at Poona (Hope). Latreille (*loc. cit.* p. 173. 8) described this form as *A. Peronii.*

c. Abdomen with only the anterior part of the first and the basal half of the second segment reddish yellow, the remainder blackish brown. Clothing as in *b*; the scutellum partly blackish, partly reddish yellow. With a black clypeus and scape this variety is indigenous at Pondicherry and in Ceylon, and has been described by Guérin (Iconog. p. 460, f.) as *A. Perrottetii*; with a red clypeus and paler scape it is *A. nigrocincta,* Smith (Proc. Linn. Soc. v. p. 93), from Macassar. The latter has lately been received from Luzon, where it is mixed in almost equal proportions with the other variety.

Knox, in his description of Ceylon, says, "The first kind of Honey-Bees are the *Memasses,* which are exactly like our Bees which we have in England; they build in hollow trees, into which the people blow, and from which they take honey and wax, without any dread of being stung." Here he seems to refer to the *Apis indica*, which he erroneously identifies with the European Bee.

The third East-Indian species, incorrectly regarded by Latreille as *Apis indica*, Fab., but which, from a comparison with the original specimens of Fabricius, is the *Anthophora florea* of that entomologist (Ent. Syst. ii. p. 341. 118), and must therefore be called *Apis florea*, Fab., is the smallest of all known species, the workers measuring scarcely more than $3\frac{1}{2}$ lines. The author has workers from Tranquebar, Java, and Poona, and workers and drones from Ceylon. This species seems to vary less than the others, although young workers may be recognized by the light colour of the abdomen and the rusty-red tint of the legs, scapes, and clypeus. The coloration, in fully developed specimens, is as follows:—Head, including upper lip and antennæ, black, with only the frontal tubercles rusty red; thorax and legs likewise black, and, like the head, clothed with white hairs. Abdomen generally with the first two segments tile-red, the rest black, and with snow-white hair at the base; rarely the third segment shows some red, and still more rarely the second some black. The wings are hyaline, with rusty-yellow veins. The drones which are believed to belong to these workers (*Apis lobata*, Smith, Catal. Apidæ, p. 416. 10) are considerably larger than the workers, namely, $4\frac{3}{4}$ lines long. They have the body black; thorax and two basal segments of the abdomen clothed with yellowish-grey hairs; the apex of the abdomen clothed with black hair; the third and fourth segments naked, shining. Structural characters distinguishing these drones from those of the European species are as follow:—1. The head is more convex, and the eyes therefore larger; 2. The antennæ are very short, the flagellum scarcely double the length of the scape; 3. The metatarsus of the posterior legs is very peculiarly forked; the outer branch of this fork is the thicker, inflated on the outside, hairy within, and bears at its apex the following tarsal joints; the inner one has somewhat the form and position of a thumb, and is only two-thirds the length of the outer. A comb unquestionably belonging to this species has been described and figured by Latreille (Annales du Mus. iv. p. 386, pl. 69, and Recueil d'Obs. de Zool. p. 302, pl. 21). In its substance it agrees precisely with that of *Apis mellifica*; its cells are hexagonal, applied to each other back to back, and with their bases alternating and interlocking. The difference in the size of the cells is very great: $33\frac{2}{3}$ cells of *A. florea* occupy the same space as $18\frac{1}{2}$ of *A. mellifica*. The drone-cells found with worker-cells in the comb are much larger, much thicker in the walls, and nearly cylindrical internally.

In conclusion, the author enters upon the question of the acclimatization of new forms of Bees. For Europe, he thinks the most valuable form would be the Egyptian, partly on account of their beauty, and partly because of their unwillingness to use their stings, which appears to be common to all African Bees, and is also one of the recommendations of the Italian Bee. The Syrian Bee agrees so closely with the Egyptian that it may prove equally valuable; and next to these in value, according to the author, are the Bees of the coasts of Asia Minor. Of the East-Indian Bees, the introduction of the fine *Apis dorsata* would probably be most welcome to the European bee-keepers; but there are doubts whether it would bear a northern climate; and before it can be introduced into Europe, it must be domesticated in some of its native haunts. The author suggests that some of the planters of Ceylon might succeed in effecting this preliminary object.

XXXVIII.—*On* Microstelma *and* Onoba, *two Forms of Rissoid Gasteropods; with Notices of new Species of the latter from Japan.* By Arthur Adams, F.L.S. &c.

In addition to the new species of Rissoid genera which I have recently published in the 'Annals,' I beg to bring before the notice of your readers an entirely new form and several new species of *Onoba*, reserving my observations on the genus *Rissoina* for a future communication, which will complete my examination of the family Rissoidæ inhabiting the Seas of Japan.

Genus Microstelma, A. Adams.

Testa turrito-ovata, rimata; spira conica; anfractibus longitudinaliter plicatis. Apertura oblonga, antice producta, subcanaliculata; labio incrassato, rectiusculo; labro simplici.

This very pretty form, which most nearly resembles the genus *Rissoina*, I obtained in the Gotto Islands, by a cast of the dredge, in forty-eight fathoms water. The shell only was obtained; so that our account of the genus, like that of many others proposed, is necessarily very imperfect. Such must frequently be the case with regard to very deep-water acquisitions from far-off and little-known localities; and such, of course, is always the case with fossil or extinct forms.

In the sand from the same locality I fortunately obtained living examples of the genus *Verticordia*, hitherto only known from its shell; and I may here take the opportunity of stating that the true position of the genus is in Anatinidæ, and not with *Isocardia,* with which, in a former communication, I had associated it. My brother, in examining one of my fresh specimens, has proved the existence of an ossicle in the hinge, very similar to that in *Chamostrea* or *Cleidotherus.*

Microstelma Dædala, A. Adams.

M. testa ovata, rimata, solida, alba; anfractibus $5\frac{1}{2}$, planis, postice angulatis et coronatis, longitudinaliter plicatis, plicis rectis, validis, æqualibus, interstitiis transversim striatis; anfractu ultimo magno, plicis, ultra peripheriam, evanidis; labro margine postice angulato.

Hab. Gotto Islands; 48 fathoms.

The whorls are very prettily coronate at the hind part, which suggested the generic name. In all essentials the shell appears to be of a Rissoid character, reminding one somewhat of *Rissoina.* Had there been any indication of columellar plaits, it might have been mistaken for a Pyramidellid.

Genus Onoba, H. & A. Adams.

1. *Onoba elegans,* A. Adams.

Rissoa elegans, A. Adams, Proc. Zool. Soc. 1851.

Hab. Seto-Uchi; 17 fathoms. Yara; 9 fathoms, mud.

2. *Onoba procera,* A. Adams.

Onoba procera, A. Adams, Ann. & Mag. Nat. Hist. 1861.

Hab. Yara; 9 fathoms, mud. Mososeki; 7 fathoms.

3. *Onoba mirifica,* A. Adams.

O. testa subulato-turrita, alba, semipellucida; anfractibus 5, convexiusculis, suturis profundis, transversim liratis, liris validis, subdistantibus, interstitiis concinne cancellatis; anfractu ultimo costa basali instructo; apertura ovata, antice integra; peristomate continuo; labro subdilatato, margine extus varicoso.

Hab. Kino-O-Sima; Tanabe.

A small shell, but exquisite in form and sculpture.

4. *Onoba bella,* A. Adams.

Rissoa bella, A. Adams, Proc. Zool. Soc. 1851, p. 267.

Hab. Yara; 9 fathoms, mud.

5. *Onoba spirata,* A. Adams.

O. testa ovato-turrita, subrimata, tenui, sordide alba; anfractibus 5, planis, spiratis, ad suturas acute angulatis, costellis longitudinalibus tenuibus confertis, interstitiis lineis transversis elevatis decussatis instructis; apertura ovata; peritremate continuo; labro margine anguste varicoso.

Hab. Mososeki; 7 fathoms.

In this rather thin species the whorls are spirate, sharply angulate at the sutures, and furnished with longitudinal riblets.

6. *Onoba patula*, A. Adams.

O. testa ovata, solida, rimata, sordide alba; spira brevi; anfractibus $3\frac{1}{2}$, postice acute angulatis, ultimo magno, costellis longitudinalibus undulatis et lineis transversis elevatis concinne decussato; apertura oblonga, antice dilatata; labro valde dilatato, margine reflexo, undulato, postice libero et angulato.

Hab. Yobuko, west coast of Kiusu; 14 fathoms, mud.

In this species the lip is greatly dilated and reflexed; the whorls are sharply angulated posteriorly, and there is an elongate narrow umbilical chink.

7. *Onoba egregia*, A. Adams.

O. testa subulato-turrita, sordide alba; anfractibus 6, planiusculis, spiratis, postice rotundate angulatis, lamellis longitudinalibus erectis undulatis, interstitiis transversim pulcherrime striolatis instructis; suturis profundis; apertura aperta, ovali; peritremate tenui, continuo; labro subdilatato, margine simplici, undulato.

Hab. Seto-Uchi; 17 fathoms. Yobuko; 10 fathoms.

A very charming species, with lamellar, undulating longitudinal riblets, and the interstices crossed by fine spiral elevated lines. The aperture is somewhat expanded, and there is no external varix on the outer lip.

8. *Onoba lucida*, A. Adams.

O. testa turrito-subulata, alba, tenui, pellucida; anfractibus 4, convexiusculis, lineolis transversis elevatis concentricis confertis ornata; apertura ovali, antice integra; peritremate continuo; labro margine tenui, varicoso.

Hab. O-Sima.

This species resembles *O. bella* in form and sculpture; but it wants the spiral callus at the base of the last whorl, and the conspicuous varix on the outer lip; it is also much smaller and more pellucid.

XXXIX.—*On the Genera and Species of* Lacunidæ *found in Japan.* By Arthur Adams, F.L.S. &c.

The *Lacunæ* have been separated by Dr. Gray from the *Littorinæ*, with which they are usually associated, on account of the peculiar appendiculate opercular lobe, which is expanded at the sides and furnished with two beards behind. The animal, moreover, has no jaws, whereas in the Littorinidæ they are distinct and horny. The Japanese seas furnish us with examples of all the known generic and subgeneric forms, and likewise with a new and peculiar type which I am inclined to refer to this family.

Fam. Lacunidæ.

Genus Lacuna, Turt.

Lacuna latifasciata, A. Adams.

L. testa depresso-semiglobosa, tenui, late et profunde umbilicata; spira parva, laterali; alba, fascia lata rufo-fusca ornata; anfractibus 3, planiusculis, rapide crescentibus; apertura semiorbiculari, regione umbilici rufo tincta; columella recta, angusta.

Hab. Kino-O-Sima.

A species of the same form as *L. pallidula*, Da Costa, but of much smaller size, and ornamented with a broad red-brown band.

Subgenus Medoria, Leach.

Medoria turrita, A. Adams.

Lacuna turrita, A. Adams, Ann. & Mag. Nat. Hist. 1861.

Hab. Rifunsiri.

Subgenus Epheria, Leach.

1. *Epheria decorata*, A. Adams.

Lacuna (*Epheria*) *decorata*, A. Adams, Ann. & Mag. Nat. Hist. 1861.

Hab. Rifunsiri.

2. *Epheria inflata*, A. Adams.

Lacuna inflata, A. Adams, Ann. & Mag. Nat. Hist. 1861.

Hab. Rifunsiri.

3. *Epheria carinifera*, A. Adams.

Lacuna carinifera, A. Adams, Proc. Zool. Soc. 1851, p. 225.

Hab. Takano-Sima.

4. *Epheria lepidula*, A. Adams.

E. testa depresso-conica, perobliqua, late umbilicata; spira brevi, acuta; alba, opaca; anfractibus 3, convexiusculis, ultimo ad peripheriam angulato; apertura semiovata; labio recto, acuto; umbilici margine carinula acuta circumcincto.

Hab. Seto-Uchi; Akasi; 15 fathoms.

A small white species from the Inland Sea of Japan, with the margin of the wide umbilicus encircled by a narrow elevated keel.

Genus Stenotis, A. Adams.

Testa compressa, elongato-ovata, auriformis; spira brevi, acuta; anfractibus planis, simplicibus, ultimo sejuncto. Apertura oblonga, postice angustata; peritremate acuto, recto, continuo, integro.

I have founded this genus on a little shell which I obtained in the Inland Sea of Japan, and also at Yobuko, a small harbour on the west coast of Kiusu. It possesses some of the characters of *Fossar*, and reminds one of *Vanikoro*: in form it resembles somewhat a minute *Naticina*; but perhaps its true relations are with *Lacuna*, although the members of that family are littoral in their habits.

Stenotis laxata, A. Adams.

S. testa elongato-ovali, compressa, tenui, sordide alba; spira parva, acuta; anfractibus 3, planiusculis, rapide crescentibus; anfractu ultimo magno, soluto, antice dilatato; apertura auriformi, postice angustata; umbilico patulo, margine angulato.

Hab. Idsuma-Nada; 17 fathoms. Yobuko, west coast of Kiusu; 14 fathoms, mud.

XL.—*On the Structure of the Valves of* Pleurosigma *and other Diatoms.* By G. C. Wallich, M.D., F.L.S., F.G.S., &c.

In a scientific point of view, it is obviously immaterial whether the markings on a Diatom-valve present this or that configuration, or whether minute points on its surface consist of elevations or of depressions. At all events, the physiology of the Protophytes, so far as we have heretofore become acquainted with it, does not appear to have been advanced a single step by the fitful controversy that has taken place on the subject, with no better result than that of rendering it distasteful to the generality of scientific readers.

But, notwithstanding this, it cannot be denied that the accurate determination of the nature of these markings is of great importance indirectly, that is to say, by furnishing a standard wherewith to gauge the powers of our highest optical combinations, and enable us to pronounce with some approach to confidence when minute appearances are, or are not, illusory. In this sense the subject may be regarded as bearing essentially on every kind of microscopic research, and in this sense only do I consider it worthy of serious investigation.

In a paper "On the Structure of the Valve in the Diatomaceæ, as compared with certain Siliceous Pellicles produced artificially by the Decomposition in moist Air of Fluosilicic Acid Gas (Fluoride of Silicium)"*, Prof. Max Schultze, after stating his views regarding the mode of formation and intimate structure of the pellicles referred to, enters on the special point towards which his investigations seem to have been directed, namely, the determination of the true character of the markings in *Pleurosigma angulatum*. Prof. Schultze alludes to the conflicting opinions entertained by English microscopists on this subject, and, whilst citing Carpenter (undoubtedly the highest of the British authorities on any question of microscopy) and, with him, many other observers who support the view that the markings of the valve of this Diatom consist of hexagonal depressions, associates my name with that of my friend Mr. Norman, of Hull, amongst the advocates of the contrary opinion, namely, that these markings consist of pyramidal elevations†. In the abstract of Prof. Schultze's paper already alluded to, it is stated that, "so far as the nature of the markings on the Diatomaceæ is concerned, opinions may not at the present day be so much divided in this country as that author appears to think;" and marked attention is for the second time drawn, by the Editors of the 'Microscopical Journal,' to an observation made by Mr. Wenham during the discussion of my paper on these markings, read before the Microscopical Society in March 1860, to the effect "that, with an object-glass of his own construction, having a focal distance of about $\frac{1}{50}$th of an inch and a large aperture, he had ascertained beyond doubt that, in *P. angulatum* and some others, the valves are composed wholly of spherical particles of silex, possessing high refractive properties; and that he showed how *all* the various optical appearances in the valves of the Diatomaceæ might be reconciled with the supposition that their structure was universally the same"‡. As the hexagonal-depression structure of the valve in *P. angulatum* rested almost exclusively, up to that period, on evidence adduced

* Verhandl. d. Naturhist. Vereins der preussisch. Rheinlande u. Westphal. Jahrg. xx. p. 1. See an abstract of this paper published in the Quarterly Journal of Microscopical Science for April 1863.

† See papers "On the Markings of the Diatomaceæ in common use as Test-Objects," published in the Annals and Magazine of Natural History for February 1860; and "On the Development of Structure of the Diatom-Valve" (read before the Microscopical Society in March 1860, and published in the Transactions), by G. C. Wallich, M.D., &c.

‡ See note appended to abstract to Prof. Schultze's paper, and note appended to the above-named paper by me, published in the Transactions of the Microscopical Society, Quart. Journ. M. S. vol. viii. p. 145.

by Mr. Wenham, it is somewhat difficult to gather from the remarks of the Editors in question whether they accepted or rejected my view. It is certain, however, that at the above period, and indeed up to a very recent date, I stood alone in supporting the pyramidal structure by evidence derived from the optical appearances of the valve under high powers of the microscope, and nearly alone as regards the secondary kind of evidence derived from the direction of the lines of fracture and effects of moisture. For although it was stated in the admirable work on the microscope by the lamented Prof. Quekett, published in 1852, that, under an improved method of illumination and a magnifying power of at least 1200 diameters, Mr. Gillett had succeeded in showing "the lines on *P. angulatum* to be dots or elevations from the surface," this interpretation of the structure was speedily set aside by subsequent writers, and principally in consequence of the view put forward by Mr. Wenham with regard to the hexagonal structure. Strange to say, Prof. Quekett was himself amongst the first to repudiate Mr. Gillett's observation. In his 'Lectures on Histology' (vol. ii. p. 59) it is stated that, by careful "management of the light, Mr. Wenham has found that the oblique lines on *P. angulatum* can be resolved into hexagons, and that he has proved *beyond doubt* the structure by means of photographs taken under a power of 15,000 diameters, —all the parts accurately in focus exhibiting hexagons with a white centre, but in those out of focus the centre being black." Mr. Wenham's photographic figure is copied by Quekett, as also a figure of the structure in the closely allied variety, *P. formosum,* under a magnifying power of 5500 diameters, the lines being resolved, on the authority of the Rev. Mr. Kingsley of Cambridge, "into dots, studs, or beads;" but, continues the Professor, "notwithstanding the enormous power employed on this occasion, there are many observers who still regard these markings as depressions, and not as elevations."

In Carpenter's work "On the Microscope and its Revelations" (*not* the latest edition), at page 306, it is stated that if we examine *P. angulatum* with an objective of $\frac{1}{4}$-inch focus and 75° aperture, the valve presents a double series of somewhat interrupted diagonal lines, inclosing between their intersections imperfectly defined lozenge-shaped spaces; but that if the valve be viewed under an objective of $\frac{1}{12}$-inch focus and an angular aperture of 130°, "illuminated by oblique rays, its hexagonal areolation becomes very distinct. And if a photographic representation obtained by such a power be itself enlarged by photography, as has been accomplished by Mr. Wenham, the appearance presented is in all respects comparable with that afforded under a low power by the valve of *Triceratium* or *Isthmia*." Here again we have Mr. Wenham's figure, with the remark that "at the upper part, which represents a portion of the object that was accurately in focus, the hexagonal areas are seen to be *light*, and the intervening spaces dark; the reverse being the case with the lower portion which was out of focus; and a curious transition from one condition to the other being seen in the intermediate part."

In a short paper by Dr. Hall, of Sheffield, "On an easy Method of viewing certain of the Diatomaceæ," published in the Quarterly Journal of Microscopical Science, vol. iv. p. 205 *et seq.*, the structure of *P. angulatum* is described and figured as consisting of "dots;" and reference is made, in confirmation of it, to the "hexagonal *areolation*" supposed to have been detected by Mr. Wenham under a power of 15,000 diameters, but evidently under a misconception as to the elevation or depression of the minute siliceous masses composing it, inasmuch as the term "areolation," in this case, evidently refers to depressions with elevated sides, and it is quite clear that such was the generally adopted interpretation of Mr. Wenham's observations, inasmuch as Dr. Carpenter, till very recently, laid stress on the analogy between the appearance presented by the photographic figure and the plainly discernible depressed areolar spaces of *Triceratium* and *Isthmia*.

The late Rev. W. Smith, in the 'Synopsis of British Diatomaceæ' (vol. i. p. 61), expressed himself as having for a time coincided in the opinion of some observers that the appearances of striæ arose from rows of beads or minute elevations, and not from depressions; but that, with careful manipulation and more perfect optical apparatus, he was led to conclude "that the lines arise from *internal* hexagonal structure, and that the semblance both of perforations and elevations may be produced in the same object by a slight alteration of focus, such appearances being illusory and due merely to the reflection or refraction of the rays passing through the minute *cellular* structure of the siliceous epiderm." He was also inclined to "attribute the yellow tint seen in the valves of some diatoms to distinct hexagonal structure in their cellular condition, and a purple colour to an absence of such character" (Synopsis, p. 63).

In the 'Micrographic Dictionary' (p. 43) we find it stated that "*Isthmia* requires defining power" (in the lens employed), "whilst *Gyrosigma* (=*Pleurosigma*) requires penetrating power and large angular aperture to exhibit the markings; and *yet the structures differ only in size.*" And, further, "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 depressions and the undepressed portions would be equally recognizable in both cases." Again, in the introductory chapter to the same volume (p. 16), the Editors express their conviction that if Schleiden "were to try to obtain a view of the hexagonal structure of the dots on the valves of a *Gyrosigma* with his object-glasses, he would signally fail; for the exhibition of this structure requires a power of about 2000 diameters to render it distinct beyond dispute, with the use of stops," &c. &c., "and the fact of its impressing its own image upon photographic paper at once shows its reality, and that its perception is not the result of the imagination."

Dr. Carpenter, in the latest edition of his invaluable treatise on 'The Microscope and its Revelations' (1862), whilst seceding from the opinion that any analogy necessarily exists between the structure of the valve of *Triceratium* and that of *Pleurosigma,* and stating that, although the idea of the valve of the latter being composed of a series of hexagonal *depressions* at one time received the sanction of Mr. Wenham, the later observations of this gentleman, "with objectives of $\frac{1}{25}$th, and even $\frac{1}{50}$th of an inch focus, have led him to concur with the view now more generally accepted by microscopists, that the areolæ are minute tubercular *elevations*, the intervening network being formed by the thinner portion of the valve," then goes on to adduce the evidence brought forward some years ago by Mr. Hunt (Quarterly Journal of Microscopical Science, vol. iv. p. 175), which shows that moisture insinuates itself in such a manner between the striæ and glass cover as to indicate that the "dots" are elevations, and not depressions. Lastly, as if to add to the apparent confusion of testimony, we find, in the 'Micrographic Dictionary' (page xxxiii., last edition), great stress laid on the fact that the line of "fracture of the broken valves" (of *Pleurosigma*) "passes *through the rows of dots*, or the dark lines corresponding to them, showing that they are thinner and weaker than the rest of the substance; for had these dots represented elevations, the valves would have been stronger at these parts;" whilst, in the Philosophical Magazine for January 1855, in an abstract of a paper read before the Royal Society "On the Structure of certain Microscopic Test-Objects, and their action on the Transmitted Rays of Light," by Charles Brooke, F.R.S., it is stated with equal certainty and, as I am still prepared to maintain, with perfect correctness, that although "the dots have by some been supposed to be depressions, this 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 they were depressions."

Having thus endeavoured to show that Professor Schultze was correct in asserting that great difference of opinion existed in this country on the subject under discussion, it is necessary to cite the evidence on which he gives his adhesion to the belief still entertained, as he erroneously supposes, by Dr. Carpenter, that the so-called "dots" are depressed spaces on the valve of *Pleurosigma*.

And first with regard to the electrotype metallic casts of *Pleurosigma*, of which a notice is contained in the Quarterly Journal of Microscopical Science, vol. iii. p. 244 *et seq*. In a note appended to Schultze's paper (Quart. Journ. Mic. Sc. for April 1863, p. 128), the editors state that Mr. Wenham's experiments do not appear to have been limited to the two species named, as he says that he had "obtained distinct impressions of the markings of some of the more difficult Diatomaceæ, such as *N.* (*Pleurosigma* ?) *balticum*, *P. hippocampus*, &c., leaving, as he says, *no doubt of their prominent nature*. But whether this prominence belongs to the *areolæ* or intermediate lines does not appear." Schultze, in the paper now under notice, does not hesitate to characterize these experiments as perfectly successful, and as having demonstrated that the impressions represented "the systems of lines or dots," thus manifestly supporting the view entertained by Smith in the Synopsis, and most other observers, namely, that the "striæ" are resolvable into "dots," an idea I cannot subscribe to, inasmuch as it shall presently be my endeavour to prove that the appearance of striation in *P. angulatum* and the whole of the forms combining diagonal with rectangular striation is engendered at the thinnest portions of the valve, through which the rays of light penetrate most readily, and along the lines of which the valve almost invariably fractures; whereas the so-called dots are produced only when those lines are thrown partially out of focus, the intervening *elevated* portions of the structure being as partially brought into focus.

The main source of error and misunderstanding amongst previous writers is traceable to the supposition that the diagonal and rectangular series of lines (as the case may be) constitute the portions of the valves which, under the higher magnifying powers of the microscope, become convertible into the so-termed "dots," "beads," or "hexagons,"—the fact being that the "striæ" seen under the lower powers, if properly exhibited, are never convertible into anything but lines, whereas the dots, beads, and hexagons are the imperfect expositions of the structure occurring in the spaces included between the intersections of those lines. This view of the structure I shall attempt to prove to demonstration in a later portion of the present paper. But it is necessary to state in this place that, whatever parts of the valvular surfaces may have been represented as "prominences" in Mr. Wenham's most interesting electrotype casts, in his later observations on the photographic representation of these structures no facts have been advanced to indicate that the portions supposed to represent those in relief on the photographs are not identical with those actually in relief on the casts; and hence it is reasonable to infer that the parts which really are convertible into "dots," &c. (that is the spaces between the intersections of the lines, and not the lines or striæ themselves), constitute the seat of the elevations *as presented on the casts* *. But here, again, we are met with a further difficulty, if my views be correct; for whereas I am of opinion that the intervening spaces in *P. angulatum* and its allies exhibit elevations, I think it probable that in *P. hippocampus* and the rectangularly marked series the intervening spaces between the lines, as seen on the external surface of the valves, are occupied by depressions.

Welcker's system for determining whether minute points of structure seen under the microscope consist of elevations or depressions on the general surface, although of service where these markings are scattered so as to leave well-defined intervals between them, becomes practically useless in testing the configuration of such objects as the *Pleurosigmata*, on the valves of which the alternate elevations and depressions are in immediate contiguity. Schultze fully recognizes this difficulty, but endeavours to explain it away, as I conceive, somewhat unsuccessfully. He alludes to the appearance presented by the larger of the artificially prepared conical papillæ of fluoride of silicium, and inclines to the belief that the successively seen "concentric rings" are attributable to these papillæ being "composed of superimposed laminæ, gradually diminishing in size."

The same appearance of concentric rings is observable, however, when any translucent uniformly curved projection or depression is viewed under the microscope, the illusory effect being much more marked where the penetrating power of the objective employed is limited. The truth of this statement may readily be put to the test by examining the valvular surface of some of the *Melosiræ* (*M. Westii*, for example), in which a continuously

* For reasons which will presently become manifest, I would mention that this remark applies only to the rectangularly lined series of the *Pleurosigmata*. Mr. Wenham, in his paper on the electrotype experiments, makes special reference to *P. balticum* and *P. hippocampus*, but to none of the diagonally lined series—a fact of no little importance, for similar reasons.

transitional series of concentric rings is invariably engendered as the focal distance is altered—showing clearly that these rings are not the exponents of successive laminæ of silex, or due to the "sutural and median siliceous ring" adduced as characteristic of that variety in the 'Synopsis of British Diatomaceæ';' but that they are simply indicative of the successive horizons (so to speak) of the conical-shaped valve, on reaching which the rays of light are refracted in their passage to the eye of the observer, and during the changes in the focal distance *.

Professor Schultze points out that the alternately luminous and darkened aspect of minute elevations and depressions is reversed according as the object is immersed in a medium of higher or lower refractive power than itself. I may add two still more perplexing difficulties which tend to render Welcker's system nugatory, namely, the impracticability of determining at all times whether a Diatom-valve is placed with its external or its internal surface towards the observer, and of ascertaining when that precise amount of definition has been arrived at under which the luminous or dark spots are to be regarded as characteristic. In endeavouring to resolve the marking on *Pleurosigma angulatum* by Welcker's method, Schultze allows that he signally failed, and that "the indistinct bright points" which precede the *dark* points brought into view upon the accurate focusing arrived at by the lowering of the tube "*do not coincide exactly with them in position, but may rather be said to be contiguous to them, and to represent, consequently, the borders of the depressions,*"—the general conclusion adopted by him being, "that neither spherical, conical, nor pyramidal elevations are the cause of the punctated appearance on the surface of the above-named species of *Pleurosigma,* although the decussating sets of ridges, at the points of intersection, afford an appearance resembling that of tubercular elevations;" and further, "in cases where two sets of lines intersect each other at a right angle, as in *P. balticum, hippocampus,* &c., the disposition of the ridges at once suffices to account for the arrangement of the quadrangular interspaces. But it is not so easy, he adds, to explain the disposition of the *hexagons* produced by the *three* sets of ridges intersecting each other at an angle of 60°, which exist in *P. angulatum* and its allies. It is most natural to suppose that they would be arranged like the cells of a honeycomb, as figured in the plate [appended to the abstract]. An arrangement of this kind is figured, amongst others, by Carpenter and Mr. Charles Hall." * * * "That the hexagons are arranged as figured by

* In specimens of this Diatom collected near Guernsey, the raised rings described in the Synopsis are extremely faint, the outline accordingly presenting an unbroken series of curves.

Mr. Hall* is fully established to the author's (Professor Schultze's) satisfaction by some photographic representations procured by the aid of Hartnack's combination. According to these figures, the lines in each set *are not continuous in a straight direction*, but are bent at short intervals, at an angle of 120°. These bends are, however, so close together as to be imperceptible with the power usually employed in the examination of *P. angulatum*, that is, with one of from 500 to 800 diameters. It is especially by oblique light (under which only it is generally the case that the sets of ridges appear as continuous striæ) that the *illusion* (?) becomes perfect that we are beholding sets of lines running in a perfectly direct course; whilst observations with direct illumination, provided that the lenses have sufficient defining power, discloses the true state of things" (?).

It will be seen from the above extract (which I have deemed it unavoidable to quote in detail) that Prof. Schultze bases his reasoning on a fundamental error, namely, the presence of only *three* sets of decussating lines in *Pleurosigma angulatum* and its allies, whereas they invariably present *four*: that is to say, two series traversing the valve diagonally, so as to leave lozenge-shaped spaces between each of these intersections; and two series, one of which is parallel to the longitudinal axis of the valve, whilst the other crosses this at right angles. In the quincuncially marked group the diagonal lines alone maintain one uniform plane, and hence are invariably the most distinct; whilst the rectangular lines, which again intersect the axes of the lozenge-shaped spaces, follow the alternately ascending and descending outline of the pyramidal projections by which these spaces are occupied, and hence constitute a series of vertical zigzags, which causes them to be defined with much greater difficulty.

In the rectangularly striated *Pleurosigmata*, of which *P. balticum* is the type, the rectangular sets of lines are the most distinctly marked, for a similar reason. They are not only on the same plane, however, as the diagonal lines are in the quincuncial group, but, as I have recently satisfied myself, they constitute the actual surface of the valve, whilst the spaces bounded by them are pyramidal *depressions*. In the one case, the fragments of a comminuted valve, when viewed in section, show that the apices of the pyramidal elevations are the most prominent points on the external surface; in the other, that the ridges, or, in other words, the rectangular striæ, are the most prominent.

As stated by me in my former paper on this subject (Annals and Magazine of Natural History, February 1860), analogy has

* Quarterly Journal of Microscopical Science, vol. iv. pl. 13. fig. 2; and Micrographic Dictionary, 1856, pl. 47. figs. 41 and 48; the former of which is "copied from a photograph by Mr. Wenham."

been strained a little too far in the attempt to *deduce*, from the appearances presented by one group of Diatoms which happens to furnish structure easily resolvable even with the lowest powers of the microscope, and the least perfect optical combinations, the nature of the markings in another group which happens to present a structure that is resolvable with the utmost difficulty. It is with no little satisfaction, therefore, that I find Dr. Carpenter, in the recent edition of his work on the microscope (1862), has relinquished the view formerly supported by him regarding the analogy subsisting between such forms as *Triceratium, Isthmia* and *Pleurosigma*, and that this eminent authority has given in his adhesion to the opinion long advocated by me, namely, that the valvular surface of *P. angulatum* is not studded with depressions, but with elevations. Moreover it is a significant fact that the woodcut representing the enlarged photographic view of this Diatom inserted in previous editions of his work is altogether omitted in the last one. Of this Prof. Schultze was obviously ignorant when he penned his remarks. Dr. Carpenter does not state, however, whether he considers these elevations as being simply tubercular or formed with distinct sides, that is, with facets, as suggested by me. Since writing my former paper, so far from meeting with any appearances or facts to cause me to modify the view then offered with regard to *P. angulatum*, that view has derived the strongest confirmation from repeated and careful re-examination of the structure under every condition capable of throwing light upon its true nature. But, owing to the extreme minuteness of the markings of this Diatom, it seemed almost hopeless to render them amenable to anything approaching proof until some closely allied variety should turn up, of sufficient size to meet the requirements of the case. Fortunately some specimens of *P. formosum** supplied the necessary conditions. One valve in my possession measures in length $\frac{1}{30}$th of an inch, the diagonal striæ being 25 in ·001. Numerous other specimens measure as much as $\frac{1}{55}$th and $\frac{1}{60}$th of an inch, their striation being only a slight degree finer. By means of these, I have been enabled with ease to see the various series of lines, under a Ross's $\frac{1}{2}$-inch objective. With the same eminent maker's lenses of $\frac{1}{4}$th, $\frac{1}{6}$th, $\frac{1}{8}$th, and $\frac{1}{12}$th focus, and with a Hartnack's No. 10 immersion lens, whether employing direct or oblique, natural or artificial light, and with either shallow or deep eye-pieces, not only is the lozenge-shaped character of the interspaces unmistakeably determined, but the angulated structure of the elevations

* Dredged by me at Guernsey in about 15 fathoms of water. According to the characters given in the Synopsis, this Diatom is intermediate between *P. formosum* and *P. decorum*. The distinction drawn between these varieties, however, is too trivial to be tenable.

occupying those spaces, and with it the character of the two remaining series of lines. In short, the appearance presented by one of these valves, as seen under a Ross's $\frac{1}{4}$-inch or $\frac{1}{6}$th inch objective and a low eye-piece, differs only in the angles* formed by the diagonal lines from what is seen on a valve of *P. angulatum* when examined under a $\frac{1}{8}$th or $\frac{1}{12}$th. In both instances hexagons may be evoked by dint of a laborious effort to detect the precise error of focus essential for the production of this illusory figure; but it is impossible to witness the contrast between the perfect definition observable whilst the true structure is visible and that presented when the hexagons or "dots" are produced, without perceiving that a fictitious image is impressed on the retina in one case, and a true one in the other.

But the question admits of demonstration in a very remarkable manner. By inserting a delicately-hinged metallic scale between the eye-piece and the tube of the microscope, so as to form a goniometer, I was enabled with accuracy to measure the two angles produced by the intersections of the diagonal lines. These were respectively 83° and 97°. By means of a piece of paper, carefully cut, so as to form a four-sided figure presenting these angles, and gummed to the plane side of the lens of the eye-piece nearest to the objective, I was subsequently able to verify the first observation. The next step was to count how many diagonal lines occupied a given number of divisions of a Ross's screw micrometer; and then, how many longitudinal and transverse lines occupied the same space. This done, a diagrammatic figure was prepared, the only essential condition in its formation being that the recorded angles should be accurately preserved. The two diagonal sets of lines being thus laid down, parallel longitudinal lines were drawn passing through the whole of the angles of 83°, and parallel transverse ones through the whole of those of 97°. It now only remained to count off as many of the diagonal series as were previously observed to occupy the predetermined number of divisions of the micrometer, and, employing these as a unit of comparison, to ascertain if the longitudinal and transverse series of lines on the diagram tallied in number with those occupying an equal space on the valve itself. The result, which appears to me conclusively to demonstrate the identity in the series and direction of the lines on the valve itself and the diagram, was as follows †:—

* The horizontal angles in *P. angulatum* are respectively 120° and 60°.

† It will at once be obvious that the degree of magnifying power employed in this observation is quite immaterial, the relative number of lines, longitudinal and transverse, in any given number of diagonals being all that is requisite.

In five divisions of the micrometer,	diagonal lines	10
" " "	longitudinal do.	15
" " "	transverse do.	$12\frac{1}{2}$
In a space equal to ten of the diagonal lines on the diagram,	longitudinal lines	$14\frac{3}{4}$
" " "	transverse do.	13

It is perhaps necessary to add that, in speaking of lines, I mean to convey the idea of perfectly clear and well-defined lines, such as are visible on the finest kind of cut glass or crystal by the naked eye—and further, that, with the highest powers, it becomes perfectly manifest that the diagonal series which bound the elevated portions of the structure are not "bent at short intervals at an angle of 120°," as supposed by Schultze and others. On this head I may remark that if the sides of an hexagonal figure, such as has been assumed to exist in *P. angulatum,* are resolvable, inasmuch as each of the sides must, *à priori,* occupy the length of one of these "bends," it follows as a necessary consequence that the same degree of magnifying power, and the same adjustments of the microscope, ought to render apparent the "bends" or zigzag formed by the succession of these deviations from a direct course. But inasmuch as these powers and adjustments avowedly fail to do so, it seems almost like an assumption unsupported by evidence of any direct kind whatever to regard the lines otherwise than as they appear.

Again, assuming the lines to be resolvable into "dots" or hexagons, and accepting the estimate laid down in the 'Synopsis of British Diatomaceæ' as correct, namely, 52 in ·001″, and further assuming the diameter of each of the hexagons to be double the diameter of the "bent lines" by which they are bounded (which is about the proportion deducible from Mr. Wenham's photographic representation), it is manifest that the diameter of the "bent lines" would be about one 100,000th of an inch, and that this would also be an approximate estimate of the length of each deviation to the right or left of the direct line. Now, since it is well known that lines of this degree of thickness can be clearly defined, and even counted, when not closely aggregated together, it follows that the "bent" form ought to be, and indeed would be, definable, did it really exist. But, as candidly acknowledged by Schultze, "these bends are imperceptible" with powers even of 500 and up to 800 diameters; and this being the case, the inference is surely warranted, that no faith can be placed in the apparent outline of the spaces said to be actually determined and defined by those "bent lines."

But, as I have formerly mentioned, in the *Pleurosigmata* there are *four* sets of lines, and not three only, as stated by Professor Schultze. This is a material point, for there are only three sets necessary in the formation of a series of hexagons. And, lastly, I have to repeat that, whereas a change in the series which happens to be most distinct (owing to the direction in which the light comes) takes place four times during a complete revolution of the stage (that is to say, once in every 90°, when *P. angulatum* is examined), the change would necessarily take place six times, or once in every 60°, were the hexagonal figure the true one.

Lastly, it is obvious that, if the striæ or lines are those parts of the valve which are "resolvable into dots" or hexagons, *two* of each of these lines ought to enter into the formation of opposite sides of each hexagon. In Schultze's figure* two of each series are actually represented as entering into the formation of each hexagon. Hence, for every three hexagons there ought to be four lines. But it is not the lines which, under the circumstances described, become resolvable into dots or hexagons, but the spaces between the intersections of those lines; and hence it will be found that the number of "dots" occupying a given number of divisions of the micrometer does not coincide with the number of lines ascertained as occurring in a like space.

There is one point, however, on which I have found it necessary to modify my previous opinions. To this I have already cursorily referred, namely, the depressed interspaces on the valvular surface of *Pleurosigma balticum* and the rest of the rectangularly marked series. But I am by no means prepared to speak positively regarding this or the difference presented between the outer and inner surfaces of the rectangularly or quincuncially arranged group. The existence of a difference is extremely probable for several reasons. Thus the direction of the lines of fracture characteristic of each group is hardly reconcileable with any other hypothesis than that the lines constitute the thinnest and weakest portions of the structure; and assuming this as a generally admitted fact, whether the interspaces are occupied by elevations or depressions, it follows that these cannot occur equally on both sides, otherwise the entire substance would be moniliform, which has never been asserted, to my knowledge.

It might naturally be supposed that elevated portions occurring on one surface of a valve would impart the appearance of depressions when viewed from the opposite surface. But I have failed to satisfy myself of any such distinction. In this dilemma I caused to be prepared two models in plate glass, on one surface of which were carefully imitated the markings of the two typical forms, the other surface remaining plain. These were examined

* Journal of Microscopical Science for April 1863, plate 8. fig. 11.

both by direct and oblique light, being placed within a box of sufficient length to exclude the rays coming in other directions, and examined with the naked eye, an opera-glass, and a hand-glass of long focus, at varying distances. The experiment was quite satisfactory so far as the production of the appearances visible under accurate and faulty focusing is concerned, even to the creation of dots where there ought to be pyramidal four-sided figures; but so identical are the appearances engendered, from whichever side the plates are viewed, that it is almost impossible to determine, from mere eyesight, which surface is nearest the observer. The same sort of difficulty may be noticed in looking directly through a plano-convex lens held up to the light at some distance from the eye. It is hardly to be wondered at, therefore, that the Diatom-valve should be equally intractable in this respect.

It is, I presume, quite unnecessary for me to enter into the concluding question raised by Professor Schultze with regard to the *foraminated* structure of certain Diatom-valves, and more especially of *Isthmia* and *Coscinodiscus*, since few, if any, microscopists in this country will be found to coincide with the opinion he expresses. That the thinning away of portions of the valvular surface is sometimes extreme admits of no doubt; but that it normally amounts to actual perforation is negatived by a number of well-known facts and appearances. Under these circumstances I only invite attention to the view he has hazarded, in order to show the danger of reliance on Welcker's test as applied to such organisms as the most delicately sculptured of the Diatoms.

It only remains for me to express my conviction—one arrived at under no undue bias in favour of lenses of British manufacture—that the apparently unavoidable and repeated succession of light and dark points, on which so much stress has been laid by Welcker and Schultze, is indicative of a very limited degree of penetrating power. Of the high qualities of the Hartnack combination I can speak with confidence from the performance of one in my possession. It equals any lens I have ever seen for clearness of definition as well as penetrating capacity; but the necessity for the employment of a drop of fluid between the thin glass cover of the slide and the front combination must always be regarded as an inconvenience and a drawback to its employment, more especially since our first-rate English lenses effect all that the Hartnack combination can effect, without any such supplementary aid, and under a much lower degree of magnifying power.

Postscript.—The following is a statement of the experiments conducted with a view to ascertain the relative thicknesses of different portions of the Diatom-valve under the action of fluoric acid—assuming, as every portion is of precisely similar density, that the thinner parts must be the first to succumb to the eroding action. I may mention that the acid was very gradually applied in fumes to the Diatoms previously dried and fixed on slips of mica.

In the stouter and more coarsely marked *Naviculæ,* in which the median line is surrounded by a broad unstriated area of silex, from the outer margin of which the striation commences, the striated portion was invariably destroyed first, the dotted points being the foremost to yield. The median line and its adjoining area yielded last.

In *Cocconeis distans* the dots at once yielded, and then increased in size until the intervening portions of silex were altogether eroded.

In *Biddulphia, Triceratium,* and *Isthmia,* the interspaces yielded first. The costæ of *B. pulchella* and *B. regina* yielded last.

In *Pleurosigma formosum* and *P. balticum* the action on the entire structure was so instantaneous and complete that it was difficult to apply the smallest quantity of the fumes without altogether consuming the valves. But wherever portions remained, the outline was identical with that shown when the valves are fractured, thus clearly confirming the view that the portions constituting the linear markings are the thinnest. In these forms the median and terminal nodules were the last to succumb.

Lastly, it is worthy of notice that in those portions of the Diatom-valve which present a delicate pinkish tint the siliceous structure is the thickest. Where the tint is grey or inclining to green, the film may be regarded as being of extreme tenuity. The same feature holds good amongst the Polycystina, and is indeed more strikingly observable in that family, owing to their superior size and solidity.

XLI.—*Further Observations on an undescribed indigenous* Amœba, *with Notices on remarkable forms of* Actinophrys *and* Difflugia. By G. C. WALLICH, M.D., F.L.S., F.G.S., &c.

[Plate IX.]

THE very singular characters presented by the new form of *Amœba,* to which attention was drawn by me in the last Number of 'The Annals,' having induced me to keep it under constant supervision during the bygone month, I am glad to be enabled to confirm the description there given, and at the same time to add several new facts regarding it and two other species of indigenous Rhizopods, which can hardly fail to excite interest. I beg to state, however, that the present and former communication on this subject must only be regarded as of a preliminary nature, and published with a view to afford naturalists an opportunity of personally investigating the organisms in question. When it is borne in mind that we are now treating of creatures holding the lowest position in the scale of being, and that it has been customary to assign to them a degree of simplicity of structure wholly incompatible, so far as all analogy teaches, with the vital functions they are known to perform, it will, I think, be allowed that this unlooked-for phase in the history of the Rhizopods cannot be too minutely scrutinized.

From a further supply of the material containing the *Amœbæ* obtained towards the close of March, it would appear that the form is tolerably plentiful—occurring, however, only in those shallow pools, highly impregnated with ferruginous matter, that are to be met with in certain parts of Hampstead Heath. In the clear pools not a single specimen, having the novel characters I have described, is to be found.

Out of the numerous individuals examined by me, I should say that not more than 5 per cent. have been deficient in the villous patch; and from the mode in which some of the larger specimens have been rent asunder by pressure whilst under observation, so as to form two distinct beings, there seems every reason to believe that these apparently exceptional specimens have been produced by similar means. Under the circumstances, I think the *Amœba* may safely be regarded as a well-marked species, and I accordingly propose that it should be named *A. villosa*.

I mentioned in my former notice that the contractile vesicle and nucleus were generally to be seen in the vicinity of the villous patch, and that, in a single example, the latter had assumed the shape of a spherical tuft attached to the body by a cylindrical pedicle of sarcode. During the past month I have had ample opportunity of verifying the observation that, in the majority of specimens, so long as the villous patch is not being employed as an organ of prehension, but is merely dragged along in rear of the main body, the nucleus and contractile vesicle retain their position in its vicinity, but that they circulate with the other contained matters whenever the prehensile action of the villi is not in abeyance. Several specimens have exhibited the tuft and pedicle, but not in so symmetrical a form as the first one observed by me. These are very material points, inasmuch as they tend to prove that some kind of consentaneous action takes place between the contractile vesicle, the nucleus, and the villous area, even independently of the appearances now about to be described.

In several specimens, a delicate funnel-shaped tubule was visible passing longitudinally through the villous tuft (Plate IX. fig. 3). When this occurred, the contractile vesicle was not to be seen. Minute particles of effete matter, accompanied at times by shreds of sarcode, were frequently extruded at the infundibuliform orifice,—their passage outwards being slow till the orifice was reached, when they seemed to be forced out with a jerk. On three occasions, what appeared to be a minute vacuole (for it did not pulsate) was similarly extruded, its sarcodic investment assuming the shape of a minute villous tuft, which remained adherent for a time to the main body by a slender filament, but became eventually detached when the creature had advanced to a sufficient distance to overcome its extensile powers (Plate IX. fig. 4).

It is a very curious fact that in one of the saucers into which the material containing the *Amœbæ* was placed, and in which the water had been purposely allowed to evaporate to a considerable extent, the whole of the specimens seemed to undergo another change. This consisted in the formation of a large subspherical or ovate mass of homogeneous granular matter, which occupied the entire posterior* fourth of the body, causing it to bulge, with more or less regularity, around the base of the villous tuft, and, like the latter, never quitting that position (figs. 1, 2, & 3).

In this phase of the *Amœba* the normal erratic pseudopodia were hardly ever projected, but the body maintained an elongated cylindrical shape, with comparatively rapid flowing movements, during the occurrence of which the villous tuft was passively dragged along. This granular mass at first sight resembled a much enlarged nucleus without its containing vesicle. Although its boundaries were well defined posteriorly, the granules seemed to amalgamate to some extent with the general endosarc anteriorly, and at times a portion of the granules left the mass and took part in the general cyclosis. But in some individuals the true nucleus could be seen distinctly within the boundary line of the granular mass, although it was impossible to determine whether it was actually imbedded in its centre, or occupied a position externally to it but within the ectosarc. In these specimens the contractile vesicle was not observed to undergo its normal diastolic and systolic action; and hence it is possible that the vesicles seen may in reality have been vacuoles, in this condition of the organism. At all events, further information is requisite before the point can be accurately ascertained.

It is highly probable, however, that the granular mass referred

* Reptation is so manifest in these *Amœbæ*, and the direction of their movements is so uniformly opposite to that in which the villous area is situated, that I have deemed it legitimate to employ the terms *anterior* and *posterior* in my description of the parts.

to is of the nature of a nucleus. In appreciable characters, both as to colour, form, and size, the component granules are identical with those seen in the true nucleus. But the analogy is well nigh confirmed from the circumstance that, at a still later period, when evaporation of the water had gone on to a greater extent, the entire granular mass referred to became segregated, as if by a process of segmentation, into numerous distinct nuclei, amongst which the true nucleus was not recognizable as a separate or different structure. These multiple nuclei, varying in number from five to about a dozen, were contained in no separate cavity or cavities, but occupied the position previously occupied by the single large granular mass. In the specimens exhibiting this structure, the animal seemed inclined to assume an encysted form, motion being almost totally suspended, and the short conical pseudopodia projected from all parts of the surface except the villous area, being withdrawn and re-extended with extreme slowness, and only at long intervals (Plate IX. fig. 5). After a time (whether from the pressure of the glass cover or otherwise, I am as yet unable to determine), these multiple nuclei were extruded, one by one, in the vicinity of the villous area. During extrusion, and for several minutes subsequently, they retained their spherical mulberry-like form. They then, one after the other, fell asunder as it were,—the granular disruption seeming to commence at a single central point, and afterwards to extend equally on all sides. The granules, when released, formed a delicate cloud, each granule maintaining a tremulous and apparently molecular movement for a few seconds, and ultimately assuming a condition of perfect rest. At fig. 5*a* I have shown one of these nuclear masses as seen when first extruded.

In a single example, occurring in the material originally procured, a very distinct membranous capsule was observable (fig. 6). This had all the appearance of being true ectosarc, inasmuch as it not only closely invested the body, but the boundaries of the villous area. I have already stated in my previous paper that acid and alkaline reagents failed to render evident any such membrane as is alluded to by Auerbach and Schneider. Repeated attempts with these reagents have since been made by me to bring the membrane into view, but without success. In the single specimen now under notice, all movement of the body had entirely ceased, and it appeared to be strictly encysted. But there still remained a slow cyclosis of the granular particles; so that life was not extinct. It is just possible, therefore, that the membranous capsule may not have constituted an integral portion of the *Amœba* in question, but that the latter may have accidentally insinuated itself into the effete cell of some other animal. It is a significant fact, however, that the membrane resisted pressure in a manner that showed its strength and at the same time the probable absence of any aperture through which its contents, if not forming part and parcel of itself, might have escaped. In short, disruption did not take place until after the glass cover in use (measuring ·008 of an inch in thickness) had been broken. The wall then exhibited very distinct angular folds and a clear membranous outline, but of too great tenuity to admit of the measurement of its thickness. In this specimen the nucleus, probably owing to displacement by the pressure, occupied a position at the centre of the body—no contractile vesicle or larger granular mass being present, but several vacuoles being scattered through its substance.

One of the most remarkable amongst the novel and varied characters of these *Amœbæ* consists in the vesicle in which the true nucleus is contained having been found to be distinctly membranous in some individuals. In the figures appended to my paper in the last Number of the 'Annals,' I endeavoured to show the definite appearance of the vesicular chamber of the nucleus; but at that time I had no idea of the peculiarity thereby indicated, nor did I become aware of it, or indeed believe in it, until I had seen several nuclei *with their vesicular covering* completely isolated from the main body by means of the compressor. The fact, startling as it seems, is nevertheless certain, that in these specimens the nucleus was contained in a distinct membranous cell of its own, and that this cell admits of perfect isolation without undergoing rupture. The cell-wall was spherical in its extruded state, perfectly hyaline, tough, and resisting, and forming irregular folds under augmented pressure, as shown in figures 7 and 7*b*,—a clear nucleolus, as before described, being visible in the interior of the granular nucleus, and the space between the nucleus and cell-wall being occupied by a still more attenuated *granular* protoplasm. In contradistinction to this, the multiple nuclei, already spoken of, had neither investing membrane nor nucleolus. Can it be that the one phase represents the germ-cell, and the other the sperm-cells?

Another fact is deducible from the appearances presented by the sarcode-substance of the largest of these *Amœbæ*. The rush of granules does not follow upon a previous contractile effort exercised at the posterior portion. As the animal progresses, occasionally altering its course, there are periods during which perfect quiescence is maintained by the granules; and the rush or flow of these seems to take place, as it were, to fill up the vacuum engendered by the sudden projection of a portion of the ectosarc in the shape of a pseudopodium. Hence it would appear that motion is dependent on the contractile power of the external sarcode-layer, and that the endosarc only passively participates in it. If this view is correct, it involves a very important consideration; for it proves that the old German doctrine of a "primary contractile mucus" is essentially correct, and that the circulation is not dependent, even in part, on the alternate expansion and collapse of the contractile vesicle. Further than this, it affords the strongest confirmation of the high degree of differentiation existing between the endosarc and ectosarc of the Amœban group.

The mysterious faculty resident in the latter portion of the structure, of forming extempore orifices for the inception or extrusion of food-particles, &c., may be witnessed in these specimens in a very singular manner, and one which, as far as I am aware, has not hitherto attracted attention. I allude to the projection of the ectosarc from some area of the general surface in the form of a hemispherical mass with a broad base, only a very small portion of the original contour line seeming to give way at first, so as to admit of the passage of the endosarc and other granular contents into the newly projected part, but its entire floor appearing to be gradually dissolved, as it were, and free communication between the main body and the new pseudopodial cavity not being established until the completion of this process. Whilst it is progressing, the endosarc-granules seem to rush round a corner into the cavity, the corner gradually receding, so to speak, and ultimately being altogether obliterated.

From these facts it is obvious that the ectosarc and endosarc *are not permanent portions of the Protean structure, but mutually convertible one into the other; and that it is an essential feature of sarcode that, whilst the outer layer for the time being becomes,* ipso facto, *instantaneously differentiated into ectosarc, the same layer reverts to the condition of endosarc under the circumstances just described.* In the latter part of the process, that is, the reversion to the condition of endosarc, the action is by no means so instantaneous as when the converse takes place. In the Actinophryans both processes are, comparatively speaking, slow.

Lastly, I have to state that when the homogeneous sarcode is poured forth from these *Amœbæ* under pressure, the globules show no tendency whatever to coalesce. In general, the masses of sarcode are expelled in irregular-oblong or ovate portions of varying sizes, which rapidly detach themselves, and then at once assume a perfect spherical form. It is very rarely indeed that foreign bodies remain within these masses, or are extruded as part of their contents. They are extruded separately under these circumstances. The sarcode constituting the spheules, when first it escapes, appears perfectly homogeneous, and s granules are extremely minute. After the lapse of a period arying from a quarter tohalf an hour, this homogeneous character disappears, and a species of segmentation takes place, the minute granules becoming more closely aggregated together, so as to form irregular and somewhat darker patches within the spherule, whilst the form of the latter is in nowise modified. A representation of these phenomena is given on a largely magnified scale in figs. 8, 8*a*, and 8*b*.

[To be continued.]

EXPLANATION OF PLATE IX.

Fig. 1. *Amœba villosa*, showing the position and appearance of the large granular mass, with the true nucleus, and cylindrical form assumed by the *Amœbæ*.
Fig. 2. A specimen in which the contractile vesicle is apparently replaced by a conical-shaped vacuole.
Fig. 3. The granular mass and villous tuft, showing the infundibuliform tubule.
Fig. 4. The villous tuft and infundibuliform tubule, with an extruded vacuole (?), and its investiture and sustaining filament of sarcode.
Fig. 5. An *Amœba* with multiple nuclear bodies.
Fig. 5*a*. One of these mulberry-shaped nuclei, as seen immediately after extrusion.
Fig. 6. Encysted? form, with distinct membranous envelope.
Fig. 7. One of the true nuclei after isolation from the parent body, showing its membranous investiture.
Fig. 7*b*. The same, as seen after augmented pressure.
Fig. 8. Largely magnified portion of an active *Amœba*, showing the appearance of the sarcode-globules (8*a*, 8*b*) isolated by pressure.

N.B. The whole of the specimens were more or less full of minute *Crumenulæ*, with which the material in which they were found abounded.

BIBLIOGRAPHICAL NOTICE.

On the Geology and Natural History of the Upper Missouri: being the substance of a Report made to Lieut. G. K. Warren, T.E.U.S.A. By Dr. F. V. Hayden, &c. &c. 4to, Philadelphia, 1862. (From the Transactions of the American Philosophical Society, vol. xii. Read July 19, 1861.)

This valuable memoir comprises information collected on three occasions:—1st. An account of the geological observations made by Dr. Hayden when associated with Lieut. Warren's Expedition, in the summer and autumn of 1857, from Bellevue on the Missouri (about 41° lat., 96° long.) to the mouth of the Big Sioux and back, and then across Nebraska to Fort Laramie, then northward across the Black Hills to Bear Peak (about 44° 30′ lat., 105° 20′ long.), and then south-eastward through the Bad Lands to the Niobara River, and along it to Fort Randall on the Missouri. 2ndly. Geological explorations, by Dr. Hayden and Mr. F. B. Meek, in the north-eastern portion of Kansas territory (between 95° and 98° long., and 38° and 39° 30′ lat.), in 1858. 3rdly. Some results of an expedition to the north-west under Capt. W. F. Raynolds, in 1859–60, Information obtained by the author on this occasion is brought to bear on observations previously made, enabling Dr. Hayden to make, in chapter xiii. of the memoir before us, "a condensed statement of the leading geological discoveries up to the present time, and to harmonize some of the conflicting opinions which may have been advanced in regard to the age of the different deposits in the west." Without careful reference to this third portion of the memoir, the reader will misapprehend the author's views on several points, such as the upheaval-era of the Rocky Mountains, the relations of the Infrajurassic sandstones, the classification of the Tertiaries, &c.

The memoir is illustrated by a few woodcut sections (seriously limited on account of the cost of publication), and by a coloured geological map, based on Lieut. Warren's survey. But this is a mere sketch-map; it does not include the Judith River (an important locality), contains no indication of the "superficial deposits," and mainly represents the determinations arrived at in 1857; and the names of places have been chosen for insertion with little reference to the routes of 1857–58; so that it proves but a poor help to the careful student of this interesting memoir.

In the "Historical Introduction" a short account is given of former explorations made in the north-west territories.

The rocks met with in the regions referred to, between the Missouri and the Rocky Mountains, and on the western slopes of the Big Horn and Wind River ranges, are:—

I. Granitic, metamorphic, and eruptive rocks in the axes of the Rocky Mountains, the Black Hills, and Bear Peak (pp. 33 & 117, &c.). Some lofty and extensive ranges consist of basaltic and other volcanic rocks.

II. Lower Silurian strata (referable to the Potsdam Sandstone), consisting of siliceous limestone, micaceous sandstone, and calcareous fossiliferous grit (with *Lingula*, *Obolus*, and *Trilobites*). This is best seen in the Black Hills, where the upheaved strata engirdle the metamorphic rocks. The author has found this fossiliferous primordial sandstone along the eastern margin of the Big Horn range (p. 120), and has recognized it in the Laramie Range; and he thinks that the sandstone and conglomerate of Stansbury Island and elsewhere in the neighbourhood of the Great Salt Lake may be of the same age, also the so-called "Old Red Sandstone" (Marcou) of the Aztec Mountains in New Mexico.

III. Carboniferous rocks, of great thickness, belonging to the upper part of the series, and possessing but little coal, in North-eastern Kansas and South-eastern Nebraska; whilst about 100 feet of fossiliferous limestone, turned up around the Black Hills and Bear Peak, and a variable group of sandy and calcareous strata, from 1000 to 1500 feet thick, with a few fossils, forming the western outcrop of the great Carboniferous formation, where its edge is upraised along the Big Horn and the Laramie Mountains, and along the Sweet-water and Wind River Mountains, represent perhaps both the upper and lower members of the series (p. 121). Still further north, the Carboniferous strata abound about the upper branches of the Missouri; and they reoccur on the western slopes of the Rocky Mountains, in South-eastern Oregon (p. 121).

Notes on the fossils collected by the author from the Carboniferous strata are given at pages 61–67. One of the most abundant is *Fusulina cylindrica,* which abounds in Russia in the upper part of the Lower Carboniferous series (Mountain-limestone); but in Kansas it is found (*F. cylindrica,* var. *ventricosa,* Meek and Hayden) within about 300 feet of the top of the Upper Carboniferous series (Coal-measures), and occurs abundantly in numerous beds far down in the series. In South-western Iowa and in Missouri it also abounds. *F. elongata,* Shumard, belongs to the white limestone of the Guadalupe Mountains, New Mexico, which has been referred to the Permian series by Dr. Shumard.

IV. In the Kansas Valley, the Coal-measures pass upwards conformably, from magnesian limestones alternating with clays, and containing *Solemya, Myalina, Pleurophorus? subcuneatus, Bakevellia parva, Euomphalus, Spirigera, Orthosina umbraculum* (?), *O. Shumardianum,* &c., into clays and magnesian limestone, with *Monotis Hawni, Myalina perattenuata, Pleurophorus? subcuneatus, Edmondia? Calhounii, Pecten, Spirigera, Nautilus excentricus, Bakevellia parva, Leda subscitula, Axinus rotundatus, Bellerophon, Murchisonia,* &c. The latter set of beds are the first that lose nearly all trace of Carboniferous forms; but the former are not nearly the first that contain genera (such as *Synocladia* and *Bakevellia*) peculiar to the Permian rocks of Europe. Here, then, Dr. Hayden is inclined to draw a provisional and artificial line between "Carboniferous" and "Permian," if such be required; though apparently he would rather admit the existence, in this region, of an intermediate and transitional group of rocks. In Illinois, however, there is an unconformity between the Carboniferous and Permian beds, according to Dr. J. G. Norwood. In Kansas, above the fossiliferous beds above mentioned, succeed calcareo-siliceous conglomerate (breccia?), local and about 18 feet thick; gypsiferous clays, 95 feet; red and variegated clays, with seams and veins of magnesian limestone, 60 feet; all unfossiliferous and doubtfully referred to the Permian series.

In the Black Hills, the limestone of the Carboniferous formation is succeeded by about 400 feet of red, gypsiferous, calcareo-argillaceous beds and sandstone, among which is a limestone, of variable thickness, with *Spirifer, Pleurotomariæ, Macrocheili,* and *Bellerophon*; and cherty magnesian limestones, with *Myalina perattenuata,* were found at the foot of the Big Horn Mountains, near the head of Powder River. These are possibly Permian. They appear to have been subjected to great denudation (together with the Carboniferous rocks) previously to the deposition of the next series of deposits.

V. These are red arenaceous and gypsiferous marls, overlying the Carboniferous rocks along the eastern slope of the Rocky Mountains, from lat. 49° southwards, also in the Laramie Plains, and on the west side of the Wind River Mountains, and over a vast extent of country, including the Wasatch Mountains, south of Lake Utah, also the Green River Valley down the Colorado into New Mexico, where they have been noticed and described by various explorers. These beds have usually been correlated with the European Trias; and the fossil plants found in them by Dr. Newberry in New Mexico appear to favour that idea; but Dr. Hayden does not feel confident on the subject, especially as he says, "On the west side of the Wind River Mountains we have discovered fossils beneath the red beds, which may include those in the Jurassic" (p. 123).

VI. "The Jurassic rocks are everywhere revealed overlying the red deposits just mentioned, and possess an equal geographical extension." Around the Black Hills and along the flanks of the Rocky Mountains, they are upheaved in a zone from a quarter to three miles wide, and consist of,—1st (lowest). Laminated sandstones and shales, with *Trigonia, Pecten, Mytilus, Serpula, Avicula* (*Monotis*) *tenuicostata*, Meek & Hayden, *Pentacrinus astericus*, M.&H., *Lingula brevirostra*, &c., 60 to 100 feet. 2nd. Marls, 30 to 40 feet. 3rd. Sandstones and marls, with *Arca inornata, Panopæa* (*Myacites*) *subelliptica*, M. & H., *Avicula tenuicostata, Ostrea, Hettangia, Ammonites cordiformis*, M. & H., *A. Henryi*, and *Belemnites densus*, M. & H.; and a calcareous grit, of freshwater origin [Wealden?], with *Unio nucalis, Planorbis*, and *Paludina* (?), altogether 50 to 80 feet (p. 42 & p. 123). These Jurassic strata are not the so-called "Jurassic" of Marcou.

VII. The Cretaceous system "holds a very important position in the North-west, not only from the vast area which it occupies, but also from the number, variety, and beauty of its organic remains." It is divisible into five members. The lowest, No. 1, "is a well-marked and distinct division along the Missouri River from De Soto to a point above the mouth of the Big Sioux River in the eastern portions of Kansas and Nebraska, and in the south and south-west." Towards the north-west it seems to merge into No. 2 division. No. 1 is an important group of beds, sandy and argillaceous, about 200 feet thick in Nebraska, and containing lignite, fossil wood, impressions of Dicotyledonous leaves, *Equisetum* (?), *Pectunculus Siouxensis*, H. & M., &c.

At the mouth of the Judith River, the beds referred to the Cretaceous groups Nos. 1 & 2 are from 1500 to 2000 feet thick, and contain lignite, *Credneria, Inoceramus pertenuis, Mactra alta, Cardium speciosum, Meretrix Owenana, Thracia subtortuosa, Ostrea glabra, Hettangia Americana, Panopæa occidentalis*, and *Mactra formosa*; also freshwater beds [Wealden?], with *Lepidotus, Uniones, Melaniæ, Cyclas*, and *Helix* (pp. 72, 125, 133).

The thick red sandstones of group No. 1 afford lofty vertical bluffs in the Valley of the Elkhorn, which the Indians have sculptured with hieroglyphics. Blackbird Hill, on the Missouri, is a typical locality for this leaf-bearing Lower Cretaceous group, which here underlies a soft whitish limestone containing *Inoceramus problematicus* and fish-remains (group No. 3?, p. 10); on the Elkhorn it is overlain by group No. 3 (p. 71); and elsewhere, though sometimes hidden and sometimes apparently wanting, it seems usually to hold a definite place as the lowest Cretaceous rock. Considerable care appears to have been taken by Dr. Hayden in these observations, as it has been supposed by Marcou that, in this zone of red leaf-bearing sandstone, beds of Miocene and Jurassic age may have been confounded together. In New Mexico, the equivalent of this group No. 1 has been seen by Dr. Newberry to be overlain by Inoceramus-limestone containing fossils thought by Marcou to be Jurassic! Cretaceous group No. 2 consists of dark grey fossiliferous clays, in Nebraska, with a thickness of 200 feet, and contains *Ammonites Alpinianus, A. percarinatus, Serpula? tenuicarinata, Inoceramus problematicus, Ostrea*, Fish-remains, &c. (pp. 69 & 72). (In the table of fossils at p. 81, *Ammonites Vermilionensis only* is quoted for this group.) Along the Big Horn, Laramie, and Wind River Mountains, from 800 to 1000 feet of black plastic clay, with beds of calcareous sandstone, represent perhaps both No. 2 and No. 1 (p. 124). Group No. 3 in Nebraska consists of Inoceramus-limestone (30 feet) passing upwards into marl with *Ostrea congesta* (100 feet); fish-remains are abundant throughout. In the west this group appears to be lost. Group No. 4 is represented in Nebraska by dark fossiliferous clays, 350 feet thick; the lowest beds are locally lignitiferous; and the lignites have in some places been burnt, and the strata thereby altered (pp. 75 & 76, *note*). This group is widely extended, gives a sterile character to the land, contains sandy seams impregnated with sulphate of soda, and is rich in numerous well-preserved organic remains: of these the chief are *Mosasaurus, Nautilus Dekayi, Ammonites placenta, A. Halli, Baculites ovatus, B. compressus*, and very many other Mollusks, &c. (See table of fossils, pp. 81 &c.): the only yet known Echinoderm of the Cretaceous rocks of the north-west occurs in these beds, on the Yellowstone River. Group No. 5 succeeds No. 4 with but little alteration in its fossil fauna; it is about 150 feet thick, consists of very fossiliferous clay and sandy beds, with much irony matter and numerous concretions: *Belemnitella bulbosa, Nautilus Dekayi, Ammonites placenta, A. lobatus, Scaphites Conradi, Baculites ovatus, Ostrea subtrigonalis*, and many other Mollusks, &c. (pp. 69, 79, 81 &c.).

On the western slope of the Rocky Mountains the series is represented by 600 to 800 feet of black clays, sandy marls, sandstones, and limestones, alternating, and containing some lignitic seams. In the middle and towards the top of the series are some Inoceramus-limestones. The group has a general dip of about 20°, and passes upwards imperceptibly into the great Lignitic Tertiary group.

Some of the Cretaceous beds suffered erosion before the others succeeded them; and in some cases it is evident that the groups Nos. 5, 4, & 3 were denuded before the deposition of the Tertiary beds (p. 125); but, on the other hand, the beds of group No. 5, after having gradually changed from a mainly argillaceous to an arenaceous condition (from deep to shallow-water formations), pass, in some instances without any apparent break, into the superincumbent "Estuarine Tertiaries": indeed, were it not that *Baculites, Ammonites, Inoceramus*, &c., which abound in group No. 5, "are everywhere supposed to have become extinct at the close of the Cretaceous epoch, we would be in doubt whether to pronounce them Tertiary or Cretaceous," the associated fossils being "more closely allied to Tertiary types than Cretaceous" (pp. 30 & 128).

VIII. The Tertiary formations in the north-west are divisible into

1 (uppermost). Yellow marl (Loess).
2. White River group.
3. Wind River Valley group.
4. Lignitic group.
5. Estuary group.

The "Estuary-group," of which the Judith Basin may be regarded as the type, is widely distributed (p. 126). These beds are found at the sources of the Moreau, Grand, and Cannonball Rivers; and at the mouth of the Big Horn they are 800 to 1000 feet thick. Similar deposits occur on the west side of the mountains near Green River. The "Estuary Beds" pass up gradually into the Lignitiferous group, the mingled brackish and freshwater shells giving place to terrestrial, lacustrine, and fluviatile forms, which alone, without any marine associates, are found in the Upper Tertiaries of these vast regions. Some dicotyledonous leaves and silicified wood occur in some of the Estuary-deposits, but are insufficient "to indicate the great luxuriance of vegetation which must have existed during the accumulation of the Lignite-strata" (p. 126). In the body of the memoir (p. 92) these two groups are described together under the heading "Great Lignite Tertiary basin." Silicified trunks of trees, 50 to 100 feet in length, occur abundantly over hundreds of square miles along the Missouri and Yellowstone Rivers, in the Lignitic Tertiaries; and there are from thirty to fifty beds of lignite, varying in thickness from 1 inch to 7 feet. The lignites on the Yellowstone River and elsewhere have been much affected by spontaneous combustion (p. 99). The Vertebrate remains as yet obtained from the Estuary and Lignite groups belong to *Thespesius occidentalis, Ischyrotherium antiquum, Mylognathus priscus, Compsemys victus,* and *Emys obscurus,* all described by Leidy in Proc. Acad. Sc. Philad. 1856, and Trans. Americ. Phil. Soc. 1859. The list of the other fossils is given in pages 101–103 of the memoir. These interesting Tertiary beds have an enormous geographical extent. Dr. Hayden is of opinion that they reach from the Arctic Sea to the Isthmus of Darien along the Rocky Mountains, with the elevation of which they have partaken (pp. 118 & 126).

The Wind River group is from 1500 to 2000 feet thick, is intermediate in character between the foregoing and the next group, occurs on both sides of the mountains, and has partaken in the elevating movements, but in a less degree, having probably been formed whilst the uprising took place (p. 127).

The White River group is of great extent, on both sides of the mountains, overlies the Lignite group, and has a nearly horizontal postion, whilst the Lignitiferous beds are much inclined (pp. 127, 128): these facts were not clearly recognized when the first part of the Memoir was written. The White River group of Tertiary beds forms the "Mauvaises Terres" on the White (or White Earth) and Niobara Rivers. It is divisible into the (lowest) A. Titanotherium-bed, 100 feet; B. Oreodon-bed, 100 feet; C. sandy beds, with few fossils, 80 feet; D. Grit and sand (few fossils), 400 feet; E. Sandstone and conglomerate, 200 feet [A–E = Miocene (?). Marcou thinks that some of these beds may be Jurassic or Triassic!]; F. Freshwater limestone, marls and sands, sand with *Mastodon* and *Elephas*, altogether 200 feet [Pliocene]; surmounted with Post-pliocene yellow siliceous marl, &c., with extinct and recent Vertebrates and recent Mollusks. A list of the numerous Vertebrata, described by Leidy, from these deposits, was lately given in the 'Annals Nat. Hist.' ser. 3. vol. xi. p. 148. The 63 extinct species (20 *Ruminantia*, 12 *Multungula*, 9 *Solidungula*, 6 *Rodentia*, 14 *Carnivora*, and 2 *Chelonia*) are tabulated, with their stratigraphical distribution, at p. 106 of the memoir before us.

The close physical and organic connexion between the Cretaceous group, No. 5, and the "Estuarine group" induces Messrs. Hayden and Meek to regard the latter as of Eocene age, and as having "ushered in the dawn of the Tertiary epoch" with lakes and estuaries on the upraised Cretaceous area. "The estuary deposits soon lose their marine and brackish character, and gradually pass up into the true Lignite-strata of purely freshwater origin, thence by a slight discordancy into the Wind River Valley beds, which give evidence of being an intermediate deposit between the true Lignite and the White River Tertiary beds. Then come the White River bone-beds, which pass up into the Pliocene of the Niobara by a slight physical break, and the latter are lost in the Yellow Marl or Loess deposits. I have estimated the entire thickness of Tertiary rocks in the north-west at from 5000 to 6000 feet; and their interest will be appreciated when I venture to suggest that by thorough investigation they will doubtless reveal, step by step, in a most remarkably clear manner the history of the physical growth and development of the central portion of this continent" (p. 129).

The author remarks that in the north-west the Lower Silurian beds indicate shallow water; that in the Carboniferous epoch comparatively few deep-water deposits were formed there, arenaceous beds predominating; that neither the Infrajurassic red sandstones nor the Jurassic shales and sandstones represent deep water; and that only in the middle Cretaceous strata is there much evidence of the prevalence of "long-continued periods of quiet water," and deep, in these ancient western seas; and these were succeeded by shallow-water conditions and dry land in Tertiary times, when the fluviatile Mollusca were such as now live in Southern Africa, Asia, China, and Siam, and when Palms, such as now exist in the tropics, flourished on the low land now represented by the Rocky Mountains, which have since formed a barrier to the moist west winds, and thus helped to bring about the comparative sterility of the central plains (p. 131).

IX. The superficial deposits (p. 107, &c.) comprise, 1st (lowest), the Drift, consisting of sand, pebbly clay, gravel, and boulders, and varying from 1 to 30 feet in thickness: this seems to extend under all the vast table-land to the northward, is thicker, more constant, and more apparent towards the base of the mountains, but intercalates with the next deposit in some places. 2nd. The yellow marl or Bluff-formation is favourable for agriculture; consists of yellow siliceous marl with calcareous concretions, and with pebbly clays at the base; sometimes attains a thickness of 300 feet, but is variable over wide areas in the Missouri Valley. It seems to be locally synchronous or continuous with the Drift, and is also, at places, seen to succeed the Pliocene bone-bearing grits with imperceptible gradations. It contains remains of recent Mammals, as well as of extinct *Mastodon*, *Elephas*, &c., and large quantities of land and freshwater shells, mostly, if not wholly, of living species. 3rd. Erratic blocks, seldom exceeding four or five tons in weight, sometimes thickly spread over large areas (in Dakota and Minnesota), sometimes forming belts with a N.W.–S.E. range (near Fort Pierre and the Bijoux Hills, on the Missouri (p. 110). 4th. Bottom-prairies, or the broad, fertile, old alluvial flats of the Missouri, were formed under other conditions than those now existing, which produce the present alluvium (No. 5), of which numerous islands, sand-bars, &c., are continually being made and re-made. A steamer wrecked fifteen years ago has given rise to Pilot Island, near the mouth of the Platte, several acres in extent, with a thick growth of cottonwood-trees, from 12 to 20 inches in diameter.

Lastly, the author briefly treats of the river-terraces, resulting from the gradual elevation of the Rocky Mountains (p. 113). This subject, with others referred to in this memoir, will be fully handled in the forthcoming Report of Capt. Raynold's Expedition.

Part III. (p. 138, &c.) comprises notes on the zoology and botany of the Upper Missouri. Some interesting remarks are here made on the Lynx, Wolves, Foxes, Beaver, Deer, Antelope, Mountain-sheep, and Buffalo. Of the last we read (p. 150)—

"The Buffalo are confined to the country bordering upon the eastern slope of the Rocky Mountains. They occur in large bands in the valley of the Yellowstone River, and also in the Blackfoot country; but their numbers are annually decreasing at a rapid rate. Descending the Yellowstone, in the summer of 1854, from the Crow country, we were not out of sight of large bands for a distance of 400 miles. In 1850 they were seen as low down the Missouri River as the mouth of the Vermilion; and in 1854 a few were killed near Fort Pierre. But at the present time they seldom pass below the 47th parallel on the Missouri. Every year, as we ascend the river, we can observe that they are retiring nearer and nearer the mountainous portion. In Kansas, they are found at this time, at certain seasons of the year, in immense droves on the Smoky Hill Fork of the Kansas, within sixty or seventy miles of Fort Riley; and from there to the South Pass they are distributed to a greater or less extent. It is true that these animals are at all times on the move, and frequent different portions of the West at different seasons of the year, or as they are driven by the hunters and Indians; but there are certain parts of the country over which they formerly roamed in immense herds, but are never or rarely seen at the present time. The area over which the Buffalo graze is annually contracting its geographical limits. As near as I could ascertain, about 250,000 individuals are destroyed every year, about 100,000 being killed for robes. At the present time, the number of the males to the females seems to be in the ratio of 10 to 1; and this fact is readily accounted for from the fact that the males are seldom killed when the cows can be obtained. Skins of females only are used for robes, and [the females] are preferred for food. Besides the robes which are traded to the whites by the Indians, each man, woman, and child requires from one to three robes a year for clothing. A large quantity are employed in the manufacture of lodges, and an immense number of the animals, which would be difficult to estimate, are annually destroyed by wolves and by accidents. The Buffaloes vary in colour, white, cream, grey, sometimes spotted with white, with white feet and legs, &c. These varieties are called by the Indians "Medicine Buffaloes," and are regarded of the greatest value, often bringing several hundred dollars. About one in fifty thousand is an albino, while one robe in one hundred thousand is called by the traders a "silk robe," and is usually valued at 100 to 200 dollars. Range: formerly found throughout nearly the whole of North America, east of the Rocky Mountains; now confined to the plains west of the Missouri and along the slopes of the Rocky Mountains" (pp. 150, 151).

Catalogues of Birds, Reptiles, and Fishes follow, also of River and Land Shells, with interesting remarks by Lea and Binney. Chapter xviii., lastly, is occupied by a catalogue of Plants and a list of the *Carices* of Nebraska. Messrs. Baird, Cope, Gill, Lea, Binney, Engelmann, and Dewey have helped the author with the catalogues. Mr. Meek has assisted him throughout.

There can be no doubt that Dr. Hayden's observations on the geological structure of the great north-west regions traversed by him on several occasions indicate correctly the distribution of the Tertiary, Cretaceous, Jurassic, Infrajurassic, Carboniferous, Silurian, Metamorphic, and Igneous rocks in that wide area, replacing hypothesis with facts, and supplying us with clear notions of the exact characters of the several formations there represented, and means of comparing them with their equivalents in other parts of North America, and with their representatives in Europe and elsewhere. The geology of the region immediately to the north of the districts examined by Dr. Hayden is described by Hind and Hector. The fossils collected by Mr. Hind in the "Canadian Expedition" were determined by Messrs. Meek and Hayden; and Dr. Hector (Quart. Journ. Geol. Soc. vol. xvii. p. 388 &c.) keeps well in view the important labours of these gentlemen, especially in the Tertiary and Cretaceous geology of the conterminous region.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

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

The following extracts were read from a letter addressed to the Secretary by Dr. G. Bennett, F.Z.S., dated Sydney.

"I have just received by Capt. McLeod a rough-dried specimen of a *Megapodius*, found abundantly over the New Hebrides and other groups of islands of the Southern Pacific. My specimen was procured from the island of Nua Fou, where it is named 'Mallow' by the natives. It accords with the description of *M. Freycineti.* The bird measures 14 inches from the tip of the beak to the end of the tail; the plumage is of an uniform blackish-brown colour, the mandibles, feet, and legs yellow. At Tanna they gave it the English name of 'Bush Fowl;' at Sandwich Island it was named Tarboosh. At the island of Nua Fou, Capt. McLeod says the bird lives in the scrubs in the centre of the island, about a large lagoon of brackish water, which has the appearance of an extinct crater; the birds lay their eggs on one side only of this lagoon, where the soil is composed of a sulphur-looking sand; the eggs are deposited from 1 to 2 feet beneath the surface. The locality frequented by these birds is, at this island, under the protection of the king or chief, and by his permission only can the birds or eggs be procured. The number of eggs deposited in the mounds varies, as the eggs are laid by different birds in succession; but as many as forty eggs are said to have been procured from one mound. At the other islands the birds visit the sandy beaches in retired localities near the sea about the months of September and October, and deposit their eggs in mounds of sand a short distance one from the other. Thus this bird has the habits of the Freshwater Tortoises, which scoop a pit in the sand near a river, deposit their eggs, and cover them up; when hatched, the young force their way out of the sand, and, guided by their instinct, make for the river. Mr. Dawson, who procured living birds from the Island of Sava or Russell Island, which unfortunately died on the passage to Sydney, informs me that the female lays daily from two to four eggs, and that the female on board laid two eggs daily until the time of her death. The natives of the various islands inhabited by these birds collect these eggs for sale (for they are richer and more delicious than those of the fowl), in baskets of two dozen each. The eggs are sometimes found fresh and good when opened, whilst others contain partially-formed young in different stages, even to the full-fledged bird just ready to emerge from the shell into active life. This might be expected, considering the irregular intervals of time the eggs are laid. The eggs I have vary slightly in size, but are usually of a pale brownish-red colour, and measure, for the most part, 3 inches in length and $1\frac{3}{4}$ inch in breadth.

"Our pair of Mooruks are thriving well in the Botanic Gardens: we have placed them in a large grassed enclosure, 117 feet in length and 45 feet broad, interspersed with a few trees and a small circular pond of water about 2 feet deep, where they are very fond of bathing. There is a thatched shed in the centre for further shelter, if required; and the whole is surrounded by a wire fence, 5 feet high. In this enclosure with the Mooruks are two native companions, an Emu and a sedate Jabiru. The latter is a very solitary, timid bird, always seen by himself. He moves with stately strides, and, if pursued, runs with great rapidity. When the Mooruks first arrived, they were placed with the Water-fowl, in an enclosure where there was a deep tank of water; they are very fond of bathing (which, I also observe, obtains with the Emu), and one of them leaped, as usual, into the water; but the sides being perpendicular and made of cut stone, it could not get readily out of it. Finding itself getting exhausted, it struggled against the edge of the tank, cut its face and severely injured the throat, laying open the pharynx, through the gaping wound of which the food passed; this was stitched, and the bird soon got quite well. From the birds being nearly drowned several times, they were removed to the enclosure before mentioned, with a more shallow pond of water. Mr. Dawson (who has just returned from New Britain) brought another young bird, but, from some cause or other, it died a few days after its arrival. It is now in the Australian Museum. He says the natives pronounce the name of this bird as if written 'Moorup.' Fifteen eggs, brought by Mr. Dawson, that I have examined (of which he gave me two, and also a pair for the Australian Museum) differ considerably in size and colour. They have all been exposed more or less to the influence of heat and various atmospheric influences; so that none are seen of the beautiful grass-green colour of the recently-laid eggs in the Zoological Gardens in the Regent's Park. One was a small abortive egg, barely one-half of the natural size, but with similar markings. The birds are brought off for sale by the natives in every stage of growth, from the young chick to the full-grown bird, with its dark plumage, purple neck, and trilobed crest. The medium of purchase is pipes and tobacco."

The following letter, addressed by Dr. Bennett to the 'Sydney Herald' of September 3rd, 1862, was also read to the meeting:—

" Since the publication of my observations on the Toothed-billed Pigeon (*Didunculus strigirostris*) in the 'Sydney Herald' of August 19th, 1862, I have received a communication from the secretary of the Acclimatization Society of Victoria, enclosing some valuable notes given to them, respecting this rare and extraordinary bird, by the Rev. John B. Stair, of Broadmeadows, Victoria, who was formerly resident for some time at the Samoan or Navigator group of islands, considered the exclusive habitat of this singular bird. I have now selected those portions relating to the bird which are either new to science or will more fully add to its history, and complete, as far as possible, our knowledge of this nearly extinct bird. Mr. Stair says he has seen the *Didunculus*, and that it is named by the natives Manu Mea, or red bird, from the most predominant colour of its plumage being chocolate-red. It was formerly found in great numbers; and this assertion may excite some surprise that this remarkable form of bird should not have been seen and procured by the early navigators. Now, Mr. Stair observes, as I have for some time suspected, the bird is nearly, if not entirely, extinct. It feeds on plantains, and is partial to the fruit of the 'soi,' a species of *Dioscorea* or yam, a twining plant found abundant among the islands, and producing a fruit resembling a small potatoe. The habits of this bird, Mr. Stair observes, are exceedingly shy and timid. Like the Ground-Pigeons, it roosts on bushes or stumps of trees, and feeds on the ground. It also builds its nest in such situations. During the breeding-season both parents aid in the duty of incubation, and relieve each other with great regularity; and so intent are they when sitting on the eggs as to be easily captured. It was in this way two living specimens were obtained for Mr. Stair. They are also captured by the natives with bird-lime or springes, and shot with arrows—the sportsman concealing himself near an open space in which some quantity of the 'soi,' their favourite food, has been placed.

"The first living bird obtained was accidentally killed; the second, when placed in confinement, at first became sullen and refused food, but soon became reconciled to captivity, and throve well. The natives fed it upon boiled taro (the root of the *Caladium esculentum*) rolled into oblong pellets, in the same manner as they feed their pet Wood-Pigeons and Doves. On the departure of a friend for Sydney in 1843, Mr. Stair availed himself of the opportunity of sending the bird here, for the purpose of ascertaining if it was known, and, if so, with what genus it was to be classed, and whether it was a new species. Some natives on board the vessel paid great attention to it, and fed it carefully during the voyage, and it reached Sydney alive. His friend informed him that he could obtain no information respecting the bird, whether it was a new species or otherwise, but left it with some bird-stuffer; and Mr. Stair heard nothing more respecting it until his return to England in 1847 or 1848, when he mentioned the subject to Mr. G. R. Gray of the British Museum, who showed him a drawing of the bird, and told him the subsequent history of the specimen he sent to Sydney.

"The power of wing of most of the pigeon tribe is very great, and it also obtains in this bird. It flies through the air with a loud noise, like our Top-knot Pigeon (*Lopholæmus antarcticus*), found in the Illawarra district, and many other of our Australian Pigeons; and Mr. Stair describes it when rising as making so great a noise with its wings, that, when heard at a distance, it resembles a rumbling of distant thunder, for which it may be mistaken. Mr. Stair concludes his remarks by observing that, when on the eve of departing for England in 1845, although he made every effort to procure more specimens of the bird, and offered what was then considered large rewards, he could not succeed in obtaining any more specimens. He considers they may perhaps yet be found at Savaii, the largest and most mountainous island of the group; but he does not think they at present exist on the island of Upolu."

A communication was also read from Sir Robert Schomburgk, H.M. Consul-General for Siam, dated Bangkok, August 15th, stating that a male of the splendid Pheasant *Diardigallus Crawfurdi* was still alive in his possession, and in excellent health; and giving the following description of the female bird, of which he also sent a Chinese drawing and some feathers:—

"Cere oblong, of a bright-red colour, such as it is in the male, set with short hair-like feathers of a blackish colour, disposed in rows following the cere in its outline; eye black, with a golden-coloured iris; bill horn-coloured. The crown of the head, and the short feathers under the chin, of a slate-colour, but otherwise a reddish brown is the prevailing colour; of such a tint is likewise the mantle, only somewhat darker, and the feathers are speckled with black; those of the throat and breast are lighter in tint, and frequently margined at their ends with white to the extent of 2 lines.

"Primaries and scapulars of a dark slate-colour, almost black, barred transversely at intervals with bands of white speckled with black. These bars do not possess regular outlines. The large or middle tail-feathers are marked in a similar manner; the lower or side tail-feathers are of a reddish brown.

"The thighs are clothed with dark-brown feathers; below the knee the feet are naked and of a bright red colour, similar to the cere. There is no trace of spurs upon the leg.

"I give the measurements taken from what I believe to be the oldest of the two hens in my possession:—

	ft.	in.	tenths.
Length from tip of bill to end of middle tail-feather	1	6	0
Height	0	10	5
Length of tail	0	9	0
——— of legs	0	7	4
——— from the foot or tarsus to thigh	0	4	0
Length of foot from the tip of the middle claw to that of the hind toe	0	3	5
——— of the large or middle toe	0	2	0
——— of wing from shoulder to end of largest primary quill	0	10	0
Depth of wing	0	4	2
Circumference over the crown of the head and round the region of the eyes	0	5	0
Length of cere	0	2	0
Depth	0	1	0
Length of bill	0	1	2"

Sir Robert Schomburgk added that Crawfurd's drawing of the male bird alluded to by Mr. Gould in his account of this bird in the 'Birds of Asia,' "although stiff, was otherwise good," and that the habitat of this Pheasant was now fully ascertained to be the Shan States to the east of Kieng-mai, at Muang Nan, Muang Phi, &c.

The following letter, addressed to the Secretary by Dr. J. Shortt, F.Z.S., dated Chingleput, 9th August, 1862, was read to the meeting :—

"Sir,—I have much pleasure in sending you a short account of the Viper *Daboia elegans* (*Vipera Russellii*)—the Tamil name being 'Kunuadi Vyrien,' or 'Kuturee Pamhoo.'

"Since sending you the skin, with skull entire, I have succeeded in procuring several specimens, alive and dead, both here and on the Shervaroy Hills, during a recent stay there of two months. The largest specimen in my collection at present measures 5 feet in length, and 7 inches in circumference at the thickest part of its body. Its head is large, elongate, depressed, rounded on the sides, and covered with acutely and regularly-keeled scales; nostrils large, subsuperior, anterior, and in the centre of a ring-like shield, edged with a large scale above; eyes convex, pupil round; nasal shield smooth in front; superciliary shield narrow, elongate, and distinct in front; jaws weak, upper toothless, with large, slightly curved, double fangs; lower jaw toothed; tongue long and forked: colour brown, with three rows of oblong (in the young, circular or oval) white-edged brown spots; two brown spots on each side of the occiput, separated by a narrow, oblique, yellow temporal streak. Scuta 168, subcaudals 52.

"From the three rows of white-edged spots being linked to each other, it is commonly called the Chain Viper. The Tamil name of 'Kunuadi Vyrien' literally means Glass Viper; that of 'Kuturee Pamhoo,' Scissors Snake. This name it receives from having double fangs, which are invariably present, of equal length, if not on both, on one side at least: these the natives of Southern India fancy resemble a pair of scissors.

"It is very common in these parts, and also at an elevation of 4800 feet above the sea (Shervaroy Hills): at the latter place I procured two specimens; the largest measured $4\frac{1}{2}$, and the other, which was young, was 1 foot in length. These reptiles are generally found under stones and in rocky places; frequently in the low country it is found in prickly-pear bushes (*Opuntia vulgaris*).

"In their habits they are extremely active for their size, and live on frogs, mice, birds, &c. On opening the Viper I procured on the Shervaroy Hills, I removed from its inside a *Mynah* (Indian Grackle), from a second in this place a field-rat, and from a third an immense toad was taken. These Vipers are readily killed by the slightest blow; on one occasion I had one caught alive by fixing a noose round its body, but raising it from the ground and suspending it by the noose for a few seconds killed it.

"The natives dread these snakes greatly, as their bite is said to prove rapidly fatal. Although they are common in this district, I have not heard of an instance of this occurring during a residence of five years at this place. Dr. A. Hunter, of our service, tells me that when he was Zillah Surgeon here, some years ago, a sepoy was bitten by one, and that the man's life was saved by his sucking out the wound. During my stay on the Shervaroys, the first specimen that was brought to me was immediately recognized by my friend B. A. Daly, Esq., a coffee-planter, who related the following circumstance that occurred to him a few years ago. Mr. Daly was out shooting with a few dogs (mongrel spaniels), when he came upon one of these Vipers, and the dogs having attacked the snake before he could kill it, three were bitten, one after the other; the first died almost instantly, the second in about two hours after, whilst it was being carried home, and the third lingered for nearly three months from emaciation, general debility, loss of appetite, &c., and eventually made a good recovery. This we can readily understand: the first dog bitten received the largest quantity of poison, whilst the second received less, and when it came to the third the supply was no doubt all but exhausted, and the rapidity with which the wounds must have been inflicted left no time for fresh poison to be secreted. This accounts for the ultimate recovery of the dog.

"In January last a lady at this place was returning from a walk with her child, followed by a bull-terrier puppy about six months old; her house was situated some distance from the gate, and the road on either side was covered with spear-grass. It was just dusk. The puppy suddenly darted in front and began to bark vociferously. Although the lady had seen nothing, she took alarm at the movements of the puppy, and called out to me as I happened to be passing by the gate at that moment. On going to see what was the matter, I found a large Viper coiled up in the centre of the road, and the puppy making a great noise from a respectful distance. The snake was closely coiled up, with the neck bent abruptly backwards, and the head fixed almost horizontally; it began to puff itself out something after the manner of the Puff-Adder, and hissed loudly, intently watching the movements of the dog, no doubt awaiting an opportunity to strike it, when I called the puppy away. The instant the puppy turned its head, the snake glided with the rapidity of lightning into the surrounding grass and disappeared. The next day it was killed in the same garden, and brought to me; it measured 4 feet 6 inches in length.

"These Snakes were formerly designated 'Cobra Manil' by the Portuguese, in consequence of their bite proving as rapidly fatal as that of the Cobra. The word Manil is a corruption of the Tamil word Mannunippāmhoo, which literally means Earth-eating Snake, and is the name given by the natives to the *Uropeltis grandis*, commonly termed 'Double-headed' Snake, and which they believe lives entirely on earth, from its being frequently found underground."

The following papers were read:—

Description of some New Species of Mammalia. By Dr. John Edward Gray, F.R.S., F.L.S., etc.

Among some Mammalia which Mr. A. R. Wallace has lately sent to the British Museum, which he collected in Morty Island in 1861, are two species of a frugivorous Bat, which does not appear to have been hitherto registered in the Catalogue. This Bat may be easily known from all the other *Cynopteri* by the extraordinary length of its tail, which induces me to form for it a section or subgenus, which I propose to call *Uronycteris*.

CYNOPTERUS (URONYCTERIS) ALBIVENTER.

Tail elongate, free, produced beyond the narrow, short, interfemoral membrane. Nostrils much produced, tubular, far apart at the base, and diverging outwardly. Fur brown-olive, with greyer base to the hairs. Face and throat only slightly hairy, grey. Sides of the neck and breast yellow-brown. Side of the body brown. Chest and middle of the belly white. Wings brown.

Hab. Morty Island (*A. R. Wallace*).

The length of the forearm-bone 2 inches; length of the tail (dry) nearly $\frac{3}{4}$ of an inch.

The wing-bone, on the upper surface of the wing, of both specimens is marked with some irregular white spots. These may be only accidental, or even artificially produced in the process of preservation or by carriage, as the spots on the two sides of the same wings are more or less unlike, and those of the two specimens are dissimilar.

Mr. Keilish, the furrier, has kindly sent to the British Museum for examination the skin of a Leopard which he has received from Japan. It is well tanned, and marked on the inner side with the red impressions of two Japanese seals. The skin at first sight seemed much like that of a fine-coloured Hunting Leopard, but it is at once distinguished from that animal by the comparatively shorter legs, by the larger size and brown centre of the black spots, and from all the varieties of the Leopard by the linear spots on the nape and the spots on the back not being formed of roses or groups of smaller spots. I propose to call it

LEOPARDUS JAPONENSIS.

Fur fulvous, paler beneath. Back and limbs ornamented with ovate or roundish unequal-sized black spots. The spots on the shoulders, back, and sides converted into a ring by a single central spot of the same colour as the fur. Spots on the back and legs large, oblong, and transverse. Head with small, regularly disposed, black spots. Nape with four series of narrow elongated black spots (the outer ones sometimes confluent into lines), and with a series of large black spots on each side of the back of the neck. Chest with a series of larger spots, forming a kind of necklace. Tail elongate, very hairy, spotted, paler, and with four black rings at the tip.

Hab. Japan.

The skin in its tanned state is 4 feet 6 inches, and the tail 2 feet 10 inches long.

Mr. W. Fosbrooke has kindly presented to the British Museum a small and beautiful species of Boshbock, which was captured by John Dunn, Esq., in the Ungo-zy Forest, between the Umbrelans and Umblatore, in the country of the Amazula. Mr. Dunn could not learn that the natives had any special name for this animal.

It is a most peculiarly-marked species, and of a very small size. The hunter mistook it for a young animal, and fed it with milk, on which it died; but when it was examined, the mammæ were found dilated with milk, showing that it was approaching full age, and probably had lately produced a fawn. It is the smallest species of the genus, standing only 10 inches high to the top of its head, and weighing not more than three pounds. It is most like *Cephalophus Whitfieldii*, figured in the Knowsley Menagerie, from a specimen in the British Museum which was brought from the Gambia by Mr. Whitfield. It differs from that species in the general shade of the brown colour; and there is no white about that animal, which is so prominent in the Natal specimens.

Cephalophus bicolor.

Fur soft, brown, with the rump, the whole of the hind legs, the chin, throat, chest, belly, the inner side of the fore legs, a broad ring over the fore hoofs, and a large spot occupying the front of the face and forehead pure white. The ears blackish, white within. The side of the forehead darker brown. The crumen on the side of the face linear, well marked. Horns not present in the female sex.

Hab. Natal.

Mr. R. Swinhoe, having shown me a part of the collection of mammals which he formed while residing in the island of Formosa, has kindly allowed me to describe a new specimen of Wild Goat or Goat-Antelope.

This species agrees in all its characters with the Cambing-outang (*Capricornis sumatrana*) of Sumatra, and the *Capricornis crispa* of Japan, but is very distinct from either of them. In colour it more nearly resembles the Japanese species, *C. crispa*, which has a white face; but it is easily distinguished from that species, which I only know from a figure and very general description in Schegel's 'Fauna Japonica.' I propose to call it, after its discoverer,

Capricornis Swinhoii.

The fur harsh and crisp, brown, with a narrow streak down the back of the neck; a spot on the knee and the front of the fore legs below the knee black. The hind legs are bay. The sides of the chin pale yellowish. The underside of the neck yellow-bay—this colour being separated from the darker colour of the upper part of the neck by a ridge of longer, more rigid hairs. The ears are long, brown, paler internally. The horns are short and conical. The skull has a deep and wide concavity in front of the orbits, and a keeled ridge on the cheek.

Notes on the Beaver in the Zoological Gardens. By A. D. Bartlett.

During one of the heavy storms of wind and rain that prevailed during the last month a large willow-tree was partly blown down. The limbs and branches of this fallen tree were given to many of the animals, and to them proved to be a very acceptable windfall.

To the Beaver, however, I wish to direct especial attention, as this animal has exhibited in a remarkable manner some of his natural habits and intelligence. One of the largest limbs of the tree, upwards of 12 feet long, was firmly fixed in the ground, in the Beaver's enclosure, in a nearly upright position, at about twelve o'clock on Saturday last. The Beaver visited the spot soon afterwards, and walking round this large limb, which measured 30 inches circumference, commenced to bite off the bark about 12 inches above the ground, and afterwards to gnaw into the wood itself. The rapid progress was (to all who witnessed it) most astonishing. The animal laboured hard, and appeared to exert his whole strength, leaving off for a few minutes apparently to rest and look upwards, as if to consider which way the tree was to fall. Now and then he left off and went into his pond, which was about 3 feet from the base of the tree, as if to take a refreshing bath. Again he came out with renewed energy, and with his powerful teeth gouged away all round the trunk. This process continued till about four o'clock, when suddenly he left off and came hastily towards the iron fence, to the surprise of those who were watching his movements. The cause of this interruption was soon explained; he had heard in the distance the sound of the wheelbarrow, which, as usual, is brought daily to his paddock, and from which he was anxiously waiting to receive his supper. Not wishing to disappoint the animal, but at the same time regretting that he was thus unexpectedly stopped in his determination to bring down this massive piece of timber, his usual allowance of carrots and bread were given to him; and from this time until half-past five he was engaged in taking his meal and swimming about in his pond. At half-past five, however, he returned to his tree, which by this time was reduced in the centre to about 2 inches in diameter. To this portion he applied his teeth with great earnestness, and in ten minutes afterwards it fell suddenly with great force upon the ground.

It was an interesting sight to witness the adroit and skilful manner in which the last bite or two were given on the side on which the tree fell, and the nimble movement of the animal to the opposite side at the moment, evidently to avoid being crushed beneath it. Upon examining the end of the separated tree, it was found that only one inch in diameter was uncut; and it was of course due to the nearly erect position in which the tree was put into the ground that it stood balanced, as it were, upon this slender stem. After carefully walking along its entire length as it lay on the ground, and examining every part, he commenced to cut off about two feet of its length, and by seven o'clock the next morning he had divided it into three pieces: two of these he had removed into the pond, and one was used in the under part of his house.

The Beaver, the subject of the foregoing remarks, was presented to the Society by the Hudson's Bay Company, in the autumn of 1861, and was probably then about six months old. It is, no doubt, less vigorous than the large wild animals of this species, who would, in all probability, bring down trees of much larger dimensions in a shorter time. In fact, it was evident that our Beaver was a novice in the undertaking, as he more than once slipped and rolled over on his back in his eagerness to accomplish the task. It was impossible to witness the actions of this animal without being struck by the amount of skill and intelligence exhibited. When the space cut through towards the centre was too narrow to admit its head, its teeth were applied above and below so as to increase the width from the outside towards the centre, until the remaining parts above and below formed two cones, the apices of which joined in the middle. Again and again the animal left off gnawing, and, standing upright on its hind legs, rested its front feet on the upper part of the tree, as if to feel whether it was on the move. This showed clearly that the creature knew exactly what it was about.

MISCELLANEOUS.

'The Land and Freshwater Mollusks of the British Isles.'

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

GENTLEMEN,—While thanking you for your notice of my little book, 'The Land and Freshwater Mollusks of the British Isles,' I beg permission to offer a word of comment on some remarks therein made on some changes in nomenclature. Your reviewer says:—

"*Planorbis imbricatus* is changed to *Planorbis crista*, on the authority of the following synonymy:—

"*Nautilus crista*, Linnæus (1758), Syst. Nat. 10th edit. p. 709.
"*Turbo nautileus*, Linnæus (1767), Syst. Nat. 12th edit. p. 1241.

"And the author remarks,—'It may be observed, on reference to the synonymy, that Linnæus made two species of this.' But Linnæus did not make two species out of *Planorbis nautileus*. The facts are that he described *Nautilus crista* in the tenth edition of the 'Systema Naturæ;' and in the twelfth edition changed the name of the species to *Turbo nautileus*, and referred to his *Nautilus crista* of the tenth edition as a synonym. We can only account for Mr. Reeve's mistake by supposing that he has never consulted the twelfth edition—a supposition which is confirmed by the fact that throughout his volume the tenth edition is almost invariably referred to."

As this declaration of opinion involves a principle in nomenclature to which I cannot agree, I beg leave to state that I purposely referred throughout my volume to the tenth edition of the 'Systema Naturæ' for the authority of the Linnæan species, after the example of M. Moquin-Tandon, because it is the first edition in which the species are established by the definition of specific names and characters. I followed also Moquin-Tandon in adopting the name of *crista* given to this *Planorbis* in the tenth edition of the 'Systema Naturæ,' because I agree with the learned author of the 'Mollusques Terrestres et Fluviatiles de France' in thinking that Linnæus was not justified in changing it, in his twelfth edition, to *nautileus*. An author is no more justified in changing his own established name of a species than any other writer would be.

With reference to your reviewer's observations on my remark that

Linnæus made two species of this *Planorbis*, it is clear, from the opening lines of the paragraph, that the sense intended to be conveyed is not that which he has presented. They are as follows:—

"The minute, semitransparent, horny shell of this species, more generally known to collectors by *the second name* which Linnæus gave to it, &c." I am, Gentlemen,

Your obedient Servant,
LOVELL REEVE.

With reference to the foregoing letter, we may remark—

1st. That what Mr. Reeve says respecting the tenth edition of the 'Systema Naturæ' is totally at variance with the generally received opinion of naturalists that the twelfth is the standard edition of Linnæus's work, which is to be referred to and followed.

2ndly. That we are fully aware how greatly Mr. Reeve is indebted to the work of M. Moquin-Tandon, and regret that he has so implicitly followed that author in numerous erroneous changes in nomenclature.

3rdly. That Mr. Reeve, however, must not shift the adoption of the name *Planorbis crista* on to his favourite authŏr's shoulders. Among Mr. Reeve's own synonymy of the species, we find "*Planorbis* (*Gyraulis*) *nautileus*, Moquin-Tandon (1855), Hist. Moll. vol. ii. p. 438, which is utterly irreconcileable with the statement in his letter that he follows that author in the adoption of the name *Planorbis crista*.

4thly. That only one construction can be put upon the following passage in his work:—"It may be observed that Linnæus and Draparnaud both made two species of this. The names *crista* and *cristata* have been given to young specimens, and *nautileus* and *imbricatus* to adult specimens." What can this mean, but that, just as Draparnaud made two species of the shell which he called *cristatus* and *imbricatus*, so Linnæus made two species which he called *crista* and *nautileus*?—a statement at variance with the facts.

On the true Nature of Pleurodyctium problematicum. By CARL ROMINGER, M.D.

Under the above name I have long kept in my cabinet a specimen collected at Kirchweiler, in the Eifel Mountains. After having identified it with the fossil described by Goldfuss, I laid it aside; and only recently, twenty years afterwards, when I happened to look over it again, the first glance convinced me that the *Pleurodyctium problematicum* is merely the cap of a *Favosites*, or, more accurately speaking, of a *Michelinia*. I have subsequently found that Milne-Edwards had already recognized the family affinity between *Favosites* and *Pleurodyctium*, without, however, suggesting a generic identity of the two.

The fossil from Kirchweiler is represented by a lenticular cavity, a little over one inch in diameter and scarcely half an inch deep. To one side of this cavity are attached the bases of conical subangular columns, three or four millimetres thick at the lower ends; between these are interpolated a good many smaller and shorter columns. They all rapidly converge toward the centre of the opposite concavity. Their sides are longitudinally striated, and covered with punctiform impressions. Numerous small cross-bars connect the columns, which are otherwise isolated from each other by a narrow intervening space.

The opposite side of the cavity, which forms the roof over the convergent smaller ends of the columns, is free, but closely approximated to them, and bears the impression of fine concentric rings of growth. This latter character is not very plain in my specimen, but Goldfuss has given a very good figure of it. He thought it to be the impression of the inner surface of a membranaceous envelope, instead of taking it for what it is—the impression of the epitheca surrounding the lower side of the corallum.

The vermicular body, frequently noticed adhering to or penetrating the root end of *Pleurodyctium,* is also seen in my specimen.

I was greatly surprised at observing the same vermicular perforation in some small specimens of *Michelinia,* which also in all other respects appear to be specifically identical with the coral of which the European *Pleurodyctium* is a cap.

The specimens were found in the shales of the Hamilton group, Cayuga county, New York, and are in the possession of Prof. Winchell, of Ann Arbor. They form small cakes, not much over one inch in diameter. The lower side is almost flat, covered with a concentrically wrinkled epitheca: the upper side is semiglobular, and shows the mouth-ends of conical subangular tubes, the larger ones of which measure from four to five millimetres.

On the polished vertical sections of the coral, longitudinal striæ and rows of spinules, together with numerous side-pores, are visible along the walls of the tubes.

The upper part of the tubes is generally filled with calcareous matter, and shows no diaphragms, which are only preserved in the lower ends, and are in part simple and straight, in part vesicular.

The vermicular channel traverses the substance of the corallum, irrespective of the direction of the tubes, and seems to cut straight through them. After some flexures, it ascends to the upper surface, and opens there with a round mouth, while the other tubes are more or less angular. It is improbable that this perforating channel has anything to do with the organism of the coral, and is more likely the work of a parasitic animal; but after all, it is still strange to see the majority of specimens, from such distant localities, attacked in the same way by a boring animal.

In the Corniferous Limestone at Port Colborne, on Lake Erie, I lately found a cap exhibiting all the characters of *Pleurodyctium.* In association with it numerous specimens of *Michelinia favositoidea* (Billings) are found; and there remains no doubt that this cast originates from a young specimen of this latter species.—*Silliman's Journal* for January, 1863.

Piedmontese Plants.

Dr. Rostan, an excellent botanist, residing at Perrier, in one of the Vaudois valleys in Piedmont, who, besides other additions to the native flora, has rediscovered several plants not known to botanists since the time of Allioni, proposes to publish a collection of 200 species of dried plants, to include the greater part of the rare and less-known species of Western Piedmont. In the list will be found *Arabis pedemontana*, Boiss., *Isatis alpina*, All., *Dianthus furcatus*, Balb., *Cerastium lineare*, All., *Trifolium pannonicum*, L., *Ribes purpureum*, Rost., *Saxifraga valdensis*, DC., *Centaurea Kotschyana*, Heuff., *Campanula Elatines*, L., *Gentiana Rostani*, Reut., *Veronica succulenta*, All., *Allium valdensium*, Reut., and many other very rare species.

The parcels will be carefully made up, the specimens well dried, and several will be given of each of the smaller species.

The price to subscribers who send their names to Dr. Rostan before the 1st of August, 1863, will be 40 francs=32 shillings. Price to non-subscribers £2; in each case exclusive of carriage.

Address applications, post-paid, to Dr. Rostan, Perrier, viâ Pignerol, Piedmont. It will facilitate the transmission of the parcels if each applicant will give an address in London to which they may be forwarded.

Obituary Notice.—William Groves Perry.

Died on the 25th of March, 1863, at his residence in New Street, Warwick, Mr. William Groves Perry, at the age of sixty-seven. He was one of the early contributors to Loudon's 'Magazine of Natural History,' and a Fellow of the Botanical Society of Edinburgh. In 1820 he published a work called 'Plantæ Varvicenses Selectæ,' or 'The Botanist's Guide through the County of Warwick,' which, following the 'Flora Midlandica' of Dr. Purton, made considerable additions to what related to the Warwickshire species included in that work, more especially in noting the localities with greater precision. With a view to still greater exactness in this particular, a table was added, showing the distance of the several localities from the nearest market town. This little work was never so well known as it deserved to be, owing probably to its having been published by the author himself at Warwick: it has, however, been long since out of print; and a second edition was in progress at the time of Mr. Perry's death, which we hope some day to see completed and published.

In addition to his botanical studies, Mr. Perry possessed considerable antiquarian knowledge, and was for many years Honorary Secretary of the Warwickshire Natural History and Archæological Society. As one of the early contributors to a periodical of which the present may be regarded as the continuation, we think this notice of his labours and of his death a proper introduction into our pages; and we are sure that all those with whom he was acquainted, and to whom his unvarying kindness of disposition and liberality in imparting information were known, will feel grateful for its appearance here.

THE ANNALS

AND

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[THIRD SERIES.]

No. 66. JUNE 1863.

XLII.—*On the* Capitellæ *and their Position in the System of the Annelida.* By Edward Grube *.

By the communications published by Van Beneden † upon the genus *Capitella*, Blainv. (*Lumbriconaïs*, Oerst.), and especially upon *C. capitata* (*Lumbricus capitatus*, Fab.), our knowledge of this very peculiar Annelide has been most essentially advanced. These statements not only complete what has been ascertained by A. S. Oersted ‡ and Leuckart § as to the external structure and the nature of the intestinal canal, but they also include the whole remaining organization, the sexual relations (the divergence of which from those of the *Lumbrici* was previously indicated by Leuckart), and furnish results which are confirmed by investigations carried on independently. When I was at Copenhagen in 1856, Oersted laid before me a series of drawings relating to the anatomy of the *Capitellæ*, and incited me, during my stay there, to convince myself of the many peculiarities which had occurred to him in the course of his observations, and amongst which the presence of numerous definitely formed and comparatively large red corpuscles in the somatic cavity, the remarkable partial inflation of the body, and the entire deficiency of blood-vessels, had most struck him. He had also learned how to distinguish males and females by their external and internal structure, and believed that he had recognized the anterior part of the nervous system. The occurrence of these Annelides in the great

* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1862, p. 366.

† "Hist. Nat. du genre Capitella," Bull. de l'Acad. Roy. de Belgique, sér. 2. iii. Nos. 9, 10 (1857).

‡ "Conspectus generum specierumque Naïdum," Kröyer's Tidssk. iv. 1842, p. 128, pl. 3. figs. 6, 10, 11.

§ Beiträge zur Kenntniss wirbellos. Thiere (1847), p. 151; and Archiv für Naturgeschichte, xv. (1849), p. 163.

channel of Copenhagen enabled me, in the few days of my residence there, to repeat these extremely interesting observations on a series of specimens; but although we then (at the end of July) still found ova in many females, we did not succeed in detecting spermatozoa in the testes of the males: these Oersted had represented of a more fusiform shape than Van Beneden, and with a more acute anterior extremity and a shorter terminal filament. That I did not at once comply with Oersted's request to make known these observations was due partly to the want of a micrometer; for it appeared to me to be necessary to give the diameter of the corpuscles which floated in the somatic cavity. A second independent confirmation of Van Beneden's investigations has lately been given by Claparède*, who, without any acquaintance with them, observed the same species in the Hebrides, but was not able any more than myself to subject the sexual peculiarities to a complete examination.

As regards the fluid of the somatic cavity and the red corpuscles contained in it in such abundance, Claparède also expresses himself in favour of its analogy with the blood. Van Beneden describes the corpuscles as "globules," and says that their form is lenticular; I convinced myself, during their flow from a wound in the wall of the body, that they are disciform and circular, as they show to the observer sometimes their broad surface and sometimes their margin. Claparède also calls them "*disques*," and I could almost think that they are biconcave like the blood-corpuscles of the Mammalia: that they contain a true nucleus, as stated by Van Beneden and Claparède, could not be ascertained positively by Prof. Reichert and myself—what might have been taken for a nucleus appearing only to adhere accidentally, and to be one of the corpuscles which also occur free in the somatic cavity; and the employment of acetic acid did not succeed in producing a more distinct appearance of a nucleus. By the action of this reagent the disks scarcely became somewhat smaller; and whilst their outer margin still remained circular, their interior appeared as if crumpled or granulated, minute sharply-defined granules being distinguishable therein.

In ether they become decidedly more irregular, and the margin and interior become more sharply discriminated. I must, however, remark that I have observed all this only upon *Capitellæ* which were sent to me in Breslau by the kindness of Prof. Van Beneden, and which, being favoured by the December weather, arrived indeed still living, but by no means lively in appearance; nevertheless even the broken or half-dead specimens exhibited no essential difference in this respect. The diameter

* Mémoires de la Soc. de Phys. et d'Hist. Nat. de Genève, 1861, p. 110, pl. 1.

of the corpuscles is given by Claparède at 0·010 mill. (=0·005 line); I found it to be greater, namely 0·006–0·008 line, or about one-tenth of the length of the shorter uncini. As far as I can remember, those observed in Copenhagen presented a similar proportion, although, from the small size of the animals examined by me (most of them measured only 5 lines), they appeared to me to be uncommonly large. The corpuscles flowed, with the fluid of the somatic cavity, from one segment into the other, above and below the ligaments (or dissepiments, as Van Beneden calls them) which fasten the wider portion of the alimentary canal to the wall of the body. This occupied by far the longest part of the body, and in a specimen of thirty-three segments (such as most of those examined by me in Copenhagen) extended through sixteen of them, increasing slowly in width towards the middle. The œsophagus, about half the size, usually reached in repose, when it describes one or two curves, into the ninth segment; the end of the intestinal canal, which, again, is considerably thinner, and lies in short convolutions, usually passed through from four to nine segments; but even in the hindermost part of the wider division of the alimentary canal I detected balls of excrement. In the extremely narrow lumen of the very muscular œsophagus, which is linear in repose, I repeatedly observed ciliary movement.

The uncini, which stand four or five together on the segments, one or two on the hindermost segments, were moved, as far as I could see, in the same way as the setæ, single muscular threads proceeding from the wall to attach themselves to the free end of the bundle which projects into the ventral cavity. Sometimes in one of the bundles of setæ, which occur only on the first seven segments (or eight, according to Van Beneden), and also contain four or five setæ, single setæ were replaced by uncini, but only in one, two, or three of the hindermost of them: Van Beneden gives this as the rule. Oersted called my attention to a flat, nearly oval body, running out, as it were, into two lobes, which was discovered by him lying over the buccal cavity, and which he thought to be the superior ganglionic mass of a buccal nervous ring. I regard this interpretation as the more probable because there was on each of the two lobes a well-defined black point, having exactly the appearance of an eye-point. Claparède also notices these points, but adds that he could not detect a lens in them.

Ova, which I observed in a specimen at Copenhagen, occurred neither in paired sacs repeated in the segments nor in the somatic cavity, into which they get from these, according to Van Beneden, but in two delicate-walled sacs situated at the sides of the intestine, which commenced at the twelfth segment and reached to the seventeenth, and the diameter of which was not much greater than that of an ovum.

D'Udekem*, in his "Classification," also speaks only of two ovaries. In one of the specimens from Ostend, sent to me in March by Van Beneden, I likewise found ova; their diameter was 0·05 line, and that of their germinal vesicle 0·0015 line. Upon the organs secreting urine, which, according to d'Udekem, are situated in almost all the segments of the body, I have made no observations.

The remarkable anchor-shaped *Gregarinæ* which Oersted discovered in the intestine of his *Capitellæ* have also been found by Van Beneden, Leuckart, Claparède, and myself. Claparède's figure† shows a completely developed form, in which the nucleus is indicated merely by the pale spot in the foremost third of the body. In younger animals, in which the body is not yet so much filled with greenish mass, this nucleus appears far more distinctly: it is sometimes nearly circular, sometimes oval, contains a nucleolus, and is situated nearly always in the same spot, but sometimes more anteriorly, between the bases of the arms of the anchor. As the median body increases in length and becomes more slender, these arms also gradually grow out; they are at first very short, like two mere teeth, and extended horizontally; and in still younger states, where the length of the body is still scarcely one-fourth of that of the mature animal, no trace of them is to be seen, the form of the animal being then a rhomb with rounded angles, much produced posteriorly. This entire series of changes, of which I only saw a few, has been observed by Oersted.

The next question which presses upon me is, whether the *Capitellæ* observed in Copenhagen, and those found at Ostend, on Heligoland, and on the Hebrides, belong to one and the same species with the *Lumbricus capitatus* described by Fabricius. The differences of size of sexually mature individuals are very considerable: whilst Oersted states the length of his *Lumbriconaïs marina* at 10 or 12 lines, and I even had males of only 5 lines, Van Beneden found the males 24–27 lines and the females as much as 4 inches long; Claparède sometimes found them still longer, and Leuckart even met with specimens as much as 7 inches in length. The indication of Fabricius—"longitudine Lumbrici terrestris"—shows that, although, according to his statement, the Greenland animals of this species do not attain such large dimensions as the Norwegian (amongst which he mentions one a foot in length), his specimens were certainly of the larger kind. The *Capitellæ* from Greenland

* Mémoires de l'Acad. Roy. de Belgique, xxxi. 1859, p. 25.

† Mémoires de la Soc. de Phys. et d'Hist. Nat. de Genève, pl. 1. fig. 15.

which I possess are 1·3 line in thickness and more than 2 inches in length. In the same way the number of segments varies, in accordance with the size, from thirty-three and forty-five (in the small Copenhagen specimens) up to sixty and eighty-two; in all the males examined by Van Beneden, Oersted, and myself, it is on the eighth and ninth segments that the peculiar, large, crooked ventral setæ occur, and in the ninth that the sexual orifice and the testis are situated*. In the number of bristles there is a remarkable diversity. Van Beneden gives eight as the normal number both in the bundles of setæ and in the transverse rows of uncini. I counted in the Copenhagen specimens never more than four or five, in many Belgian ones twelve, and in the Greenland specimens twelve or more setæ, and far more than twelve (even nearly thirty) uncini, of which, however, those standing nearest to the median line of the ventral surface were scarcely distinguishable, whilst in the opposite direction they increase considerably in length. As the smallest number of bristles belongs to the smallest specimens, it may easily be supposed that the number increases with the growth; and in these diversities, as in those already mentioned, I see no inducement to the assumption of two species, but rather believe that the *Capitellæ* of the Baltic, like many other animals which it has in common with the North Sea, do not attain such large dimensions as in the latter.

I must further indicate that Dalyell's *Lumbricus capitatus*† does not belong here, but that the *Lumbricus capitatus* described by Johnston‡, the length of which was from 3 to 6 inches, is the same species, and that he also united with it his previously described *Lumbricus littoralis*§, which he had characterized as "aculeis uniserialibus." That he assumed for the blood, the very irregular ebb and flow and grumous masses of which also struck him, two lateral vessels situated between the intestine and the wall of the body, may be easily excused if he did not perseveringly observe. He himself says that the movement of the blood appears to depend upon the movements of the body and the extension of its segments. The synonym of *Lumbricus fragilis*, Müll., which is now recognized as a *Scoloplos*, is only cited by him with doubt. Our Annelide is also regarded by Fabricius as identical with Olaffsen's *L. littoralis minor* from

* Van Beneden's statement of the ninth and tenth segments (p. 17) appears to be a mere printer's error, his figure representing the eighth and ninth as those in question. In a specimen from Greenland, I find these bristles, singularly enough, not on the ventral, but on the dorsal surface!

† The Powers of the Creator, vol. ii. 1853, pl. 17. figs. 8, 9.

‡ Loudon's Mag. Nat. Hist. vol. viii. p. 258.

§ Zool. Journ. iii. p. 328.

Iceland. But the distribution of *Capitella capitata* is not closed with the Icelandic and English coasts; for the *Lumbricus canalium,* mentioned *en passant* by Nardo as an inhabitant of some of the shallower and less frequented canals of Venice*, is likewise nothing but our *Capitella,* as I have ascertained by the examination of the spirit specimens captured by him. Whether it also occurs on the French coast has not yet been ascertained.

The determination of the position which the genus *Capitella* should occupy in the system appears to Claparède not to be settled by the discussion with which Van Beneden closes his memoir; and I am of the same opinion. Van Beneden comes to the conclusion that the *Capitellæ* are diœcious Lumbricinæ: all that can be cited in favour of the supposition that they belong to the Polychætæ is limited to the mode of development, to the form of the embryos, which escape into the world with a globular body, with two eyes and two tufts of cilia close to these, and then pass through a metamorphosis, a posterior circlet of cilia being added to the ciliary circlet before the eyes, which originates in the above-mentioned tufts, and the portion of the body between these extending itself and dividing into rings; the absence of vessels and the distribution of the male and female sexual organs upon two individuals are not of sufficient importance to have much stress laid upon them. But what is there positively in favour of referring the *Capitellæ* to the Lumbricinæ, and in what signification is this name taken? It does not correspond with the family which I have established under this name, as Van Beneden also refers to it *Tubifex* (*Sænuris*), *Enchytræus,* and *Chætogaster,* but rather to D'Udekem's suborder of *Agemmes,* which forms the opposite to his *Gemmipares* (the *Naïdes*). As the Lumbricinæ, in D'Udekem's sense, include nothing but Annelides with series of but slightly projecting uncini standing singly or in pairs, *Capitella* would approximate to them less than to *Tubifex,* a genus three of the six species of which occur in the sea; whilst for the *Lumbrici* the proportion of marine forms is far less favourable.

The organization of the *Agemmes* is expressed (besides the occurrence of uncini, rarely also of setæ) especially in the concentration of the genital organs in certain limited regions of the body, in their hermaphrodism, and in the appearance of the so-called *loop-like organ*; whilst external organs of respiration never appear (except in *Alma nilotica*). If, therefore, the *Capitellæ* be, as Van Beneden supposes, *Lumbrici* of a low degree of organization, this degeneration of the type shows itself in the disappearance of the blood-vessels and the simpler arrangement of

* Prospetto della Fauna marina volgare del Veneto estuario, 1847, p. 11.

the generative organs. As something new added, we have the large curved bristles at the orifice of the testis, the arrangement of the bristles in lateral rows, the separate sexes, the different structure of the ova, and the metamorphosis of the young; but it must certainly be admitted that we do not know the young states of the marine forms of the *Agemmes*; and whether these pass through a metamorphosis it is as impossible to predict as it was to suppose, in the case of the Lobster, that it follows a different course of development from that of its nearest ally the river crayfish.

Turning to the Polychætæ, would it be more difficult to find among them forms with which the *Capitellæ* could be arranged? I admit that, however I was determined by Oersted's first communications, and before I had myself seen these animals, to follow him and place them among the Naïdes, I afterwards hesitated about leaving them in this position; and at the first sight of a large spirit specimen I thought no more either of the Naïdes or of other Oligochætæ. In this specimen the segments were proportionally considerably longer, in the anterior portion of the body, furnished only with setæ, half as long, in the posterior portion, bearing uncini, one and a half times as long as broad; moreover the uncini were grouped in regular combs, and inserted in distinct ridges. This had also struck Claparède, and appeared to him so important that he approximated the *Capitellæ* to the *Maldaniæ**, which, indeed, stand near the Lumbricinæ, according to the views of Cuvier and Milne-Edwards, but were placed by Savigny and Lamarck, with whom I agreed, near the *Arenicolæ* and *Terebellæ*. For my own part, I was more vividly reminded of the genus *Dasybranchus* (olim *Dasymallus* †) and of *Notomastus*‡. If Van Beneden only assumes that the evolution of the organization in the Lumbricinæ may retrograde, and the vascular system disappear, this decidedly takes place among the Polychætæ. As regards the respiratory organs, in the first place, we find, in the genus *Eunice*, together with species with greatly developed branchiæ (such as *E. gigantea* and *E. Harassii*), others with very rudimentary branchiæ (such as *E. siciliensis*), and, in the genus *Lumbriconereis* (in the wide sense), species with very simple branchiæ, and others with none at all. Quatrefages§ has already shown by examples how, besides the Polychætæ with a vascular system ramifying everywhere, others occur in which it is only partially developed, and others, again, in which it is entirely wanting; and in the latter

* Mémoires de la Soc. de Phys. et d'Hist. Nat. de Genève, 1861, p. 110.
† Archiv für Naturgeschichte, 1846, p. 166, tab. 5. fig. 3.
‡ Sars, Fauna litt. Norveg. ii. p. 11, tab. 2. figs. 8–17.
§ Ann. Sc. Nat. sér. 3, Zool. xiv. pp. 268, 294, 296.

the corpuscles contained in the fluid of the somatic cavity appear more numerous and more highly developed. I have hitherto been unable to detect blood-vessels in the *Dasybranchi*, either in the living state or in a spirit specimen; their branchiæ seem to resemble those of the *Glyceræ*, forming a diverticulum of the somatic cavity, and taking up its fluid when they extend themselves. Just as the *Glyceræ* stand near Polychætæ with vascular branchiæ, I place the *Dasybranchi* near the *Arenicolæ*. The *Notomasti*, however, agree so closely with the *Dasybranchi* that they are essentially distinguished only by the want of branchiæ. In them also I have hitherto detected no blood-vessels; but in a living specimen, I distinctly saw a red fluid moving between the intestine and the body-wall; its accumulation caused the segments to dilate, and it consisted almost entirely of circular corpuscles, 0·006 line in diameter; in a spirit specimen, which wanted the posterior half, I found regular balls of apparently similar corpuscles in the somatic cavity. With regard to the alimentary canal, the same statements apply to both genera: it commences with a rather short protrusible pharynx, surrounded by pro- and re-tractor muscles, forming a proboscis; then follows a narrow tube (œsophagus or stomach?); and about where the change of bristles takes place this tube passes into an intestine embraced by dissepiments, the anterior part of which, in the spirit specimens examined, is not wider than the tube, and is narrower than the posterior portion, which is usually filled with much excrement. The distinctly double nervous cord, with separated inflations, shows the greatest similarity to *Lumbricus**, and the arrangement of the muscular system to *Arenicola*.

I must further remark that in both genera the bristles are grouped on each side in two rows; that on the anterior segments only setæ, and on the remainder, which are far more numerous, only uncini, occur: the former stand in very short transverse rows behind narrow and low ridges; the latter in combs upon ridges. It is worthy of notice that the projecting part of both kinds of bristles is bordered†—a peculiarity which occurs frequently in the setæ of the Polychætæ, although very rarely in the uncini (as in several genera of Euniceæ, on individual segments in *Leucodore* and *Colobranchus* among the Ariciadæ), but which I have not met with among the Oligochætæ.

If we return again to the *Capitellæ*, everything that I have just explained is repeated, leaving out of consideration the generative organs and the sexual relations in general, as to which, in *Dasybranchus* and *Notomastus*, I can say nothing; and in treating of generic characters it would be difficult to state how

* See Cuvier, Règne Animal, Annelid. pl. 1, fig. 2.

† Van Beneden, *l. c.* pl. 1. figs. 8, 9; Claparède, *l. c.* pl. 1. fig. 12.

the *Notomasti* are distinguished from the *Capitellæ*. Nay, it may even appear questionable whether *Dasybranchus* and *Notomastus* are to be generically separated; for if it be confirmed that some *Glyceræ* are destitute of branchiæ, and the presence of these organs here furnishes no generic character, the same thing might be applied to *Dasybranchus*. In both, the superior combs of uncini at the commencement of the posterior division of the body are brought quite upon the back, and are much narrower than the inferior ones, by which *Notomastus* acquires a greater similarity to *Dasybranchus* than to *Capitella*; it is also only in these two that a proboscis (protrusible pharynx) is observed; nevertheless, from what I have seen in the anatomy of a *Capitella*, I must assert that in them also the commencement of the alimentary canal can be turned out. The *appareil sécrétoire rénal,* which D'Udekem describes in *Capitella,* I have hitherto been unable to find in *Dasybranchus* and *Notomastus*; but the specimens examined by me were not in the best possible condition; and it would be very important, in future investigations, to pay attention to this point.

The large curved bristles which appear in a transverse series before and behind the genital orifice of the male, and have their apices directed towards each other, have hitherto only been observed in the *Capitellæ*; they may perhaps be regarded as a transformation of the combs of small bordered uncini, which are wanting on the segments in question. But are we acquainted with the males of *Dasybranchus* and *Notomastus*? Perhaps they may possess a similar character. At any rate, these organs remind us of the two strong hook-like bristles (spicula) which are so striking on the ventral surface of the *Thalassemæ, Echiuri,* and *Bonelliæ,* and are likewise placed before the paired and median genital orifices of these animals. In the *Echiuri* a posterior pair is also concealed within the skin*. The more distinct separation or partial amalgamation of the genera *Dasybranchus, Notomastus,* and *Capitella* must be left for further and more accurate investigations; but I think I have demonstrated that these three genera stand in a close relationship, and must be referred to one family, the *Capitellaceæ,* which, in my opinion, are related to the *Arenicolæ* in the same way as the Gephyrei without vessels and with a highly developed fluid in the somatic cavity to the Gephyrei with vessels. The development of the *Capitellæ,* upon which we have such interesting information from Van Beneden, and which so much resembles that of the *Arenicolæ*†, the form of the ova, and the separation of the sexes, all agree

* M. Müller, Obs. Anat. de Verm. quibusd. marinis, 1843, p. 11.

† Schultze, Ueber die Entwickelung von *Arenicola piscatorum,* Halle, 1856; transl. in Ann. Nat. Hist. ser. 2. vol. xviii. pp. 105 *et seq.*

excellently with the rule in the section of the Polychætæ, and would form an exception if we referred the *Capitellaceæ* to the Oligochætæ; this applies also to the absence of the vascular system, and to the form of the bristles and their insertion in ridges.

With regard to the distinctions between *Dasybranchus* and *Notomastus* indicated by Sars in addition to the occurrence and want of branchiæ, I will only remark that, in well-preserved small spirit specimens of *Dasybranchus caducus*, the two-ringed nature of the segments is very distinct, and the proboscis of such a specimen appears not so much scaly as covered with papillæ.

XLIII.—*Remarks on the Vessels of the Latex, the Vasa propria, and the Receptacles of the elaborated Juices of Plants.* By M. Lestiboudois*.

The older botanists looked upon the coloured fluids in vegetable organisms as peculiar to certain plants, and called them "proper juices." The vessels containing these juices they, moreover, named "proper vessels," and the plants in which such secretions were recognized, laticiferous or lactescent plants.

Besides coloured liquids, other juices, of a completely distinct character, occur in plants, such as gum, resin, oil, &c. Grew termed the receptacles of resinous fluid in the Coniferæ "turpentine-vessels," and those that contained a milky or white fluid "milk-vessels." Linck designated all such organs by the name of "reservoirs of special secretion." Mirbel gave the title of "proper vessels" to all receptacles of special secretion, whether milky, resinous, or oily, calling those "solitary" which were scattered throughout the tissues, and those "fascicular" which were aggregated together. In this latter category he placed the textile fibres of *Asclepias*, of Hemp, &c., although such structures were destitute of laticiferous juices and were, in fact, nothing more than the cortical fibres of those plants.

DeCandolle, whilst recognizing the heterogeneous nature of special secretions, at first regarded them as the nutritive juices of the plants, but subsequently abandoned this opinion (Organographie, 1827), and ranged all coloured fluids among secreted products, or those prepared by vesicular glands, and thus established a distinction between them and the juices occupying the lacunæ of the cellular tissue. These latter cavities he agreed with Linck in calling "reservoirs of proper secretion." In his 'Physiologie végétale,' published afterwards in 1832, although

* Translated by Dr. Arlidge from the 'Comptes Rendus' for March 1863.

then acquainted with the earlier researches of M. Schultz, he adhered to the opinion that the laticiferous juices are of the nature of secretions.

M. Schultz specially studied the proper vessels of plants, and enunciated various striking discoveries. He advanced the opinion that the coloured juices of plants were no other than the nutritive fluid; that this fluid is coagulable, and characterized by the presence of granules floating in a transparent liquid; that it circulates in thin, transparent, contractile vessels, without pores or fissures, which ramify and anastomose together. The nutritive fluid he called the *latex,* its containing vessels *laticiferous* vessels, and its circulatory movement *cyclosis.* This movement he attributes to the contractility of the walls of the vessels, and to the properties of attraction and repulsion subsisting between the granules and the walls of the vessels. The movement of attraction he terms *autosyncrisis,* and that of repulsion *autodiacrisis.* Such plants as have no coloured sap have, he believes, a latex analogous to that found in laticiferous ones, differing only in its not possessing colouring granules. Moreover, he represents the laticiferous vessels as occurring in a state of *expansion* when they are dilated and filled with granules, in a state of *contraction* when they exhibit only a fine granular streak, and in a state of *articulation* when they are gorged with juices, but are divided, in consequence of advancing age, into sections by complete septa.

According to these views, plants possess a fluid analogous to blood, and a circulatory apparatus resembling the vascular system of animals.

The statements of M. Schultz produced a great sensation at the time of their publication among botanists, by many of whom they were accepted as true. However, his hypothesis was very soon keenly attacked, and its foundations disputed, by Mohl, Meyer, Treviranus, and others. Mohl denied the existence of the molecular movements of the globules of the latex (the autosyncrisis and autodiacrisis), and also the phenomenon of cyclosis. According to him, any onward movement that may be observed in the liquid within the proper vessels of a plant is not a normal condition, but a consequence of a wound or section of the tissues permitting an escape of their fluid, or else of pressure, of heat, &c., whereby the liquid is driven from one vascular ramification into another. Lastly, the very existence of *vasa propria* has been denied, and the structures so called have been asserted to be merely passages or channels which, as a secondary phase of growth, acquire distinct walls; at the same time, the analogy of the latex with the blood of animals has been disowned; and these various objections have induced many botanists, who at first accepted Schultz's views, to abandon them more or less completely.

Thus Adrien de Jussieu entirely accepted M. Schultz's views in the first edition of his 'Cours élémentaire,' but in the fifth edition of that work omitted the description of laticiferous vessels, referring to the channels so called by Schultz as lacunæ or intercellular spaces which, as an effect of age, ultimately acquired a special wall. He also no longer recognized cyclosis, nor the nutritive nature of the coloured juices. M. A. Richard has likewise ceased to adopt Schultz's opinions, and, instead of recognizing an analogy between the special juices of plants contained in vessels and the blood of animals, concludes that those juices are rather of an excrementitious nature, more akin to bile or saliva, or fluids which are only indirectly concerned in nutrition. "The proper juices are not," he writes (Elémens de Botanique, 7ième édition, p. 253), "the same with the descending sap."

M. Lestiboudois would endeavour to dispel the obscurity and doubt which thus prevail respecting the existence and nature of latex and laticiferous vessels. He wishes to determine whether plants have a special vascular system for the circulation of a fluid analogous to the blood of animals, or, in other words, whether there is such a generally diffused nutritive fluid, called latex, distributed to all the organs of a plant by a system of vessels termed laticiferous vessels. With this object in view, he proposes to study the question first in the case of plants furnished with coloured juices, which have more particularly been compared by analogy with blood, and next in respect to plants with limpid juices; and he advances the following propositions for solution:—

1. Are the coloured juices of plants analogous to blood?
2. Are such juices distributed through the medium of vessels, as in the vascular system of animals?
3. Are such juices gifted with the movement of cyclosis?
4. Are they met with in other reservoirs besides vessels?
5. Can the coloured juices in different reservoirs be distinguished from one another?
6. Are vessels of a similar character discoverable in the generality of non-lactescent plants?
7. In non-lactescent plants are reservoirs found analogous to the non-vascular reservoirs of coloured fluids?
8. Is there an organic apparatus in plants of a more general character than that which encloses coloured juices, and which may be considered to be intended to transport the nutritive sap?

Beginning with the first question, respecting the analogy of the coloured fluids of plants with blood, he remarks that such fluids contain globules, that they coagulate by rest, and that in these particulars they consequently present some features in common with blood. Yet though the coloured liquids become inspissated, they do not present the phenomena of blood-coagulation; for in this latter the fibrinous portion coagulates in a solid mass containing the globules to form the clot, the other portion remaining liquid in the form of serum; whilst in the case of coloured vegetable juices, the globules are aggregated together in a thick mass, and the liquid portion evaporates. In blood, again, the globules have a determinate form and a special organization; while in the proper juices of plants they are often irregular in form, without organization, and of very varied composition. The composition of blood is in harmony with that of the tissues of animals; it contains their elements: on the contrary, no such analogy subsists between the proper juices of plants (the composition of which is very varied and complex) and the fundamental tissue of plants, constituted of cellulose. Lastly, the proper juices are not found at every part, and indeed are generally absent from young tissues, in which the process of growth principally proceeds.

Therefore it may be said that the coloured juices of plants neither resemble a fluid which has to furnish organs with the materials of growth, in their physical properties, in their composition, or in the situations in which they are found.

In the next place, are the vessels in which the proper juices are contained analogous to blood-vessels? Now, it must be admitted that, in certain lactescent plants, these fluids are contained in ramifying and anastomosing vessels having simple translucid walls without pores or fissures, just as Schultz has represented them. To see such vessels, this observer recommended the examination of the stipules of *Ficus elastica*, the epidermis of which is very readily detached from the subjacent tissue. On placing a portion of the tissue so prepared under the microscope, the network of laticiferous vessels is at once seen. If, again, of a large number of lactescent plants portions be boiled, the vessels containing the coloured juices are readily displayed, because the granules of those fluids are coagulated into a more or less compact and continuous mass, filling the tubes and rendering them very visible. By maceration for a longer or shorter time, the surrounding cellular tissue becomes broken up, and the ramifying tubules or vessels are left isolated and open to the ready examination of their characters. Such preparations may be made from the leaves, stems, or roots of the plants, and among others from those of *Campanula Medium*, *C. pyramidalis*, *C. rapunculoïdes*, *Euphorbia sylvestris*, *E. Lathyris*, *Cichorium Intybus*, *Lactuca sativa*, *Papaver somniferum*, *Ascle-*

pias syriaca, Ficus elastica, Broussonetia papyrifera, and *Chelidonium majus.*

In these plants, the reservoirs of the coloured juices clearly constitute a vascular system such as one is accustomed to conceive; there are tubes of more or less tenuity, frequently isolated, though sometimes aggregated in bundles, which anastomose and reunite to form larger trunks, are often flexuose, with thin transparent walls, not lined by a lamina pierced by fissures or pores, and without trace of a cellular organization. They further contain a coloured fluid, varied in appearance by a multitude of small granules held in suspension—these granules being at times comparatively few, but at others so numerous as to render the tubules altogether opake. After the granular liquid is condensed by boiling, the granular matter is either uniformly diffused through the tubes or agglomerated in irregular masses. The tubules readily break across, and the disunited fragments either remain in contact, giving rise to the semblance of an articulation, or become detached and leave a thread of the coagulated liquid they contained stretching between them as an extensible connecting link.

In leaves, these *vasa propria* are generally situated externally to the bundles of cortical fibres and spiral vessels; and they are also met with alongside these bundles, either above or beneath them, as, for example, in *Ficus* and *Asclepias.*

Their arrangement may be readily examined in *Asclepias,* for instance, by preparing the leaves in the following manner:—After boiling them and leaving them to macerate for some days, the epidermis is removed from the veins on the under surface, and the transparent fibrous tissue situated beneath the spiral vessels is then to be separated. On placing a small portion of that tissue under the microscope, the *vasa propria* are readily distinguishable in the form of opake wavy and branching vessels, whilst the neighbouring fibrous tissue is seen to be formed of transparent, very slender, straight, simple tubes with more or less acute extremities, either empty or occupied with more or fewer granules.

The ramifications of the proper vessels are so disposed that the several branches follow the plan of venation of the leaf; some of them, however, are given off in advance of the venous branches, and have rather the appearance of collateral vessels than of ramifications of the *vasa propria.* Sometimes, again, vessels which have been given off in company with a branch in the system of venation send back a recurrent branch, which retraces its course towards the original point of departure of the vessel—a fact, like the two former, also illustrated in the structure of the leaves of *Asclepias.*

The remotest venules are accompanied by fine vascular branches; for in the course of division the latter become more and more attenuated. This circumstance is observable in *Ficus* and *Chelidonium*.

The *vasa propria* of stems appertain especially to the cortical system. Thus, in *Papaver* and *Lactuca*, the special juices are seen, on section, not to flow from the central medulla; or if they do so at all, it is only in very minute quantity. Nevertheless in some other plants, as *Campanulæ* and *Chelidonium majus*, very many such special vessels occur in the woody lamina; and there are plants, indeed, in which such structures are more abundant in the medulla than in the cortical zones; among such is *Asclepias syriaca*. The vessels of stems may be detached in considerable numbers, and isolated by maceration after previous boiling. The proper vessels of the cortex are distributed in the different tissues of its layers: thus, in *Campanula* they are diffused in the parenchyma and in the fibrous layer of the bark; in *Chelidonium* they lie outside the fibrous bundles. The *vasa propria* of stems are generally but slightly ramified, though not, indeed, devoid of frequent divisions. In *Asclepias* these vessels anastomose at every node, in such a manner, too, as to form a plexus and a kind of septum in the medulla. Some of the branches emanating from this plexus are continued to the petiole of the leaf at its junction with a node, and to the young branch which springs from its axil; in this way they traverse the medullary space left between the bundles of woody fibre, and anastomose with the *vasa propria* of the bark, thus establishing a communication between the vascular network of the medulla and that of the cortical system.

The proper juices are in general more dense and of a deeper colour in the lower and older parts of a plant. In young shoots they are pale, and not thick; towards the base of the stem they are habitually much more intense in colour. Thus, in *Asclepias syriaca*, the juices, which are of a pure white colour in the upper portions of the plant, are of a yellow colour near the base of its stem. In *Chelidonium* the juices at the extremities of the branches are of a very pale yellow, but of a deep yellow tint in the main stem, and a reddish yellow in the root.

These dispositions are reversed, however, in certain species: in *Papaver* the proper juices are of a milky-white colour and well marked in the capsules, though scarcely opaline in the root. The proper juices of this plant seem to be derived principally from the fruit, which gives off a white juice on incision in great abundance: yet if the petiole be cut, little exudes; and if the incision be low down in the stem, no escape at all will probably take place.

In other plants where the juices are more coloured and denser in their lower portions, they are there less abundant: thus, for example, in *Chelidonium*, sections of the root are followed by a very small discharge of laticiferous fluid. The *Asclepias syriaca*, which possesses so many latex-vessels in its stem, has very few such in its stock, and none at all in those parts which give off no buds: for instance, the portions contiguous to the aërial stems allow the escape of a coloured fluid; while the remoter parts, together with the roots, give off a scarcely appreciable quantity. I should state, however, that I have sometimes observed a few isolated vessels in the roots. These radical vessels are impregnated with a mucilaginous liquid, of thick consistence and capable of coalescing in little globules of various diameters, themselves sometimes becoming confluent, and apparently being proper juices.

In certain plants the coloured fluids, instead of being less abundant in the roots, accumulate there in a larger quantity than in the aërial portions: thus, in the stem of *Lactuca sativa* the *vasa propria* do not constitute the principal elements of the cortical bundles, which are composed of woody fibres; whilst in the root they almost exclusively form the cortical bundles, into the composition of which few fibres enter. Hence this portion of the plant contains the largest proportion of the laticiferous juices; and on tearing the plant up by the roots, little drops of white fluid are seen to escape from all the torn ends of the fibrils.

As a rule, the *vasa propria* are distinguishable from neighbouring tissues, and particularly from cortical fibres, by the circumstance of their being filled with a granular fluid of some particular colour, and by their flexuous, thin, branching, anastomotic, and isolated form—the fibres being, on the contrary, straight, parallel, closely packed, and often empty. However, in certain plants these proper vessels are straight, very long, with few ramifications, and contain excessively minute granules few in number; on the other hand, cortical fibres occur of very fine calibre, of delicate form, and more or less filled with granular matter, and therefore not so readily distinguishable from *vasa propria*. This happens in *Campanula Medium*, *C. rapunculoïdes*, and *C. pyramidalis*, in *Euphorbia Lathyris*, *E. sylvatica*, &c. The distinction is rendered still more difficult when the vessels are articulated. According to Schultz, the articulations are not primary, but are the consequence of age; on this point we shall have something to say hereafter. The reported movements of expansion and contraction we shall also defer, remarking here only that though the difficulties in determining the existence of proper vessels are often great, yet the plan of boiling the parts to be examined, and thereby suddenly destroying vitality and coagulating the proper juices, renders the existence of *vasa propria* in certain parts clearly demonstrable.

XLIV.—*On* Acantholeberis (*Lilljeborg*), *a Genus of Entomostraca new to Great Britain.* By the Rev. Alfred Merle Norman, M.A.

[Plate XI.]

Fam. Daphniidæ.

Genus Acantholeberis (Lilljeborg).

(Syn. *Acanthocercus*, Schödler.)

Anterior antennæ large and conspicuous, porrected from the front of the head. The upper branch of the posterior antennæ four-jointed, and bearing at its termination three plumose setæ and a spine: lower branch three-jointed, and having the first joint provided with a remarkably long-spined seta, the second also furnished with one very long seta, and the last joint terminating in three setæ and a spine. The postero-ventral angle of the carapace is fringed with very long setæ of a spine-like character. Feet five pairs. Intestinal canal simple and straight at first, but furnished with a loop near the anus.

The genus *Acanthocercus* was founded by Schödler, in the 'Archiv für Naturgeschichte' for 1846, for the reception of a remarkable Entomostracan which Müller had described in the 'Zoologia Danica,' under the name of *Daphne curvirostris*. Fitzinger had, however, established a genus of reptiles under the same name three years previously; and Lilljeborg, therefore, in his work on the Entomostraca (De Crustaceis ex ordinibus tribus Cladocera, Ostracoda, et Copepoda in Scaniâ occurrentibus) changed the name of the genus to *Acantholeberis*.

In general characters *Acantholeberis* is closely—perhaps almost too closely—allied to *Macrothrix* (Baird). The resemblance is seen in the general form of the carapace and of the organs of the body, but especially in the large size and position of the anterior antennæ, and in the peculiar and exceptional structure of the long seta of the first joint of the lower branch of the posterior antennæ. The chief differences are to be found in the number of setæ on the upper branch of the posterior antennæ, which in *Macrothrix* are four, but in *Acantholeberis* only three; and in the fact that there is a loop in the intestinal canal of *Acantholeberis* towards the posterior extremity below the point of attachment of the fifth feet; while in *Macrothrix* there is no such fold, the course of the canal being straight.

In 1858, Lievin described a second species of the genus; but his *A. sordida* shows such marked points of divergence from the type as to make us doubt whether the genus has been founded on sufficiently good grounds, and whether it should not rather be united with *Lathonura*, Lilljeborg (=*Pasithea*, Koch), and *Macrothrix*. *A. curvirostris* and *A. sordida* are the only known members of the genus, and both these species have now been found in Great Britain.

Acantholeberis curvirostris (Müller). Pl. XI. figs. 1–5.

Daphne curvirostris, O. F. Müller, Zool. Dan. Prod. p. 200. No. 2403.
Daphnia curvirostris, O. F. Müller, Entomostraca, p. 93, pl. 13. f. 1 & 2.
Acanthocercus rigidus, Schödler, Archiv für Naturgeschichte, 1846, B. i. p. 301, pl. 11 & 12. Lievin, "Die Branchiopoden der Danziger Gegend," Neueste Schriften der Naturforschenden Gesellschaft in Danzig, B. iv. p. 33, pl. 8. f. 1–5. Leydig, Naturgeschichte der Daphniden, p. 195.
Acantholeberis curvirostris, Lilljeborg, De Crust. ex ord. Clad. Ostrac. et Copep. p. 52, pl. 4. f. 3–7, & pl. 23. f. 10, 11.

The carapace is somewhat oblong in form, rather truncate below, and with the hind margin nearly straight, since the matrix is but little protuberant in the gravid female. The head does not lean forward, as is usually the case among the Daphniidæ, but is remarkably upright. To the upper point of the beak the anterior antennæ (Pl. XI. fig. 2) are attached, and from it they are projected at nearly a right angle. These organs are very large, and strap-shaped; they are slightly serrate on the upper margin, and gradually widen towards the extremity, which is furnished with six or eight cylindrical tentaculiform filaments. The supplemental eye-spot is situated close behind their bases, and is very small.

The posterior antennæ are long and slender; their peduncles are not very muscular, are corrugated on the basal half, and bear a few minute spines on the surface towards the distal extremity. The upper and four-jointed branch of these antennæ has the first articulation very small, the second considerably longer, and furnished with a spine on the upper margin, but no seta; the third is unprovided with appendages; the fourth terminates in three two-jointed plumose setæ and a spine, which does not equal one-third of the basal portion of the setæ in length. The first joint of the lower branch bears an unusually long two-jointed seta of remarkable character, and which, indeed, forms one of the chief features in this interesting Entomostracan. The basal portion of this seta is provided with short cilia on the outer or upper margin, while the inner margin is smooth; the second portion of the seta (Pl. XI. fig. 3) has a series of rather distant spines upon the outer margin; and between these spines a high power of the microscope shows a fringe of short, closely-set cilia.

The second joint of the lower branch of the posterior antennæ bears another seta of great length, which differs, however, in its armature from that of the first joint. This seta is plumose on both margins throughout its entire length; and between the longer hairs of the outer margin of the distal portion are short closely-set cilia (fig. 4), similar in character to those between the spines of the seta which is attached to the first joint. The third joint ends in three two-jointed plumose cilia and a spine.

The labrum has a large and conspicuous, much elevated, acutely papilliform process in front. The terminal portion of the abdomen is bordered with a closely-set array of spines, and has the sides, moreover, thickly studded with an admixture of slender spines and hairs. The abdominal setæ are long, while the terminal claws (fig. 5) are rather short, a little flattened, and minutely pectinated along the edges. The ventral margin of the carapace is fringed throughout its entire length with plumose setæ; and these setæ attain an extraordinary length at the angle formed by the junction of the ventral and posterior margins.

Acantholeberis curvirostris was discovered last summer by Mr. D. Robertson, in the Isle of Cumbrae in the Firth of Clyde, living in some abundance in a small shallow pond about 12 feet square, which had been cut out of the sandstone rock, and was covered at the bottom with moss and Confervæ. Mr. Robertson informs us that though the species seems fond of remaining quietly among the weeds, it nevertheless is tolerably active when swimming, which it effects with a slight jerking motion, often in curves. It has a habit of mounting to the surface of the water, and then allowing itself passively and slowly to sink to the bottom, with its antennæ spread out on either side. It rarely resumes active motion when in its downward course, unless it is disturbed.

A second locality for the species is Crag Lake, Northumberland, where it has been met with, during the present spring, by Mr. G. S. Brady.

Acantholeberis sordida (Lievin). Pl. XI. figs. 6–9.

Acanthocercus sordidus, Lievin, "Die Branch. der Danziger Gegend," Neueste Schriften der naturf. Gesells. in Danzig, B. iv. p. 34, pl. 8. f. 7–12. Fischer, Bull. de la Soc. Imp. des Nat. de Moscou, 1854. Leydig, Naturgeschichte der Daphniden, p. 199.

Carapace nearly round, widest below, and slightly truncate on the inferior margin, tumid, and having the surface clothed with short hair. Anterior antennæ largely developed, long, cylindrical. Posterior antennæ short and stout; their peduncles very large, stout, and powerfully muscular. Both branches very short, the separate articulations being scarcely longer than they are broad, and the total length of the branches barely exceeding the width of the bases of the enormously developed peduncles. Upper and four-jointed branch terminating in three plumose setæ and a long spine, which equals two-thirds the length of the basal portion of the setæ. Lower and three-jointed branch having a seta at the extremity of the first and second joints, and three setæ and a spine at the termination of the third joint. The setæ of the first two joints do not differ materially in character from those at the extremity. The last portion of the abdomen (Pl. XI. fig. 7) is in the form of a somewhat flattened semicircular plate, margined with large spines. The claws are large, produced, simple, and cylindrical. Just below their base is a cluster of small spines, which are succeeded by some still smaller spines; behind these the spines increase in size, becoming both numerous and large. The abdominal setæ are long and slightly plumose. The ventral edge of the carapace is fringed with plumose setæ (fig. 8); but at the posteroventral angle these setæ become much longer, assume quite a spine-like character, and bear, as it were, smaller spines attached to one side (fig. 9). The entire animal is of a brilliant crimson colour.

This Daphnian is remarkable alike in history and in habits. On examining with a hand-lens the vegetable matter in a bottle of water brought home from a clear pond which had been cut out of the limestone rock, to contain water for the supply of the engine at a now unworked colliery at Bishop Middleham, in the county of Durham, a small blood-red Entomostracan, which was lying upon its back in the water, attracted attention; and on further search, two more individuals were found in the same bottle. They at once became a source of great interest; for *A. sordida* is the most helpless animal possible. It is totally unable either to swim or to walk. The setæ of the antennæ are apparently of insufficient length to confer the power of swimming; and the feet in this family, though valuable agents in respiration, are totally unfitted in their structure for purposes of locomotion, and, indeed, being contained within the carapace, could not by any possibility be used for the support of the body. The animal therefore lies upon its back, kicking and struggling, swinging to and fro its brawny arms (the posterior antennæ), and thrusting in and out of the carapace-valves its largely developed and strongly spined abdomen in the vain attempt to push itself from place to place; but the efforts, though most vigorous, are of little avail, and its progress is extremely slow. It is probably in consequence of these sluggish habits, and of the animal rolling itself in the mud, as well as owing to the pilose covering of the shell, that it owes the coating of mud, Diatoms, and Desmids which render it so difficult a a matter to see the structure of the organs of the body contained within the carapace. That the coating of extraneous matter is the effect, and not the cause, of the inability of the animal to swim is proved by the fact that one of the specimens obtained, which was sent to Mr. G. S. Brady for the purpose of obtaining his kindly extended and valuable aid in the delineation of the species, gave birth to five young while in his possession; and he informed us that, though these young, when first born, were able to raise themselves slightly in the water, yet it was not more than about half an inch, nor could this be effected without great effort, or, apparently, without the assistance of the sides of the vessel in which they were contained; and when two or three days old, even this limited power of locomotion was lost. Mr. Brady wrote to us the following vivid description of the motions of these young specimens:—"It is a sight to see the brutes swim, or *try* to swim, under the microscope. When a good view from the dorsal aspect is obtained, one sees that they put their two great antennæ together, and strike out in a good bold sweep like any Christian, the superior antennæ working synchronously, but in a smaller arc, inside the greater ones. The motion of these lesser antennæ is very beautiful; and the muscular contractions in the basal joints of the greater ones are remarkably plain, throwing the limb into great wrinkles. When the animal is tired of this sort of exertion, it stops its arms, and begins working its branchial apparatus at a great rate; but, so far as I can see, the two systems are never in active motion together. They seem to attract dust and parasitic growths; for, though kept in simple water, they are surrounded with confervoid filaments, Diatoms, Oscillatoriæ, &c."

Another remarkable feature in the history of this Daphnian is the great scarcity of the species individually. As a rule, where an Entomostracan occurs at all, it is to be met with in abundance. This is very far from being the case with *A. sordida*. Failing in the attempt to make out the structure of the three specimens we had obtained in the Bishop-Middleham colliery pond, and being unwilling to destroy them by attempted dissection, we hoped to render the dense character of the carapace-valves more transparent by mounting them in Dean's medium. The result was far from satisfactory. The pond was therefore revisited in the hope of again finding the species, and this not once, but many times; but, though the greatest trouble and care were taken, no further specimens could be met with. Subsequently, however, a single example was obtained under precisely similar circumstances to those under which the former had been taken, among material collected in the Forge Dam at Sedgefield, a spot about two and a half miles distant from the first locality. It is from this example that the figures and description of this paper have principally been derived. All after-attempts (and they were not a few) to take this species in the Forge Dam were as unavailing as they had proved in the case of the colliery pond.

We had at first thought that this abnormal species might be new to science; and when we found the description of this animal in Leydig's work, we could not help being amused at the remarkable parallelism between our own experience and that of Fischer and Leydig; and we really are afraid that it was some consolation, after the great trouble that had been taken in the vain attempt to obtain additional specimens, that other naturalists had suffered precisely similar disappointments. Fischer says that he could only find a single specimen, and therefore is obliged to content himself with referring to the description of Lievin; and Leydig writes, "I have only once observed *Acanthocercus sordidus*, in a muddy lake at Tübingen. It was a single specimen, which struck me by its blood-red colour, and also by the ample investiture of mud which surrounded the animal. Added to that, it did not swim, but crept slowly along the bottom of the vessel. Circumstances prevented my drawing the animal, and every subsequent trouble I took to find the animal again was in vain."

We have already referred to the fact that this species does not appear to embrace all the characters which are assigned to the genus *Acantholeberis*. It agrees with *A. curvirostris* in the number of setæ attached to the posterior antennæ, and also in the presence of setæ of great length at the posterior ventral angle of the carapace. It differs in the fact that the setæ of the first two joints of the lower branch of the posterior antennæ are short, and do not differ in character from the ordinary plumose setæ of the Daphniidæ. But a more important instance of divergence would appear to exist in the structure of the intestinal canal, which does not seem to possess a loop near the excretory orifice, as in *A. curvirostris*; nevertheless a great dilatation of the canal exists in an analogous position, forming apparently a strong muscular rectum. At the same time, we speak with hesitation on this point, and our opportunities of investigating the structure of the species have not been sufficient to enable us to speak with certainty on this and other points.

Sedgefield, county Durham.
May 18, 1863.

EXPLANATION OF PLATE XI.

Fig. 1. *Acantholeberis curvirostris* (Müller), ♀.
Fig. 2. Anterior antenna of the same species.
Fig. 3. Portion of the terminal half of the seta attached to the first joint of the lower branch of the posterior antennæ; greatly magnified.
Fig. 4. Portion of the terminal half of the seta attached to the second joint of the lower branch of the posterior antennæ, greatly enlarged.
Fig. 5. Abdominal claws.
Fig. 6. *Acantholeberis sordida* (Lievin), ♀.
Fig. 7. Abdomen of the same species.
Fig. 8. Setæ from the ventral margin of the carapace.
Fig. 9. Setæ from the posteroventral angle of the carapace.

XLV.—*On the Form of the Cells made by various Wasps and by the Honey Bee; with an Appendix on the Origin of Species.* By the Rev. SAMUEL HAUGHTON*, Fellow of Trinity College, Dublin.

THE geometrical form affected by the cells of various kinds of wasps and bees has attracted the attention, and called forth the speculations, of naturalists and geometers from the earliest periods. By one class of writers the geometrical properties of these cells have been used as proofs, not so much of the skill and instinct of the insects as of the wisdom and intelligence of their Creator; while, by the opposite class of writers, these same geometrical properties of the cells are alleged as a sufficient cause for the production of the insects that make them, from the advantages which these forms of cells are supposed to possess over other forms—advantages said to be so important as to decide the battle of life in favour of the insects that adopt the geometrical plan of making their cells.

I have for a long time felt convinced that both parties in this controversy are in error, as men generally are when they attempt to speculate on the reasons for the existence of things; and that the properties of the cells are only the necessary consequence of their geometrical form, which form itself is the necessary consequence of mechanical conditions totally unconnected with design, and incapable of rendering an account of the origin of the insects that make the cells.

The geometrical cell of the wasps and bees that I have had an opportunity of examining may be divided into three classes.

1st. Hexagonal cells formed of adjoining pyramidal figures, with slightly curved axes, not terminating in a point, but in a rounded extremity.

* Read before the Natural History Society of Dublin, November 21, 1862. [Reprinted from a separate pamphlet by permission of the author.]

The British tree-wasp forms its pupa-cells in this manner, and, in consequence of the pyramidal form of the hexagonal cells, the comb opens out on the lower side, so as to present a larger surface than on the upper side.

2nd. Hexagonal cells formed of adjoining prismatic figures, with rectilinear axes, terminated by a truncated plane, at right angles to the axes of the prisms.

These cells are found in wasps' nests from St. Lucia, in the West Indies, and at Graham's Town, in South Africa, which were placed at my disposal for this investigation by Mr. Robert J. Montgomery.

3rd. Hexagonal cells formed of adjoining prismatic figures, with rectilinear axes, terminated by three faces of a rhombic dodecahedron, which three faces also form each one-third of the termination of a similar set of adjoining hexagonal prismatic cells, placed end to end behind the first set of prisms.

This double comb is produced by the well-known form of the cells of the honey-bee.

All these varieties of cells may be accounted for, simply by the mechanical pressure of the insects against each other during the formation of the cell. In consequence of the instinct that compels them to work with reference to a plane, and of the cylindrical form of the insects' bodies, the cells must be hexagons; and in consequence of the instinct that induces the bees to form double combs, the mutual pressure of their heads against each other compels the bottom of the cell to assume the form of the rhombic dodecahedron. If we could imagine spherical insects endowed with the instinct of working from a point and not a plane, their cells would cease to affect the forms of the hexagon and rhombic dodecahedron, and would imitate the totally different form of the pentagonal dodecahedron—instances of which may be seen in the bubbles produced in the froth of an organic solution, and in the shapes of the elementary cells of vegetables, equally restricted in their growth in every direction—and also in the pentagonal faces assumed by leaden bullets made to fill completely the inside of a hollow shell, and then discharged against a bank of earth, or a wall, from a mortar.

On this subject, I cannot do better than quote the words of Buffon, who was the first person that put forward a rational theory of the shape of the cells of bees. The passage which I quote may be found in his 'Histoire Naturelle,' tom. iv. p. 99:—

"Dirai-je encore un mot; ces cellules des abeilles, ces hexagones, tant vantés, tant admirés, me fournissent une preuve de plus contre l'enthousiasme et l'admiration: cette figure, toute géométrique et toute régulière qu'elle nous paroît, et qu'elle est en effet dans la spéculation, n'est ici qu'un résultat mécanique et assez imparfait qui se trouve souvent dans la nature, et que l'on remarque même dans ses productions les plus brutes; les cristaux et plusieurs autres pierres, quelques sels, &c., prennent constamment cette figure dans leur formation. Qu'on observe les petites écailles de la peau d'une roussette, on verra qu'elles sont hexagones, parce que chaque écaille croissant en même temps se fait obstacle, et tend à occuper le plus d'espace qu'il est possible dans un espace donné: on voit ces mêmes hexagones dans le second estomac des animaux ruminans, on les trouve dans les graines, dans leurs capsules, dans certaines fleurs, &c. Qu'on remplisse un vaisseau de pois, ou plutôt de quelque autre graine cylindrique, et qu'on le ferme exactement après y avoir versé autant d'eau que les intervalles qui restent entre ces graines peuvent en recevoir; qu'on fasse bouillir cette eau, tous ces cylindres deviendront de colonnes à six pans. On en voit clairement la raison, qui est purement mécanique; chaque graine, dont la figure est cylindrique, tend par son renflement à occuper le plus d'espace possible dans un espace donné, elles deviennent donc toutes nécessairement hexagones par la compression réciproque. Chaque abeille cherche à occuper de même le plus d'espace possible dans un espace donné, il est donc nécessaire aussi puisque le corps des abeilles est cylindrique, que leurs cellules soient hexagones,—par la même raison des obstacles réciproques. On donne plus d'esprit aux mouches dont les ouvrages sont les plus réguliers; les abeilles sont, dit-on, plus ingénieuses que les guêpes, que les frelons, &c., qui savent aussi l'architecture, mais dont les constructions sont plus grossières et plus irrégulières que celles des abeilles: on ne veut pas voir, ou l'on ne se doute pas que cette régularité, plus ou moins grande, dépend uniquement du nombre et de la figure, et nullement de l'intelligence de ces petites bêtes; plus elles sont nombreuses, plus il y a des forces qui agissent également et qui s'opposent de même, plus il y a par conséquent de contrainte mécanique, de régularité forcée, et de perfection apparente dans leurs productions."—*Buffon.*

The opinions of the older writers, especially of mathematicians, on this subject, differ widely from those advanced by Buffon.

I shall here translate some of the most important of the passages bearing on this point.

The famous Pappus, of Alexandria, in the Introduction to the Fifth Book of his Mathematical Collections, says:—

"God has imparted to men, indeed, the best and most perfect knowledge of wisdom and discipline; and has assigned to some animals, devoid of reason, a certain portion. To men, therefore, as making use of reason, He has permitted that they should do all things by reason and demonstration; but to other animals without reason, He has given the possession of what is useful and conducive to life, by a certain natural providence.

"Any one may understand this to be so, as well in many other kinds of animals, and more especially in bees. For order, and a certain admirable deference to those who rule in their republic, ambition, moreover, and cleanliness, heap together an abundance of honey; but their foresight and economy concerning its conservation are much more admirable: for holding it for certain, as is just, that they carry back some portion of ambrosia from the gods to choice men, they pour out this, not rashly on the ground, or into wood, or any other unformed and misshapen matter; but collecting from the sweetest flowers that grow in the earth, they form from them most excellent vases as a receptacle for the honey (which the Greeks call *κηρία*, and the Latins *favi*), all indeed, equal, similar, and cohering among themselves, of the hexagon species. Now it is thus evident that they construct these by a certain geometrical foresight; for they consider it fit that all the figures should cohere together and have common sides, lest anything, falling into the intervening spaces, should spoil and corrupt their work.

"Hence, three rectilinear and ordinate figures can effect what is proposed—I mean ordinate figures which are equilateral and equiangular, for ordinate and dissimilar figures did not please the bees themselves. Now, equilateral triangles, and squares, and hexagons (neglecting other dissimilar figures filling space) may be placed next each other, so as to have common sides—other ordinate figures cannot; for the space about the same point is filled, either by six equilateral triangles, or by four squares, or by three hexagons; but three pentagons are less than sufficient, and four are more than sufficient to fill the space round a point, neither can three heptagons be established, so as to fill the space round a point*.

"The same reasoning will apply much more to figures having a greater number of sides. There being, then, three figures, which, of themselves, can fill up the space round a point, viz. the triangle, the square, and the hexagon; the bees have wisely selected for their structure that which contains most angles, suspecting, indeed, that it could hold more honey than either of the others.

"The bees, forsooth, know only what is useful to themselves, viz. that the hexagon is greater than the square or triangle, and can hold more honey, an equal quantity of material being employed in the construction of each; but we, who profess to have more wisdom than the bees, will investigate something even

* The proofs of these assertions are omitted in this translation.

more remarkable, viz. that, of plane figures, which are equilateral and equiangular, and have equal perimeters, that is always the greatest which consists of most angles, and the circle is the greatest of all, provided it be included in a perimeter equal to theirs."—*Pappus.*

In 1712, Maraldi published, in the 'Mémoires de l'Académie des Sciences, Paris,' 1712, p. 299, a remarkable paper, in which is investigated, for the first time, the terminal planes of the bees' cell, which are now well known to be formed of the faces of the rhombic dodecahedron. He appears to have believed that the object of having lozenges of the same form, as terminating planes, was to enable the bees to carry in their mind the idea of one geometrical form only, in addition to their original idea of the hexagon. The angles of the lozenge are found by him to be 110° and 70°, by observation; and 109° 28′ and 70° 32′ by calculation. He gives, also, the following mean measurements of the cells:—In a foot long of comb there are from 60 to 66 cells, about two lines for each cell, and the depth of the cell is five lines.

Réaumur appears to have been the first who introduced the fantastic idea of economy of wax, as the motive cause of the peculiar shape of the terminating planes, and, not being a geometer, he obtained the assistance of König to calculate the angle of the lozenge which should give the least surface with a given volume. König determined this angle at 109° 26′, agreeing with Maraldi within two minutes.

MacLaurin published, in the 'Philosophical Transactions,' 1743, p. 565, an elaborate geometrical paper on the subject, in which he proves that the tangent of the angle in question is the square root of 2, and that it is therefore equal to 109° 28′ 16″; and he computes the saving of wax as "almost one-fourth part of the pains and expense of wax they bestow, above what was necessary for completing the parallelogram side of the cells."

L'Hullier, in 1781, published, in the 'Berlin Memoirs,' p. 277, an elaborate discussion of the entire problem, in which he arrived at the following results, already found by MacLaurin's geometrical method:—

a. That the economy of wax is less than one-fifth of what would make a flat base.

b. That the economy of wax, referred to the total expenditure, is $\frac{1}{51}$st, so that the bees can make fifty-one cells, instead of fifty, by the adoption of the rhombic dodecahedron.

He does not share, however, in the enthusiasm of the naturalists, but maintains and proves that mathematicians could make cells, of the same form as those of the bees, which, instead of using only a *minimum* of wax, would use the *minimum mini-*

morum, so that five cells could be made of less wax than that which now makes only four, instead of fifty-one out of fifty.

Notwithstanding this conclusive decision in favour of the mathematicians, the advocates of final cause, and those who maintain that economy of wax can create a new species, have both persisted in using the bees' cell in illustration of their respective theories, with a pertinacity that proves the persistent vitality of an exploded theory. In illustration of this remarkable tendency of false theories to reproduce themselves, I shall here add, as an appendix to my account of the form of the wasps' and bees' cells, some remarks on the origin of species, the substance of which originally appeared in the 'Natural History Review' of 1860.

Appendix on the Origin of Species.

The active and restless mind of man has never been content with the knowledge of the present, but has always sought to know the future and the past. The guesses of the ancients as to the future of man are amongst the most interesting and, at the same time, the most puerile of their philosophical speculations. The reader of the Tusculan Disputations rises from his task, charmed by the style of the writer, but thankful that a certain revelation of the future renders him immeasurably superior in knowledge to the weavers of these pleasant webs of fiction; and though he admires the skill of the ingenious sophists who live again and dispute in the pages of Cicero, he would not for an instant exchange his own position for theirs.

The moderns have resolved, by their speculations on the past, to show that in ingenuity and oddness of conceit, and, probably, also in wideness from the truth, they are in no respect inferior to the ancients. The future being shut out from us, we are resolved to try what we can effect, in proof of our versatility of imagination, by guessing at the history of the past.

To establish a character for subtlety and skill, in drawing large conclusions on this subject from slender premises, the first requisite is ignorance of what other speculators have attempted before us in the same field; and the second is, a firm confidence in our own special theory. Neither of these requisites can be considered wanting in those who are engaged in the task of reproducing Lamarck's theory of organic life, either as altogether new, or with but a tattered and threadbare cloak thrown over its original nakedness.

The sciences of geology and political economy are mainly answerable for the revival of these exploded and forgotten fancies,—geology, in supplying the lost history of organic life, which could never be studied profoundly from the creatures living at any given time; and political economy, in furnishing, from its mean and sordid motives, a Malthusian force, supposed to be sufficient to supply the wants of previous theories.

One of the earliest speculators on the origin of the diversified forms of life we see around us, and class as varieties, species, and genera, was Buffon, who published in 1766* his theory of the derivation of all mammal forms by degradation, from fifteen primary and perfect types, and nine special or isolated species.

This theory of *βιογένεσις* by degradation, although now superseded by the theory of progression, has much to be said in its favour, and derives additional importance from the facts of the history of life made known since Buffon's time, by the science of geology. The principal of these additional facts are, the degradation of fishes from their first introduction in the Old Red Sandstone period to the present day; the corresponding degradation of the Cephalopods, and, though in a somewhat less degree, of the Reptiles.

Some of the classes given by Buffon are as old as the time of Moses, who defines with accuracy the class Ruminantia, distinguishing it from the Pachydermata and Rodentia, in his classification of "clean" and "unclean" beasts†.

Whatever may be thought by the more enlightened moderns of the merits of this classification of mammals, Buffon certainly agrees with them in one respect: he takes the non-reality of species as the starting-point of his theory, and by a continued degradation downwards, developes all the varieties of life we see on the surface of the globe.

To those who love to dwell upon the past, this theory of degradation will afford solace and consolation in the troubles of the present, as they can reflect upon how good and excellent their ancestors were, and congratulate each other upon their superiority to those that will come after them. Every system of philosophy provides its followers with a "*solatium doloris*;" the degradationists find it in the contemplation of the past, and the progressionists in the prospect of the future; to those who are contented with the present, and deny our knowledge of the past or future, both theories appear as the idle dreams of childhood, the awakening from which will disclose a reality totally different from the troubled fancies of the night.

Lamarck is the father of the progressionists; and of the many who quote his name as an authority in support of their systems, or express their disapproval of his doctrine, few have taken the trouble to understand his theory or trace it to its origin. It is apparently founded on the confusion of species, like that of Buffon; but there is in reality an *arrière-pensée*, like an unseen

* Histoire Naturelle, tom. xiv.

† Leviticus, xi. 2–8.

presence, which corrupts his reasoning, and discloses the motive force of his entire system. This hidden spring of action and theorizing is a profound and, as many think, a well-founded contempt for humanity, which pervades his writings as thoroughly as it does the "Voyage to the Houyhnhnms." Lamarck was too quick-witted and acute an observer, however deficient he may have been as a reasoner, to have believed his own theory, the real mainspring of which is the desire to degrade man into an intelligent baboon or Yahoo; what difference is there in a name! In his desire to do so, he overlooks every fact at variance with his foregone conclusion, and writes of mankind with a virulence which, though devoid of the wit of Swift, springs from the same profound and unalterable conviction of the worthlessness of the creature he describes:—

"Si Newton, Bacon, Montesquieu, Voltaire, et tant d'autres hommes ont honoré l'espèce humaine par l'étendue de leur intelligence et de leur génie, combien ne la rapprochent pas de l'animal cette quantité d'hommes bruts, ignorans, en proie aux préjugés les plus absurdes, et constamment asservis par leurs habitudes, qui cependant composent la masse principale chez toutes les nations?"*

Lamarck's contempt for his species is again shown in the strange list of resemblances he selects for his comparison between man and the chimpanzee—a comparison fully as degrading as Swift's mock imitation of a naturalist's description of a Yahoo.

Lamarck's theory consists in the assertion of the following laws, six in number, which he dignifies with the title of Laws of Nature:—

I. *Law of Specialization of Function,* by which a function at first general, or belonging to the whole body, is determined to a particular organ.

II. *Law of Nutrition producing Death* by the forced inequality between the materials fixed by assimilation and removed by excretion. This law is intended to account for death, which is a puzzle to the naturalists.

III. *Law of Movement of Complex Fluids in Canals.* This law I profess my inability to understand. In the statement of it, Lamarck, who, like most naturalists, is unacquainted with physics, and untrained in the severe discipline of mathematical reasoning, attributes properties to fluids in motion which must be considered by lookers-on as little short of miraculous.

IV. *Law of Change of Composition of Fluids in Circulation.* This law is as obscure, and as miraculous in its results, as the

* Recherches sur l'Organisation des Corps Vivans, p. 127. Paris, 27 Floréal, An X.

preceding. Natural religion, however, would appear to consider herself entitled to her miracles, as well as revealed religion.

V. *Organic Forms, acquired under the presiding influence of external circumstances, are transmitted by Generation.* This law involves the famous Law of Natural Selection, attributed within the last few months to Mr. Darwin.

VI. *By the concurrence of the preceding Laws, of a long lapse of time, and an almost inconceivable diversity of surrounding circumstances, all Species have been formed in succession.* Lamarck's theory is essentially one of progression, and is totally opposed to that of Buffon, which is one of degradation; yet it is remarkable that they both rest upon the same foundation—the assumed non-reality of species. Like his successors in the Progression theory, Lamarck spent his life in the establishment of the reality of species; and it is a humiliating reflection, that, at the close of it, he believed himself to have lived under a delusion. Let us hear his confession:—

"J'ai long-temps pensé qu'il y avait des *Espèces* constantes dans la nature, et qu'elles étoient constituées par les individus qui appartiennent à chacune d'elles. Maintenant je suis convaincu que j'étois dans l'erreur à cet égard, et qu'il n'y a réellement dans la nature que des individus."

What must we think of the principles that guide the speculations of naturalists, when we find minds like those of Buffon and Lamarck drawing opposite conclusions from the same premises? It matters little in this question whether the premises be true or false, whether species be truly distinct or not; our surprise at the logic of the naturalists is natural, and must border on a courteous contempt.

The English revival of Lamarckianism, or "Progress in Organic Life," by Mr. Darwin, involves no idea in advance of those contained in Lamarck's six laws, but gives a greater prominence to the law of Continuation of Peculiarities by Generation, by the assertion that such peculiarities, and such only, as are useful to the creature, in its struggle for existence, will become hereditary—the reason being, that animals provided with such peculiarities will have the advantage in the battle of life over their fellows in the competition for food, females, and other necessaries for the preservation of the individual and species. This notable argument is borrowed from Malthus's doctrine of population, and will, no doubt, find acceptance with those political economists and pseudo-philosophers who reduce all the laws of action and human thought habitually to the lowest and most sordid motives. It is dignified with the title of a Law of Nature, called the *Law of Natural Selection,* and forms the only *bonâ fide* addition made by Darwin to Lamarck's famous theory of Progression, in which, however, it is implicitly involved.

I make no account of Mr. Darwin's geological additions to Lamarck, for two reasons. In the first place, the laws of geographical distribution explained by geological change are not *ad rem*, and were previously fully treated of by Buffon and Forbes; and in the second place, Mr. Darwin admits that the facts of geology are opposed to his (Lamarck's) theory; and they are pleasantly alluded to as the geological difficulty! So far as the history of life on the globe indicates a progression, Lamarck is entitled to the benefit of it—as in the case of mammals and plants,—but certainly not to the exclusion of the facts in favour of degradation—such as the case of Fishes, Reptiles, and Cephalopods, which must be credited to the account of Buffon and his followers.

Lamarck says distinctly—"Ce ne sont pas les organes, c'est-à-dire, la nature et la forme des parties du corps d'un animal, qui ont donné lieu à ses habitudes et à ses facultés particulières; mais ce sont au contraire ses habitudes, sa manière de vivre, et *les circonstances dans lesquelles se sont rencontrés les individus dont il provient*, qui ont *avec le temps* constitué la forme de son corps, le nombre et l'état de ses organes, enfin les facultés dont il jouit."

This statement implies all that is essential in Mr. Darwin's "law of Natural Selection," which, by its prominence, fills in his system the place occupied by the law of Imitation in the original theory of Lamarck. This difference arises from the difference of the points of view of the Frenchman and the Englishman—a difference characteristic of the two races. The Frenchman, with the vivacity and perception of the ridiculous belonging to his nation, seizes upon the quality most likely to elevate a monkey into a man, selects the faculty of imitation, and, with a bitter satire, endows his monkey with the human desire to better his condition, and lift himself above his brother chatterers. He thus magnifies the monkey power of imitation—which is truly wonderful, and extends to the most extraordinary actions—into the position of a law of nature, sufficient to create man! The Englishman, on the other hand, firmly believes his theory, and, with a confident faith in the power of food and comfort, equally characteristic of his country, elevates the desire to supply the stomach into a law of sufficient force to convert an eel into an elephant, or an oyster into an orang-outan.

Other theorists, whose name is legion, have printed their crude fancies, and have met with numerous readers among the young and inexperienced, the sciolists of science. It is not to be supposed that a public which accepted mesmerism and table-turning could judge with accuracy of the pretensions of loose and ill-reasoned speculations on the origin of life. It has rained, hailed, and poured theories of life—religious, philosophical, and pseudoscientific—with a marvellous rapidity within the last few years. Some theorists have started from the nebular hypothesis of Laplace; others have speculated on the results of superfœtation; and others on the brilliant and seductive theory of the correlation of physical forces; but they may all be classed as, knowingly or not, the followers of Lamarck. Some have taught that all the planets, being composed of the same mineral constituents as the earth, must produce in succession the same organic phenomena, and weary the reader with the idea of the same Pterodactyles and Cetacea, the same monads and men, appearing on all the globes that circle round the sun! Others have called to mind the loss of heat of our planet, and, by the correlation of forces, have reproduced it in the increasing intelligence of the successive forms of life that have peopled our globe!! In a word, there is no folly that human fancy can devise, when truth has ceased to be of primary importance, and right reason and sound logic have been discarded, that has not been produced and preached as a new revelation. Neither have the disciples of Lamarck wanted the martyr spirit, *i. e.* the disposition to make martyrs of others, which is generally supposed to be essential to the apostles of a new faith. They have courted persecution, and reviled their opponents with bitter words, and with such weapons as are permitted by the free civilization under which we live. They argue, with a logic worthy of their system, that because truth has been often in a minority, therefore minorities and theories in a minority must necessarily be true.

It is curious to observe the natural instinct by which Lamarck and his followers appeal from the judgment of their peers to the young, the enthusiastic, and the inexperienced. I shall quote but two instances of this necessary instinct of self-preservation:—

"Que de réflexions ces considérations pourront faire naître dans l'esprit du petit nombre de ceux qui en sont susceptibles et qui sont lents à prononcer! les autres auront bientôt fait à cet égard: ils trancheront sans examen, et décideront d'après ce qui leur conviendra le mieux, ou selon la portée de leurs conceptions."—*Lamarck*, p. 123.

"I by no means expect to convince experienced naturalists, whose minds are stocked with a multitude of facts, all viewed, during a long course of years, from a point of view directly opposite to mine . . . . . .; but I look with confidence to the future, to young and rising naturalists, who will be able to view both sides of the question with impartiality."—*Darwin's Origin of Species,* pp. 481–82.

The theories of *βιογένεσις*, already described, and many others, are based upon the following three unwarrantable assumptions, the denial of which, until proved, brings to the ground the entire structure, like a child's house of cards—

I. *The indefinite variation of species continuously in the one direction.*

II. *That the causes of variation assigned,* viz. cross-breeding (Buffon), imitation (Lamarck), and natural advantage in the struggle for existence (Darwin), *are sufficient to account for the effects asserted to be produced.*

III. *That succession implies causation.*

On each of these a few words of explanation are necessary.

I. *The indefinite variation of species continuously in the one direction.*

This has been expressed by some Lamarckians as a state of unstable equilibrium of nature; but should we assume the existence of a law which is contrary to all we know of every other department of nature? If we must have a mechanical analogy to fix our ideas, nature might be better compared to a condition of *dynamic equilibrium,* in which all the parts are in motion, and never return to precisely the same relative positions, but, nevertheless, continually balance round certain definite positions of equilibrium, which never change. What should we think of the astronomer who, from a few years' observation of the precession of the equinoxes, should predict that in due time the north pole of the earth's axis would point to the same position among the stars that the south pole now occupies? yet this very species of assumption is made by Lamarck and Darwin, in their appeal to the supposed influence of a long lapse of time. Yet, in the writings of the latter progressionist there is this singular inconsistency, that while he shows the utmost effects of human breeding on domestic animals to be capable of production in ten or twenty years, he denies the right of his adversaries to appeal to the unaltered condition of the ass, the ostrich, or the cat for 3000 years as a proof that specific forms balance round central types, and have no tendency to depart indefinitely from them.

Is it rational to suppose that man can alter the head and neck of a pigeon into any desired form in six years, and that nature, with her greater skill, cannot in 3000 years lengthen the ostrich's wings by a single inch, although, according to the theory, it is her evident wish to do so?

II. *The causes of variation assigned are not adequate to produce the effects assigned to them.*—The discussion of the inadequacy of the causes assigned would lead to a treatise longer than that of Buffon, Lamarck, or Darwin; and I must therefore content myself with an example. The humble bee and the hive-bee coexist together, and the latter is supposed to be developed from the former by the law of natural selection, breeding, in succession, bees possessed of the talent of economizing more and more of wax in the construction of their cells.

1. The humble bee constructs single cells and uses 100 units of wax.

2. A bee (not known to science, but, doubtless, extinct) was grown, that made cells in the form of *equilateral triangles* placed in double combs, with flat bottoms to the cells. This bee used only 50 units of wax.

3. A bee (also extinct) was grown, that built *square* cells in double combs. This bee used only $41\frac{2}{3}$ units of wax.

4. A bee (also extinct) was grown, forming *hexagonal* cells with flat bottoms, in double combs. This bee used $33\frac{1}{3}$ units of wax.

5. The hive-bee (now living side by side with his humble progenitor) was produced by natural selection dependent on the economy of wax, arising from the contrivance of substituting for the flat bottoms of the hexagonal cells the trihedral angles and planes of the rhombic dodecahedron.

This bee (*our* bee) uses $32\frac{2}{3}$ units of wax.

6. The *Bee of the Future* (not yet produced), which shall have learned how to construct the cell described by the mathematician L'Hullier.

This bee will be broader and shorter than the present, the breadth and length admitting of prediction to any degree of approximation.

This Bee of the Future will only require $24\frac{1}{2}$ units of wax!! *Vivat Geometria!*

Of these six species of bee (the first and the fifth are living), No. 5 using only $32\frac{2}{3}$ lbs. of wax in the construction of its cells for every 100 lbs. used by No. 1. According to the Malthusian law, No. 5 has exterminated No. 4, by virtue of the trifling advantage of $\frac{2}{3}$rds of a pound of wax in every 100 lbs.; and this slight advantage is gravely alleged as the efficient cause of converting one species of bee into another! This would be all very well, if No. 1, the spendthrift humble bee, were not still living, and holding his ground well against his enemies, to bear witness against this silly theory.

In fact, the whole question of the economy of wax, and other such questions, require a thorough sifting. To my mind, it is evident that economy of wax has nothing whatever to do with the making of the bee's cells, but that this and other properties, such as maximum resistance to fluid pressure, &c., necessarily reside in the bee's cell because they are the inherent properties of the rhombic dodecahedron, which is the form affected by that cell. The true cause of that shape is the crowding together of the bees at work, jostling and elbowing each other, as was first shown by Buffon. From this crowding together, they cannot help making cells with the dihedral angles of 120° of the rhombic dodecahedron; and the economy of wax has nothing to do with the origin of the cell, but is a geometrical property of the figure named.

III. The most serious logical blunder committed by all who invent a theory of life from the geological succession is, that *Succession implies causation.* It is agreed that the Palæozoic Cephalopoda produced, in some way or other, the Red Sandstone fishes; that these in turn gave birth to the Liassic reptiles; that the non-placental mammals of the Upper Oolite *grew* after some fashion, and ultimately produced the Tertiary mammals, some of which, in an unhappy hour, gave birth to man. The only fact at the basis of this astonishing inverted cone of reasoning is, that these creatures *did* succeed each other in the manner described; and from this, forsooth, it follows (*post hoc, ergo propter hoc*) that they succeeded each other in the way of cause and effect. I propose to test this strange theory by a corresponding theory of the mineralogical succession of igneous rocks, which opens up a fertile field of speculation, hitherto unwrought. The igneous rocks of the Palæozoic period contain abundance of felspar, whose principal constituent is potash; the Mesozoic igneous rocks abound in soda, replacing potash; and in the Tertiary period, soda itself gives way to lime and magnesia. Viewed in the light of the Lamarckian philosophy, here is a distinct indication that soda and lime are only allotropic conditions of potash. We may read the history of their formation in the crust of the globe, if we will only open our eyes and see it written. I may add, by the way, that this theory of the origin of lime is more intelligible than that of many geologists, who would attribute the greater accumulations of calcareous rocks in secondary and tertiary strata to the creation of lime by organic force.

If any chemist or mineralogist were to put forward such a geological theory of the origin of soda and lime as the foregoing, he would be regarded as a lunatic by other chemists and mineralogists.

How does it happen that a theory of the origin of species, which rests on the same basis, is accepted by multitudes [?] of naturalists as if it were a new gospel? I believe it is because our naturalists, as a class, are untrained in the use of the logical faculties which they may be charitably supposed to possess in common with other men. No progress in natural science is possible as long as men will take their rude guesses at truth for facts, and substitute the fancies of their imagination for the sober rules of reasoning.

It has been well observed by the greatest of living palæontologists, "that past experience of the chance aims of human fancy, unchecked and unguided by observed facts, shows how widely they have ever glanced away from the golden centre of truth!"

XLVI.—*On the former Connexion of North Africa with South Europe.* By Prof. Edward Suess*.

A letter lately received from M. Anca, of Palermo, addressed to M. Senoner, induces me to return to a subject which I have previously discussed, but the repeated consideration of which appears to me adapted to show the value which is possessed by the researches of M. Anca and some similar observations, even in connexion with the investigations now being carried out at Vienna.

On the former occasion, I mentioned, as having resulted from the investigations of our distinguished Professor Hörnes regarding the fossil Mollusca of the Vienna Basin, an unexpected identity of some species of our marine strata with shells now living on the coast of Senegambia.

I then named as examples *Cypræa sanguinolenta, Buccinum lyratum*, and *Oliva flammulata*, and inferred, in accordance with the descriptions we possess of the great Sahara, that a sea once extended from the Gulf of Gabes to the region south of the Idjil range in the province of Aderer uniting the Senegambian shores with those of the Mediterranean. I appealed to the detailed statements of Laurent, who was commissioned to execute Artesian borings on the north border of the desert. In his report, he represented the desert as once covered by a wide arm of the sea which flowed in from the Gulf of Gabes, and of which unmistakeable traces are to be seen in the repeated terraces along the south border of the Aoures Mountains, where the former positions of the sea-coasts are indicated also by one of the most abundant inhabitants of the Mediterranean coast, *Cardium edule*, the shells of which lie here strewn about in great quantities, and which is even said to be still living in some pools of the desert. I also added that, at present, considerable tracts of the

* From the Transactions of the Royal Imperial Geological Institution of Vienna, January 1863. Communicated by Mr. S. P. Woodward.

desert still lie far below the level of the sea, and that the wide-spread saline incrustations have from the remotest times been regarded as proofs of a former overflow of the sea.

With the progress of Hörnes's investigations, indications of the accuracy of this conclusion have increased. Not only have we become acquainted with several species of bivalves whose present distribution extends as far as the Senegal, such as *Lutraria oblonga, Tellina crassa, T. lacunosa, Venus ovata,* and three of our four species of *Artemis,* namely, *A. exoleta, A. lincta,* and *A. Adansoni,* but we now meet in our basin with some of the most prominent of Adanson's types, which at present are only to be found living on the coast of Senegambia, namely, Adanson's "Tugon" (*Tugonia anatina*) and "Vagal" (*Tellina strigosa*): the great *Mactra Bucklandi,* also, no longer living on European shores, is met with still at the Senegal. All accounts of the desert, however, agree so closely with the supposition of an overflowing, that, independently of these palæontological indications, other observers as well as Laurent were led to it solely by the form and constitution of the soil. Barth appears to have kept to the old Roman road between Tripoli and Mourzuk, almost always beyond the easterly margin of this ancient sea; and it would not be uninteresting to ascertain how far the outlines of this sea agree with Duveyrier's account of the boundaries of the land.

The present land-fauna of Morocco and Algeria, as far as Cyrenaica, agrees at the present time in its most essential points entirely with that of South Europe—on the one hand with that of the Pyrenean peninsula, and on the other with that of South Italy; whilst on the Senegal and Gambia, and the other successive regions beyond the desert, as far as the Nile, only the true African type appears. The elephant, rhinoceros, hippopotamus, giraffe, crocodile, and many other important members of the African fauna do not extend beyond the Sahara; and the contrast of this Morocco-Algerian land-fauna is very remarkable, as opposed to the true African fauna in most classes of animals, whilst the connecting links with Europe are not to be mistaken.

Moritz Wagner's 'Journey in the Kingdom of Algeria' contains numerous proofs of this, and they increase with every comparison. The extension of the *Inuus ecaudatus* to Gibraltar is well known. The *Sorex etruscus,* an otherwise exclusively Italian animal, is met with in Algiers. The fox, paler in Italy than in Germany, appears in Algeria as a still lighter variety. Of greater value for these investigations is the distribution of reptiles, as they are very little influenced by man; and it may be mentioned that the new 'Algerian Herpetology' of

Strauch contains most of the known reptiles of Southern Europe, as *Cistudo europæa, Lacerta viridis, Tropidonotus natrix, Rana esculenta,* &c., and that others, as the *Chamæleo africanus,* are known to occur in Spain and Sicily. Erichson, from the examination of Wagner's collection, observes of the Coleoptera—"A certain number of species belong to the fauna of Middle Europe; a greater portion is spread over all the coast-lands of the Mediterranean Sea; a few of these *are,* but the greater portion *are not,* Egyptian, the Egyptian fauna partaking more of the character of that of Central Africa. Algeria has most species in common with the adjacent Italian islands, Sicily and Sardinia, but fewer with the Italian mainland, as is the case with the Spanish peninsula and the proximate Morocco land; and it is often found that Spanish-Moroccan and Italian-Algerian species stand to each other in analogous relations."

It is the same with the land-Mollusca. According to Forbes, the agreement between the species of Morocco and Spain is so great that, even upon the heights, the Spanish mountain-snails reappear. *Glandina algira* occurs, in a slenderer form, from Isonzothale to Constantinople, whilst the broader variety unites Lower Italy, Sicily, and Algeria; other South-European species, which appear to have come from the East, are, on the contrary, absent in Algeria, as *Cyclostoma elegans,* whilst *Cyclostoma sulcatum* is found upon the Italian islands and Malta, in the South of France, and South-east Spain, and also in North Africa. All the South-European freshwater bivalves are said to occur in Algeria. In the vegetable kingdom, to avoid giving superfluous examples, it may suffice to mention *Chamærops humilis* and its distribution on the coast of the Mediterranean. After this it will not be wondered at if, taking another line of argument, Andrew Wagner wrote, in the year 1846, "In a natural-history point of view, the Mediterranean separates North Africa much less from Europe than the Sahara separates it from the African continent. According to all evidence, the Sahara was once covered by the sea, and Barbary thus became an island in the Mediterranean."

The present land-fauna also leads us to recognize a close connexion between the Canary Islands, Morocco, Algiers, and South-western Europe, the extension of which to Cornwall was rendered probable by the late Edward Forbes. This fauna is called the Lusitanian land-fauna.

Let us now proceed to the investigations of M. Anca. In June 1860, M. Anca succeeded in finding in the bone-caves of Sicily a number of determinable remains accompanied by land- or sea-shells, such as *Helix aspersa* and *Cardium edule,* which are living at this day: the richest list, that of the Grotto of S. Teodoro, is as follows, according to Lartet:—the spotted hyæna, a bear (*Ursus arctos*?), wolf, fox, porcupine, rabbit, *Elephas antiquus*?, *E. africanus*?, hippopotamus (one or two species), *Sus* (probably *Sus scrofa*) resembling the North-African, ass?, ox (two forms), stag (one or two species), sheep or some similar animal, a large toad, and a bird. The recent letter of M. Anca confirms the occurrence, in this grotto, of *Elephas africanus*, while *E. antiquus* belongs to deposits of another date. We have therefore here, along with typical European forms, as, for example, stags and bears, which are quite foreign to Southern and Eastern Africa, and of which even Morocco and Algiers possess very few representatives (bears, perhaps only fossil, in caves), a small number of such animals as no longer pass beyond the region of the desert, but are Nilotic and Abyssinian, the African elephant, species of hippopotamus, and a hyæna, not the striped species which at present lives in North Africa and frontier India, but the spotted hyæna which inhabits South and West Africa. These Sicilian bone-caves prove, therefore, the existence of a close contact between South-European and genuine African types, which is nowhere seen in our day. This fact gains in importance if we bear in mind that similar points of contact could also be pointed out in Spain, at the time when the prevailing types of both the faunas were living. It must not be overlooked that, at an earlier period Cuvier sought the nearest representatives of our diluvial fauna in Southern Africa, even at the Cape; and that our rich antilopean fauna of Pikermi and Baltavar has a decided African character.

At the present time it is scarcely possible even to conjecture in what way and by what causes the disappearance from Europe of the present African group of forms, which long had their home in our part of the world, was brought about. M. Anca tells us that, even during the existence of the present fauna, a connexion has continued. As a first indication of a communication, we regard the submarine ridge stretching from Sicily to the opposite coast of Africa, and respecting which Admiral Smyth has informed us that it comprises the extensive plateaux of the "Adventure Bank" and the Skirki Rocks, which must be the sunken *Aræ* of Virgil. If, however, as stated, we are still ignorant of the causes of these changes, we are nevertheless already able not only to distinguish in the present population of Europe a certain number of independent *form-groups* of faunas, out of which the present population of Europe has sprung; but we can even give the succession in which they have appeared. The first still capable of being recognized is that which we call the *African*: it has long since disappeared; its last traces in Europe are made known to us by M. Anca. The second is the northern, the remnants of which still continue to exist on our high mountains, like an elevated stratum overlying all the others which live beneath. These lowest are, on the one hand, the western fauna, which we designate the *Lusitanian,* the types of which are the forms common to the North of Africa and Europe; on the other, the eastern fauna, which we may perhaps venture to call the *Asiatic,* and which is broken up into several members, depending on the physical differences existing, for example, between the Caspian Steppes and Asia Minor.

It is not my intention here to point out what relations the superposition of the individual faunas of the European seas bear to this; but we may draw attention to the fact that the Mollusca which Vienna has in common with Senegambia (as *Tugonia anatina*) were without doubt formerly inhabitants of some parts of the present Mediterranean east of Sicily, probably became extinct during the diluvial epoch, and were subsequently unable to regain their former abode. M'Andrew, it is true, informs us that, favoured by the current, some tropical species, as, for instance, *Cymba olla,* make their way through the Straits of Gibraltar to the North-African coast; but they do not proceed very far, and the character of the Mediterranean fauna is totally distinct from the Senegambian. We are accustomed to consider climatic variations as the essential cause of all these displacements of land- and sea-faunas and floras; and some distinguished naturalists in Switzerland, impressed with the great effects which the sirocco produces on their glaciers, have thought that they could explain the greater extension of the ice-masses in former times by its absence. In this way they have arrived at the same result as that obtained by the study of palæontology, geology, and geographical distribution—namely, that the Sahara Desert, the source of the sirocco, was once covered with water. Upon the heights of a continental Europe a more severe climate may certainly have been produced by such a cause; but for Europe, broken up into a sort of archipelago (such as we must imagine it to have been at the time when the Senegambian Mollusca of to-day were living near Vienna), no great lowering of the temperature of the sea could have resulted, and the whole archipelago had, without doubt, notwithstanding the absence of the sirocco, a moderate sea-climate.

Questions and doubts still arise on all sides, but we are at least able to form some idea of the path we have to pursue in studying the origin of the present creation from the preceding, and by which it will be possible to arrive at a more correct conception of the repeated changes of the organic world.

XLVII.—*Further Observations on* Amœba villosa *and other indigenous Rhizopods.* By G. C. Wallich, M.D., F.L.S., F.G.S., &c.

[Continued from p. 371.]

[Plate X.]

Before proceeding to offer a few general remarks on the relations of *Amœba villosa,* and two other forms obtained from the same locality, with the rest of the group to which they belong, it is desirable that I should adduce some supplementary observations made by me during another month's study of these organisms.

In many specimens of the *Amœba,* and more especially such as appear to be in full vigour of growth, the protoplasm is densely charged with certain granules, of larger size than those mere points which pervade it under all circumstances, but nevertheless extremely small. If examined cursorily, these granules may readily be mistaken either for extraneous bodies derived from without, or for mere consolidated particles of the sarcode itself. They are so minute as to render it difficult to trace any difference in their dimensions, when seen under the medium powers of the microscope. But their aspect when isolated along with a thin film of their sustaining protoplasm, and examined under a power of from four to five hundred diameters, at once led me to suspect their crystalloid character; and this view was fully borne out on submitting them to a still higher degree of magnifying power; for whilst no analogous bodies, or, indeed, any insoluble saline particles, were discoverable in the material in which the *Amœbæ* were contained, these crystalloids proved to be distinct rhombohedrons possessing a higher index of refraction than water. They measure in length from $\frac{1}{15000}$th to $\frac{1}{4500}$th of an inch, with a breadth of from $\frac{1}{20000}$th to $\frac{1}{5000}$th of an inch. Their minuteness renders the precise definition of their angles a matter of considerable difficulty; but nevertheless, by taking the mean of a number of measurements, I found the more obtuse angle to be about 140°. Hitherto I have been unable to determine their nature by chemical tests, further than discovering that when a slide, on which a number of the *Amœbæ* have been dried, is treated with dilute hydrochloric acid, all trace of the crystals is entirely lost. Coupling their rhombohedral figure with this fact, it seems probable that they may consist of carbonate or some other salt of lime. This, however, is a point demanding further careful investigation. I may mention that precisely similar crystalloids have also been detected by me in the sarcode of *Euglypha, Arcella,* and *Acanthometra.* (See Pl. X. fig. 7.)*

* As is well known, "prismatic crystals" were observed by Huxley in *Thalassicolla.*

In addition to these crystalloids, which seem to occur more largely in some individuals than in others, two other kinds of corpuscles are to be found. Both have a spherical outline, and are not discoidal, as may be seen on watching them roll over when at the immediate extremity of a pseudopodium. They vary from $\frac{1}{3300}$th to $\frac{1}{1600}$th of an inch in diameter, are devoid of any appreciable cell-wall, even when examined under the higher powers of the microscope, and are formed of a peripheral layer of pale, nearly colourless, granular protoplasm surrounding a clear fluid centre, the average diameter of which is about $\frac{1}{10000}$th of an inch (fig. 5). To these bodies (which are in all probability identical with the "discoid ovules" described by Carter, in his admirable observations on the Organization of the Infusoria of Bombay*, as occurring in *A. Gleichenii,* and as also seen in *A. verrucosa*†) I have applied the term nucleated *corpuscles,* as not involving a function which must still be regarded as only hypothetical, although I fully agree with Mr. Carter in the view that these bodies perform some important part in the process of reproduction. The second kind of spherical corpuscle to which allusion has been made, although not nucleated as in the former case, appears destined to exercise the function of a true ovule in some of the Rhizopods, if not in all, as shall presently be shown; and therefore, taking into consideration the very marked resemblance of the latter, in all save the trivial item of depth of colour, to the "yellow bodies" met with in the Foraminifera, Polycystina, Thalassicollidæ, Acanthometrina, and two new families I propose to establish for the reception of certain allied but heretofore imperfectly understood pelagic genera, it appears absolutely necessary to distinguish between the two kinds of structure.

To these bodies I have accordingly given the name of *Sarcoblasts.* In *Amœba* they are somewhat larger than the nucleated corpuscles, being from $\frac{1}{2000}$th to $\frac{1}{1650}$th of an inch in diameter. In their earlier stages they present a faint yellow tint, are somewhat oily-looking, but afterwards become almost colourless. They are distinctly granular, nearly homogeneous throughout, and, like the corpuscles, devoid of cell-wall (fig. 6). Both, however, are distributed equably through the endosarc, and take an equal share in the pseudocyclosis which involves all foreign matters and, under certain circumstances, the nucleus, contractile vesicle, and vacuoles.

There seems reason to believe that all organic substances intended for food are invariably subjected to the digestive process through the medium of vacuolar cavities specially extemporized

* Ann. Nat. Hist. ser. 2. vol. xviii. pl. 5. fig. 5. † *Ibid.* vol. xx. p. 37.

for their reception. In the case of insoluble substances—such as particles of mineral matter, many of which effect an entrance into the endosarc of the Amœbans, either along with alimentary matter or accidentally—the vacuolar cavity is not necessarily present, but the atom simply rests within the protoplasm. In *A. villosa* the food-vacuoles are generally observable, although with difficulty when the body is much distended by extraneous substances and endogenous organic granules. In some specimens they are very strikingly developed. For these vacuoles I propose the term *food-vacuoles*, in contradistinction to the simple vacuoles which form and disappear spontaneously within the protoplasmic substance and, when in such great numbers as to impart an almost parenchymatous character to portions of the structure, apparently forebode its disruption or death.

From the manner in which the food-vacuoles are formed at the surface—in *Amœba* by the coalescence of pseudopodia which envelope the object about to be incepted, and in *Actinophrys*, by the projection of a coarse irregular network of ectosarc, aided by the coalescence of the pseudopodia in the immediate vicinity—it would appear that a certain quantity of the surrounding water is always admitted into the newly formed cavity. This water is probably essential to the due performance of the digestive process, and in part enters into the composition of the alimentary fluid. On the other hand, it is probable that, in certain cases, a portion of the water becomes absorbed by endosmosis, without undergoing chemical change, more especially where the food-particles have been completely dissolved through the digestive process. In this condition, the vacuoles may frequently be seen sharing in the pseudocyclosis, till by slow degrees they entirely disappear,—the effete watery particles, as I have already stated, being then poured exosmotically into the contractile vesicle, and ultimately discharged.

In my previous notice I drew attention to the highly developed membranous capsule within which the nucleus of *A. villosa* is contained. According to Carpenter (the latest authority on the subject)*, the nucleus of *Amœba* presents "the aspect of a clear flattened vesicle surrounding a solid and usually spherical nucleolus, and is adherent to the inner portion of the ectosarc, and projects from it into the general cavity." Carter also describes it "as an organ situated on the outer portion of the sarcode, which, when well marked, presents under the microscope the appearance of a full moon (to use a familiar simile), with similar slight cloudiness." He adds, "It is discoid in shape, of a faint yellow colour, and fixed to one side of a trans-

* Introduction to the Study of the Foraminifera, London, 1862, p. 24.

parent capsule, which, being more or less larger than the nucleus itself, causes the latter to appear as if surrounded by a narrow pellucid ring"*.

Now, whilst both these observers speak to a vesicular boundary to the nucleus, it is evident, I think, that they do not allude to that highly specialized membranous covering which is so remarkably manifest in *A. villosa*, and is actually separable from the body. The point is not so immaterial as it would seem to be at the first glance, inasmuch as a definite vesicular covering has also been supposed by Claparède and others to appertain to the contractile vesicle of *Actinophrys*, whereas, as I shall presently endeavour to show, none is in reality present either in the contractile vesicle of that genus or of *Amœba*; and hence the character becomes to this extent a distinctive one. Moreover it is important from its at once stamping as complete the analogy I desire to draw between the nucleus of *Amœba* and of *Plagiocantha, Thalassicolla, Acanthometra*, and *Dictyocha*, whereby the relation of the several parts to each other in these genera although belonging to a distinct order, becomes intelligible.

The position of the nucleus in *Amœba villosa* has already been shown to be variable. I am not aware that, under any circumstances, the nucleus of this form can strictly be said to adhere to the inner portion of the ectosarc, as indicated by Carpenter, or to be situated on the outer portion of the endosarc, as stated by Carter—its temporary location in the vicinity of the villous patch, spoken of in my former paper, being due, as I conceive, to that more highly differentiated condition of the posterior part of the organism which constitutes so striking a feature in *A. villosa*. I have as yet been unable to ascertain positively the manner in which both nucleus and contractile vesicle are periodically sustained near the villous patch; but, from the constricted shape frequently assumed in this region, and the tendency to project the pseudopodia principally from the advanced or anterior portions of the body, there can be little doubt that it is brought about by the augmented contractile power of the posterior extremity. On the same hypothesis we may account for that peculiar state in which a mass of granular matter, resembling

* On the Organization of the Infusoria, Ann. Nat. Hist. ser. 2. vol. xviii. p. 221.

Mr. Carter is of opinion that there is a central cavity in *Amœba*, at times distensible with water. Thus he speaks of an "Amœbous cell under spherical distension." This may account for the view held by him with regard to the position of the nucleus in the Bombay form; but I must distinctly observe that no such cavity is present in *A. villosa*. (Ann. Nat. Hist. vol. xviii. p. 223, and explanation appended to fig. 1. plate 5, accompanying his paper.)

that of the true nucleus, and which is derived in all probability from the sarcoblasts already referred to, becomes first aggregated in that region. It only remains to be further noticed regarding the nucleus, that in that condition of the organism in which a very limited quantity of foreign matter is present, and the crystalloids, nucleated corpuscles, and sarcoblasts are most abundant, this organ frequently undergoes subdivision—two separate nuclei occurring under these circumstances, and sometimes, but much more rarely, three. Endogenous subdivision (that is, endogenous with reference to the capsule) does not take place in such cases, but nucleus and capsule both undergo complete and simultaneous binary division. I am unable to say whether, in those examples that present three nuclei, the whole of these become separated by one duplicative act or by two. It has already been shown that where the multiple nuclear bodies supervene on the accumulation of granular matter at the posterior portion of the *Amœbæ*, I failed to trace any capsular coverings. It seems probable, therefore, that, in the former case, the process may be regarded as one of simple fission, in the latter, of molecular segregation*. But on this head anything like positive information is still wanting.

Great diversity of opinion seems to exist amongst naturalists not only regarding the office, but also the actual structure of the "contractile vesicle." That misapprehension should exist on the subject is by no means surprising, however, when we bear in mind that the name has been indiscriminately applied both to the rhythmically contracting organ of the Rhizopods and of the true Infusoria, and that, under the supposition that identity of action involves identity of conformation, a true vesicular wall has been assigned by several of our most eminent writers to the pulsating cavity of the former group of organisms. Without entering at present upon the question whether the Rhizopods ought to be regarded as unicellular, multicellular, or altogether devoid of cell-structure, I would observe that, if the presence of such structure within the substance of certain members of the Amœban group has not been already demonstrated by the perhaps less definite examples adduced by Carter and others, the indisputable envelopment of the nuclear body of *Amœba villosa* by a distinct membranous capsule at once settles the point. But, on the other hand, my own observations tend to prove that this structure is only to be met with in the two higher orders of the Rhizopods, and not in the lowest order, which, according to

* Carter describes a somewhat similar process as occurring in *Amœba radiosa*, and "ending in the production of a mass of spherical, delicate, transparent, granuliferous cells." (See his paper on the Organization of Infusoria, Ann. Nat. Hist. ser. 2. vol. xviii. p. 225.)

my arrangement, comprises the Gromida, Foraminifera, and Polycystina. In these families, the nuclear granules are diffused, and assume the multiple character of sarcoblasts, which, on separation from the parent sarcode, constitute the rudiment or "primordial segment" of the new brood.

In my experience, the contractile vesicle does not make its appearance either in the Herpnemata (which constitute the first or lowest order) or the Protodermata or second order (which comprises the Thalassicollidæ, Acanthometrina, and their allies), but occurs, for the first time, in the third order or Proteina, in which I associate the *Actinophryna*, *Lagynidæ*, and *Amœbina*—the name of this order being adopted from the classification of MM. Claparède and Lachmann, who, in like manner, associate *Actinophrys* and *Amœba*, but on widely different grounds from those that have led me to assume their ordinal unity.

In the third order both nucleus and contractile vesicle, I believe, are invariably present, although naturally difficult of detection in the testaceous genera. The latter organ, however, in so far as my experience of living representatives of nearly every important form enables me to arrive at a correct opinion on the subject, ought not to be regarded as a definite-walled contractile sac, distinct in composition from the remainder of the protoplasmic matter, but simply as a specialized vacuolar cavity *formed out of a portion of the ectosarc.*

Mr. Carter, in his paper on the Organization of the Infusoria, already referred to (*l. c.* p. 130), says, "That the vesicula is a distinct organ, and not merely a space like the digestive globule, might be inferred from its always appearing in the same place in the same species"*. For reasons already adduced, I am inclined to regard it in an opposite light—that is to say, as merely a space bounded by a layer of ectosarc, and not by a membranous wall of distinct origin and character. And I think my view will be at once recognized as correct when it is taken into consideration that we constantly see multiple contractile vesicles, not only already formed, but actually forming under our eyes and again

* On reference to what has been stated in a preceding page, it will be seen that Dr. Carpenter speaks of the nuclear capsule as "a clear flattened vesicle;" whilst he considers the contractile vesicle to be "a vacuole with a defined wall" (Introduction to the Study of the Foraminifera, p. 14). Mr. Carter, again, describes the nucleus as discoid in shape, and fixed to one side of a transparent capsule, whereas he refers to the contractile organ as "distinct and not merely a space like a digestive globule." In directing attention to these definitions, I am desirous of showing that both these authorities express their opinions on the subject with a degree of reserve which was fully warranted under the circumstances, but which leaves the proofs as to the existence of a true membranous vesicle in one case dependent on equal proofs of its existence being forthcoming in the other.

coalescing to constitute a single cavity, or, as happens occasionally, each undergoing a separate systole. This I maintain could not possibly take place except under the conditions I have endeavoured to describe.

The vacuoles within which organic substances, or animalcules, incepted for food become amenable to the digestive process are similarly constituted; and if what has been advanced by me in my previous paper be correct (that is to say, if endosarc and ectosarc are not permanent portions of the Rhizopodal structure, but mutually and temporarily convertible one into the other), it is manifest that the higher state of differentiation exhibited by the vacuolar wall is wholly due to a like cause, namely, contact with a portion of the surrounding fluid.

I am well aware that the permanently visible villous area of the Hampstead *Amœba* appears to militate in some measure against the universal correctness of this hypothesis. But I have already stated that this species can hardly fail to be regarded as embodying the highest type of Rhizopod life, and as bridging over the hiatus between true Rhizopod and true Infusorial organization. If a boundary exists at all between these two great groups of the Protozoa, it will, I think, be found to consist in this—that whereas in the Rhizopods there is no permanent orifice for the inception and extrusion of foreign or effete matter, and the endosarc and ectosarc are not permanent portions of the organism, but, as already maintained, mutually convertible one into the other, in all mature Infusorial forms permanent orifices occur for the inception and extrusion of such matter, and there is no convertibility of parts once established*. Hence, even granting, for the sake of argument, that the villous patch in *Amœba villosa* is not only permanent in position as regards the rest of the body, but, in a like sense, permanent in composition during the entire period of the individual's existence, I contend that we should not be warranted, on this ground alone, in pressing such an objection. But I am by no means prepared to allow that such a permanent condition of the villous region does exist, inasmuch as it appears to me to be far more probable and conformable with the phenomena referred to, to assume that a slow but constant interchange of protoplasmic matter takes place there, as it does, although more rapidly and perceptibly, in the other portions of the structure.

During the bygone month I have seen numerous examples of the infundibuliform excretory tubule of *A. villosa*. But I have likewise been able to satisfy myself that this tubule is an extem-

* *Asplanchna* furnishes no valid objection to this generalization, even if we hesitate to accept the most recent views promulgated regarding its structure; for one orifice may serve both purposes.

porized part of the organism, and that, in many cases, the layer of protoplasm which constitutes it during the extrusion of effete matter, and occasionally also of minute but perfectly formed *Amœbæ*, is actually disengaged along with the object whose egress from the main body it presides over and probably effects; so that even here we encounter phenomena which, although as yet inexplicable, tend directly to prove the accuracy of the views referred to. In short, the vacuolar sac becomes the tubule, being in some cases reabsorbed into the substance of the body, in others actually expelled entire, as shown in Pl. IX. figs. 3 & 4.

Again, it appears to me that, assuming the hypothesis to be admissible, we not only render intelligible the mysterious and otherwise inexplicable properties of sarcode, but find a clue to the determination of the function performed by the contractile vesicle.

I am able fully to confirm the statement of Carter that this body invariably discharges itself externally in the Rhizopods, although aware that this view is opposed by M. Lachmann and others. The orifice through which the discharge of its watery contents is effected is not of a permanent nature, but, like the tubule occasionally seen in the region of the villi, comes into existence only under the operation of the force that distends the wall and eventually bursts it. We frequently see that the systole of the vesicle is interrupted before the entire obliteration takes place, which most commonly occurs. But it is a mistake to suppose that the circular outline then left, and which forms the basis, as it were, of the vesicle when renewed, represents the orifice by which the contained fluid escaped. That orifice we can very rarely detect, even under the highest powers of the microscope*. I can personally speak to its subtle but nevertheless appreciable character, having watched its action for a considerable period on two occasions, in Bengal—namely, in an *Amœba* closely allied to, if not identical with, *A. villosa*, and in a *Kerona*, its distinctness in the Infusorial animalcule being only rendered greater by the greater ease with which the latter was maintained in the position best fitted to carry on the observation.

Mr. Carter, in describing the contractile vesicle (*loc. cit.*), says it is neither a circulatory nor a respiratory, but an excretory organ, and, referring more particularly to *Amœba* and *Actinophrys Sol*, he adds,—"During the act of dilatation, the vesicula projects far above the level of the pellicula, even so much so as

* I would distinctly guard myself against appearing to convey the idea of a *valvular* opening such as is supposed to exist by Weston in *Actinophrys Sol* (Quart. Journ. Micr. Soc. vol. iv. p. 116).

occasionally to form an elongated, transparent, mammilliform eminence, which, at the moment of contraction, subsides precisely like a blister of some soft tenacious substance that has been pricked with a pin"*. Mr. Carter does not mention any special excretion—that is to say, whether he means the excretion of effete nutritious matter or water only. If the latter, I entirely agree with him—my view being that, whilst the general substance of the body absorbs water from the surrounding medium by endosmotic action, and partly also by admission *en masse* into the extemporized food-vacuoles; through the agency of the opposite or exosmotic action the fluid is poured into the contractile vesicle, gradually distending it, as described, until rupture ensues. The moment that the tension on the most prominent and, consequently, the most attenuated portion of the vesicle is relieved by the escape of its contents, the orifice becomes obliterated by the union of its edges, and the process is repeated. In this sense, then, the contractile vesicle may be regarded as a true water-vascular and excretory organ. I need only add that, according to my own experience, and in accordance with the opinion expressed by several eminent observers, the contractile vesicle takes no share, under any circumstances, in the capture, inception, or extrusion of any solid substances.

In a former page, allusion has been made to a mode of reproduction which, although closely bordering on simple gemmation, must, I think, rather be regarded in the light of viviparous parturition. I had never noticed it prior to my recent and almost continuous observation of the Hampstead *Amœba*, nor am I aware that it has previously attracted the attention of other naturalists, although M. Jules Haime records examples amongst the Infusoria in which minute bodies ejected from the body of the parent have become converted into young animals whilst still under observation†. In *Amœba*, however, such an oversight may easily be accounted for by the circumstance that the newly liberated individuals are so minute, in comparison with the parent form, as to be barely distinguishable unless examined under high powers and with a knowledge of their origin. They rarely measure more than $\frac{1}{2500}$th to $\frac{1}{1600}$th of an inch in their most extended state, and yet, when carefully analysed, exhibit nucleus, contractile vesicle, villous tuft, and even protoplasmic granules, with every distinctive character discernible in the parent from which they sprang. It is also a very significant and remarkable fact, that, even in this minute stage of their existence,

* Ann. Nat. Hist. ser. 2. vol. xviii. p. 126.

† Carter on the Organization of Infusoria (Ann. Nat. Hist. ser. 2. vol. xviii. p. 223.

they throw out pseudopodial processes so various in outline that, were it legitimate to base specific distinctions on such variations, we might have nearly every form heretofore regarded as specifically distinct by some observers produced from one parent source. Indeed, coupling this fact with others bearing on the same subject, although not prepared to affirm that the whole of the varieties of *Amœba* are reducible to a single primary specific type, I candidly confess that the balance of evidence appears to me to point towards such a conclusion, and to indicate that the divergences in form and outward characters may be wholly dependent on the local and even temporary conditions of the medium in which the young animal happens to make its appearance in the world.

It is one of the most perplexing accompaniments of microscopic research, that, in addition to the ordinary difficulties attending the study of the reproductive phenomena in organisms which admit of observation by the unaided vision or with the aid of low magnifying powers, the chances are greatly against our having the object under our eye at the exact moment that the phenomena are taking place which we desire to witness. From the extreme rapidity with which they are sometimes completed, compared with analogous processes in the higher orders of being, this result is scarcely surprising, even if we treat lightly the difficulty inseparable from the survey of vital actions on so minute a scale. On the other hand, there is reason to fear that erroneous interpretations have often been put upon microscopic phenomena in consequence of a failure on the part of the observer to watch them from their commencement to their termination*. The following instances, which are not the only ones that have presented themselves to my notice during my recent close scrutiny of the indigenous Rhizopods, will prove the truth of this remark.

Fig. 11 represents an abortive effort at division taking place in a specimen of *Amœba radiosa*. It will be seen that nothing could be less conformable with the published descriptions and figures of that form than the individual here portrayed. But nevertheless I can vouch for its being the form which has been so named, not only from the fact of the locality in which it was found containing numerous specimens unmixed with

* The drying up of the minute portion of water in which living organisms are being submitted to long-continued observation under the microscope may be very successfully obviated by resting the slide, when not actually required, across the mouth of a wine-glass containing water, and carefully placing a strip of fine calico across the thin cover, with its ends hanging down into the fluid in such wise as to allow capillary attraction to do all that is requisite.

other varieties, but from the specimen itself having ultimately assumed all the characteristics of *A. radiosa* immediately after the termination of the appearances depicted in the figure.

Judging from the appearances at first presented, I naturally expected the occurrence of binary division—two lobes instead of three being then only visible; and accordingly I directed special attention to the share taken in the process by the nucleus and contractile vesicle. But these bodies gave no sign of participation beyond passing several times, during the ordinary contractile movements of the lobate masses, through the connecting isthmuses, either into the same or into separate lobes. No pressure was exerted, nor was the form assumed due to the juxtaposition of foreign matters. Nevertheless fission did not take place; and after an hour's apparently incessant struggle to part company, during which period the lobes and isthmuses did not materially alter their relative proportions, the three portions gradually coalesced, and the specimen moved away energetically, putting forth the tapering and radiate pseudopodia supposed to be distinctive of *Amœba radiosa*.

It is no doubt true that the unity of the nucleus may have interfered with the consummation of the process. But here, again, generalization fails to some extent; for on two occasions I have seen *Amœba villosa* divide without the nucleus being involved. In both cases the villous patch was nearly equally parted; only that half of the body, however, which retained the nucleus moved about vigorously and exhibited the typical characters, whilst the other half assumed a spherical shape, and merely oscillated very slowly and steadily to and fro on the same spot, without projecting pseudopodia, or materially altering its outline.

In these examples, also, all undue pressure was avoided; and the extrusion of nearly the whole of the effete alimentary particles by each half—which I have frequently found to be the precursor of the process of fission—took place almost at its commencement.

The third example I have to mention occurred in a large specimen of *Actinophrys Eichhornii* which I disengaged from the side of the vessel to which it was adhering, and carefully placed for observation in a watch-glass. When removed, it was apparently undergoing the common process of binary division. At all events, whether that process was going on or the case was one of "zygosis" or amalgamation of two individuals, it is quite certain that there was a partial, but nevertheless effective, fusion of the sarcode substance at the constricted portion. In this species, as shall presently be shown, the nuclear bodies are small and, generally speaking, multiple. Hence no information was derivable from their distribution. The contractile vesicles were multiple also, two being distinctly visible, and in regular rhythmical action along the peripheral plane of each half; whilst others may have been present, but obscured on the upper or under surfaces of the structure. When first seen, the well-marked peripheral layer of protoplasmic cellules belonging to each half was uninterrupted at the constricted portion; and around the latter was a somewhat irregular zone of bubble-like protoplasm, which merged into that of the masses on either side of it. But soon the constriction became more and more complete; and after a time the two halves were held together only by a narrow isthmus of sarcode. At this stage, however, a retrogressive action commenced, and ultimately the two portions became fused into a single *Actinophrys*. No movement was observable except on the systole of the contractile vesicles, when the half on which the vesicle was situated oscillated slightly, but very perceptibly. I have only to add that no other specimen was placed on the watch-glass during these appearances, which lasted over a period of four hours. The single specimen then measured $\frac{1}{70}$th of an inch in diameter independently of the pseudopodia.

These examples are instructive for two reasons: firstly, because they tend directly to confirm the statement originally put forward by Schneider with reference to the occasional zygosis or coalescence of two previously distinct individuals; and secondly, because they indicate how much caution ought to be exercised before an opinion is pronounced upon the nature of phenomena the order of which has not been followed from their commencement to their termination*.

It now remains for me to direct attention to forms of *Actino-*

* In my notes on the presence of animal life at great depths in the ocean (published in November 1860), and also in a paper in the 'Annals and Magazine of Natural History' for July 1861, I directed attention, for the first time, to the occurrence of the Coccoliths (minute discoidal structures previously detected by Huxley in the material of the soundings, but regarded by him as inorganic) in spherical cells, to which I accordingly applied the name of Coccospheres; and I further pointed out that as entire Foraminiferous shells, and more especially those of *Textularia* and *Rotalia*, are frequently met with in the soundings wholly made up of segments resembling these Coccospheres in every particular, these bodies would appear to be connected with the reproductive process. Although I have not had the opportunity of tracing the actual sequence, I think it highly probable that the Sarcoblasts, to which I have alluded in a former page, first become Coccospheres, and are then developed into the perfect shell by the ordinary process of gemmation. Here, then, is a case in which the difficulties attending the study of the reproductive phenomena in the Rhizopods are yet further enhanced. I may take the opportunity of stating that I have recently met with Coccospheres in great abundance in dredgings from the English Channel. The means of clearing up the point are therefore at hand.

phrys and *Difflugia* (also from Hampstead) which, although not specifically new, offer some important and, if I mistake not, hitherto unnoticed characters.

As is well known, in *A. Sol* the body consists of a spherica or nearly spherical mass of sarcode, the external layer of which is said to be permanently distinct from the endosarc, notwithstanding the admission that no definite boundary-line is traceable between these two portions of the structure, and that they insensibly merge one into the other. Carpenter* describes it as follows:—"The pseudopodia seem to be derived from the ectosarc alone, the endosarc not extending itself into them. They possess, moreover, a degree of consistence which usually prevents them from coalescing when they come into contact with one another; and whenever such a coalescence does take place, it is to a much smaller extent than is common among Foraminifera." And again, "Although the existence of a nucleus in *Actinophrys* has been denied, its presence (in certain species at least) must be regarded as a well-established fact." Speaking of the inception of food, he says, "The body taken in as food is received into one of the vacuoles of the endosarc, where it lies, in the first instance, surrounded by liquid." . . . . "Several vacuoles may be occupied at one time by alimentary morsels; frequently from four to eight are seen thus filled, and occasionally ten or twelve, Ehrenberg having in one instance counted as many as sixteen."

From what has been already advanced by me with regard to *Amœba*, it almost follows that I should view with extreme doubt the specific value of the characters assigned by different writers to the various forms of *Actinophrys* that have been described as distinct; and, in addition to the reasons I shall adduce in support of this view, I would call attention to the indirect evidence of its correctness afforded in the errors of identification committed by some of the most acute observers with regard to the forms looked upon as the most persistent and definite. Thus Kölliker mistook *A. Eichhornii* for *A. Sol*. Claparède wrote a long paper on *A. Eichhornii*, and afterwards discovered he had been describing *A. Sol*†. Perty is of opinion that *A. Eichhornii* is an enlarged state of *A. Sol*, whilst Stein also affirms that *A. Eichhornii* is no other than the latter species. I have only to observe on this head, that it would indeed be surprising if the confusion thus created were one whit less than it is, where such characters as the length of the pseudopodia, the diameter of the

* On the Study of the Foraminifera, p. 18.

† See Prichard's 'Infusoria,' 4th ed. p. 560, and M. Claparède's paper in the 'Annals,' 2nd ser. vol. xv. pp. 211 and 285. These examples might, however, be multiplied.

body, the perfectly regular or irregular outline of the latter, and even trifling modifications in its colour, have been accepted as specifically valid*.

Why, then, it may be asked, have I referred the Hampstead form to *A. Eichhornii*? I reply, solely because the characters presented by this variety are those which appear to me to illustrate in the same individual the true offices and relations of the several parts of the Actinophryan structure to each other and to allied genera, and ought therefore to be regarded as typical of that genus.

The Hampstead form, like the *Amœba* already described, is unusually large, at times attaining a diameter of $\frac{1}{50}$th of an inch, irrespectively of the pseudopodia. Whilst I write, I have a number of living specimens before me, obtained two months ago, in which the entire structure is so pellucid and definite that it can be resolved with a common pocket-lens. The shape is spherical, not discoidal, under ordinary conditions, even when the creature is adherent to the sides of the glass vessel in which it is contained,—this being reconcileable with a fact I can attest, namely, that the surface of the body does not come in contact with the glass, but is entirely supported by the tenacity of the intervening pseudopodia. The sarcode substance is colourless, as is the sarcode of all *Amœbans* and *Actinophryans*, except under abnormal circumstances. The pseudopodia are sometimes long, sometimes short; at times perfectly rigid and smooth, at times slightly tuberculated and sinuous. When rigidly extended, they never coalesce; when bent and supple, and more especially when about to encircle some food-particle in their inevitable embrace, they coalesce as freely as those of the Foraminifera. Now and then, but rarely, the vacuolation, so universal and marked in the form as it most constantly occurs at Hampstead (fig. 1), is partially superseded by the coalescence of a number of the cell-like cavities, and the ectosarc or endosarc exhibits the aspect of ordinary unvacuolated protoplasm, and we may more legitimately apply the terms "medullary" and "cortical" to the inner and outer portions of the organism. But physiologically there exists no such permanent distinction of parts. There is invariably a line of demarcation between the "cortical" and "medullary" portions; but the most careful analysis of the structure, even when assisted by the highest powers of the microscope, does not enable us to detect the

* If the characters of *A. oculata* are correctly drawn, and if, as asserted, food does not pass into the "medullary" substance, but remains during the assimilative process within the "cortical" layer, that form must not only be regarded as specifically distinct, but as presenting a feature which is quite anomalous in the group to which it belongs.

slightest appreciable difference between the intimate texture and composition of the two parts, the figure of their polygonal cavities, the proportional thickness of the walls of the latter, their optical characters, or the capability of the two portions to coalesce *,—the fact being that each polygon is essentially composed of both endosarc and ectosarc, the latter being the necessary result of the contact of its internal surface with its fluid contents, which do not consist principally of protoplasm, but of water; whereas the former may be said to occupy the interval between the wall of adjacent cavities, and is actually distinguishable by its finely granular and viscid appearance wherever fusion or coalescence has taken place to a certain extent. The pseudopodia and slightly thickened peripheral layer are also finely granular. The former are given off from the external surface, it is true; but, on the other hand, the walls of the polygonal cavities present no appreciable differences in character from the pseudopodia, beyond being flattened instead of filamentous expansions of the same tissue. And, lastly, I would lay special stress on a phenomenon which this form of *Actinophrys* constantly enables us to witness, namely, the absorption of the vacuolar food-cavities, *formed at the immediate surface of the organism only at the period when required, and which are not previously existing and persistent portions of the creature,* as has been supposed. As in *Amœba,* the process of inception of food consists simply in the formation of an extemporized cavity, partly derived from the coalescence of the pseudopodia that have captured the object, partly from the portion of ectosarc that happens to be brought into contact with the object, and the subsequent elimination of the nutrient matter by the vacuole thus formed and now drawn into the centre of the body by the inherent contractility of the surrounding protoplasm. If this view of the phenomena be correct, we must either assume that a constant diminution in bulk of the ectosarc must take place at each formation of a food-vacuole, or admit what I contend for, namely, that for every portion of the outer layer, constituting the ectosarc for the time being, which is so removed from its position, a portion of the subjacent endosarc forthwith steps forward and fills up the vacant rank. As is well known, the organism captured for food is sometimes almost as large as the *Actinophrys* itself (see fig. 4). Unless my hypothesis be admitted,

* There appears no good ground for supposing that the vacuolation witnessed in *A. Eichornii* is anything more than an extreme example of what takes place frequently in *Amœba* to a great, but not so great an extent. In *Thalassicolla nucleata* we have a near approach to the same structure; and, as in the form under notice, the larger vacuoles are external, the smaller ones internal, with reference to each other.

if the vacuole for the reception of such particle is formed at the surface (and it unquestionably is so), there is nothing for it but to accord to *Actinophrys* the power of turning itself inside out after the fashion of *Hydra*. But even assuming this incredible explanation to be correct, we must remember that in *Hydra*, after the operation, the external surface becomes differentiated into the normal condition previously existing. In short, here, as in *Amœba*, the portion of protoplasm in immediate contact with the surrounding medium becomes *ipso facto*, and *for the time being only, ectosarc*; and on no other supposition is it possible rationally to account for the phenomena.

I have stated that in *Actinophrys Eichhornii* there is invariably present a line of demarcation between the external and internal—or "cortical" and "medullary"—portions of the structure. This is not produced by any difference in the intimate composition of these two portions, but is entirely dependent on the occurrence of a larger and more symmetrically arranged series of polygonal vacuolated cavities around a smaller and irregular central series. Owing to the uniform size of the former series, and the union of such of their polygonal planes as are nearest the centre of the body, the appearance of a distinct concentric ring is produced. Sometimes, however, more than one ring is observable. This is due to the formation of a second series of symmetrical cavities in the protoplasm.

My reasons have already been given for discarding the view that the outer and inner portions of *A. Eichhornii* represent the ectosarc and endosarc as separable from each other. On what then, it may be asked, does the peculiarity referred to depend? I would answer, on that manifest idiosyncrasy which in one case leads to the formation of a symmetrically sculptured test composed altogether of an exudation from the animal, and in another of a test in which the animal exudation shows no sculpturing, and is merely the basal matter into which mineral or other foreign particles are impacted. And, lastly, I need hardly remind the reader that, in the vegetable kingdom, we constantly meet with manifestations of a like idiosyncrasy, in similar lines of demarcation between the cells constituting the external and internal layers of a leaf or a stem.

Taking all these circumstances into consideration, I think there is sufficient ground for believing rather that *A. Sol, A. oculata, A. viridis*, and *A. Eichhornii* are varietal forms of the same species, at different periods of its history, or engendered by the varying conditions of the medium in which it is found, than that they are specifically distinct forms.

Allusion has been made to the multiple nuclei of *A. Eichhornii.* Before briefly describing their appearance, it is desirable that I should define the meaning of a term which has been so indiscriminately applied to the most widely differing portions of the Rhizopodal structure. Müller* uses the term at one time to signify the central or primordial chamber of the siliceous shell of the *Polycystina*, and at another to distinguish the more brilliantly coloured contents of that chamber from the otherwise identical sarcode of those portions of the structure that are subsequently developed. He also employs it in defining the central point of union of the siliceous framework of *Acanthometra*. Stein, it would appear, applies it to the entire "medullary" portion of *Actinophrys oculata*, which I regard as nothing more than a small form of *A. Eichhornii*; whilst Carter and Carpenter employ it in its only legitimate sense—that is, to denote a permanent part of the protoplasmic substance, more or less distinctly granular when fully developed, having a definite outline, contained within a definite-shaped cavity, often seen to undergo binary division whilst the rest of the body still remains entire, and apparently serving some important purpose in the reproduction of the individual. In the latter sense the term is used by me in these pages.

In *A. Eichhornii*, the subdivision of the nuclear body seems to keep pace with the extraordinary degree of vacuolation to which reference has already been made. For instead of meeting with it as a simple aggregated mass such as we find in *Amœba*, it is split up into numerous minute spherical masses, each of which presents the characters of a true nucleus on a reduced scale. These multiple nuclei are distributed, here and there, through the protoplasm—each occupying a spherical cavity which is completely filled up by the granular matter, and quite distinct in outward appearance from the polygonal soap-bubble-like mass of which the rest of the body is constituted. Facts are, however, still wanting to show whether the subdivision of the nuclei in *A. Eichhornii* is due to a repetition of the process which brings about the double or treble nucleus of the *Amœbæ*, or whether it is to be regarded as a normal and original condition in this form. If normal, it would certainly furnish a substantial character whereon to build a specific distinction. (See figs. 1 and 2.)

The hyaline transparence of the form under notice is admirably suited for affording an unobstructed view of the structure and mode of action of the contractile vesicles. As already stated, these vary in number. I have counted as many as five in the same specimen, all of which maintained a regular but perfectly independent rhythmical action. They never change their position, nor do they produce any appreciable effect on the cellular-

* Uber die Thalass. Polycyst. und Acanthom. des Mittelmeeres. Berlin, 1858.

looking protoplasm with which they are in immediate apposition, beyond what would be produced were they solid substances pressing mechanically on the structure with which they are in contact. As before stated, they never take part in the capture or inception of food, but continue their pulsations uninterruptedly even when in close proximity to a food-particle which is being dragged inwards. It is deserving of mention, that on the completion of the systole of the vesicle a depression or pit is temporarily formed, as shown in fig. 3, the surface of which is studded with villous corrugations not unlike those seen in the villous patch of *Amœba villosa*; and further, that, *previous to the actual contact* of the food-particle with the surface towards which it is being drawn by the cooperation of the surrounding pseudopodia, that portion of the surface, acting under an unexplained vital impulse, projects its irregular network of sarcode often far beyond the peripheral outline, to assist in building up the vacuolar cavity. This projection constitutes the "probosciform" apparatus of Ehrenberg.

Lastly, I have to mention the existence, in the majority of the polygonal cavities, of little clusters of the minutest granules, which during the vigorous condition of the organism are freely suspended by the watery contents, but fall down by their own specific gravity on the death of the creature, and rest passively on the most dependent planes of their polygons. Minute as are the crystalloids of *Amœba*, these are still more minute, and hence I have heretofore been unable to determine if they are of similar nature. However, from their appearance, their superaddition to the mere points that form an integral part of the protoplasm, and their uniform size, it is not improbable that these bodies will eventually turn out to be crystalloids also.

Rich as the Hampstead pools have thus been proved to be in facts illustrative of the life-history of the Rhizopods, many others remain to which my limits prevent any allusion being made on the present occasion. I must, however, briefly call attention to two forms of *Difflugia* that occur abundantly in the same material as the *Amœba*, and which, in like manner, have their tale to tell. In the variety depicted in fig. 12, the test is sometimes made up entirely, as there represented, of minute cylindrical pellets, probably chitinous, but certainly of animal origin. These are placed side by side in very regular order, resting, as it would appear, on a delicate and continuous membranous layer of the same substance. Sometimes, however, a part or the whole of these pellets is superseded by angular particles of sand. So far this form exhibits no novelty. But its new and unexpected feature consists in the mouth of the flask-shaped test being developed into a distinct septum and tube, whereby its character at once merges into that of a Dithalamous shell resembling those of certain Foraminifera. In crushed specimens the septal plate, and its aperture (which is situated at the dorsal side of the tubular expansion) may readily be seen. Fig. 13 exhibits a somewhat different shape, but no material difference in the composition or general character of the test, as is evident from the construction of that portion around the aperture, of chitinous pellets identical with those in the previously described variety. So that whereas in one form we observe a decided tendency to assume a character not ordinarily met with in any of the freshwater Rhizopods, in the other we have presented to us, in the same individual, a combination of characters on each of which it has been thought expedient by some writers to found as many distinct species. Nay, more than this, if the *principles* so admirably enunciated by Dr. Carpenter* are those on which alone a natural classification of the Rhizopods can be built up, we must at once and for ever discard as Ordinally distinctive those differences which do not involve the animal that forms the test, but only the test that is formed by it. It is, I conceive, impossible to examine the pseudopodia and other soft parts of *Arcella* and *Difflugia*, without at once perceiving their generic identity. It is equally impossible to examine those of *Euglypha*, *Lagynis* †, and some allied but less-known forms, without perceiving that the animals producing them are also generically identical. At most, mere modifications in the shape and proportionate quantities of the organic and inorganic elements that enter into the formation of the shell ought only to be employed to discriminate between species. But even here we may go a step too far, as is shown by the varieties of *Difflugia*, unless we start with the admission that the separation of such forms is simply a matter of convenience.

In conclusion, it only remains for me to state that, whilst courting the scrutiny on which the acceptance of every new scientific fact very properly depends, I have for the present purposely abstained from the extension of my hypothesis beyond those lowest forms of animal life to which reference has been made—my desire in so doing having been to dispel, with as little delay as possible, what I cannot regard otherwise than as a most unsatisfactory and untenable view of the mystery of Sarcode.

* Introduction to the Study of the Foraminifera.

† If we include those forms of decided *Euglyphæ* to which Schlumberger has given the distinct specific appellations of *Cyphoderia*, *Sphenoderia*, and *Pseudodifflugia*, the force of the observation becomes doubly manifest.

Errata in paper on Amœba *in the 'Annals' for May*: p. 366.

Twelfth line from bottom, *dele* "not."

Eleventh line from bottom, *instead of* "but is" *read* "and not."

Seventh line from bottom, *dele* "not."

Page 369, end of twentieth line from top, *dele* "comma."

EXPLANATION OF PLATE X.

Fig. 1. *Actinophrys Eichhornii*, showing the complete vacuolation of the "cortical" and "medullary" portions. A *Macrobiotus* and an *Astasia* are seen undergoing digestive absorption within the body, these organisms being enclosed within separate food-vacuoles. At *m* a second *Macrobiotus* is in the act of being drawn into the peripheral substance, and partially surrounded by the layer of sarcode which especially constitutes its special vacuole: *c v*, *c v*, contractile vesicles.

Fig. 2. A portion of the same individual, more highly magnified, in order to show more distinctly the vacuolation and polygonal character of the protoplasmic matter in this species of *Actinophrys*: *n*, *n*, nuclei; *m*, the *Macrobiotus* now completely enveloped by the layer of sarcode, and being slowly drawn into the endosarc; *f*, *v*, a food-vacuole, either after its contents have been altogether absorbed or after the excrementitious matter has been extruded. Both the above organisms are shown as focused down to a horizontal plane.

Fig. 3. Showing the villous appearance of the depression produced on the completion of the systole of the contractile vesicle.

Fig. 4. *Actinophrys Sol*, containing a large *Pinnularia* within a food-vacuole: *o*, *o*, oily globules within the protoplasm of the latter. This specimen, which was obtained from Hampstead also, is figured with a view to show how impossible it would be to distinguish it from an *Amœba* when, as often happens, the pseudopodia are entirely retracted. The food-vacuole was here very distinct.

Fig. 5. Nucleated corpuscles of *Amœba villosa*.

Fig. 6. Sarcoblasts or granular corpuscles of the same.

Fig. 7. Rhombohedral crystalloids of the same.

Fig. 8. Detached gemmule of the same, after the pseudosegmentation of the granular protoplasm of which it is composed; *p*, its mamilliform process.

Fig. 9. A young *Amœba villosa*, supposed to be the advanced stage of the gemmule, fig. 8: *a*, its villous tuft; *c v*, contractile vesicle; *n*, nucleus.

Fig. 10. Minute viviparous forms of *A. villosa*.

Fig. 11. *Amœba princeps* (var. *radiosa*), showing an abortive effort at fission: *c v*, contractile vesicle; *n*, nucleus.

Fig. 12. *Difflugia proteiformis* (var. *septifera*), showing a dithalamous tendency.

Fig. 13. *Difflugia proteiformis* (var. *acuminata*), showing transitionary tendency towards the characters of *Arcella aculeata*; at *c*, the portion of the test around the aperture built up entirely of chitinous pellets. *d*, terminal spine.

Fig. 14. Showing the configuration of the test in *Arcella vulgaris*, consisting of hexagonal depressions, through which the line of fracture generally passes.

Fig. 15. Showing the configuration of the test of *Euglypha* ——— ? from Stony Stratford; the chitinous pellets taking a perfectly symmetrical form, namely, discoidal masses connected one with the other by regularly disposed bands of the same material. The line of fracture accordingly follows that of the thinnest portion of the test—that is to say, the spaces intervening between the rows of pellets.

BIBLIOGRAPHICAL NOTICES.

A History of British Sessile-eyed Crustacea. By C. Spence Bate, F.R.S., F.L.S. &c., and J. O. Westwood, M.A., F.L.S. Parts I.–XI. 8vo. London: Van Voorst, 1861–1863.

In a former Number of this Journal (January 1862) we called the attention of our readers to the appearance of the first numbers of this important work, and we have now to notice the completion of its first volume with the eleventh number just published. This volume contains the descriptions of nearly all the British Amphipoda—only the Hyperine forms and the Læmodipoda of Latreille (which are included by Mr. Spence Bate among the Amphipoda) being left for the second volume.

Being usually of small size, and destitute of that variety of form which renders the Stalk-eyed Crustacea so interesting even to the unscientific, the animals treated of in this volume would seem perhaps to possess few attractions, except for the zealous student of nature; but this is far from being the case; for, notwithstanding a general uniformity of structure, the different genera exhibit many curious peculiarities in the various development of their parts; and this will apply still more strongly to numerous forms of Amphipoda and Isopoda which still remain to be described. The importance of these creatures in the economy of nature is also very great: making up for the smallness of their size by the immense numbers in which they exist and the ubiquity of their presence, they are ready at the first moment to seize upon the dead animal matter which constitutes their ordinary food, and thus to act their part as scavengers of the ocean without the least delay, whilst in their turn they furnish an abundance of excellent nourishment to fishes and other aquatic animals, some of which thrive better upon this Crustacean diet than upon any other. Many of the species also (*Podoceridæ*) are predaceous in their habits; and most of these form dwellings for themselves, the construction of which presents many singularities. Among the forms still to be described, we have both terrestrial and aquatic, herbivorous, carnivorous, and even parasitic species; so that, whatever might be our opinion at the first glance, we soon discover that the Sessile-eyed Crustacea really present a greater variety of interest both in structure and habit than the more striking Podophthalmous forms.

Under any circumstances, the Edriophthalma form a group which the student of our marine zoology must not neglect; and he may congratulate himself on the excellent guide through the intricacies of a somewhat difficult branch of natural history which is afforded him by the joint work of Messrs. Spence Bate and Westwood. If we had much pleasure in speaking in high terms of the first few numbers, it is an equal gratification to be able to say, now that it has advanced halfway on its course, that the excellent character of the work has been maintained throughout, and that, notwithstanding the limited public upon which such books depend for their support, both the authors and the publisher have used every effort to render their 'History of British Sessile-eyed Crustacea' as perfect as possible. It is a work to which we most heartily wish success, and which we can warmly recommend to the notice of our readers.

The Tropical World: a Popular Scientific Account of the Natural History of the Animal and Vegetable Kingdoms in the Equatorial Regions. By Dr. G. Hartwig. With eight Chromoxylographic Plates and numerous Woodcuts. 8vo. London, Longmans, 1863.

One of our ancient Universities is adorned by the presence of an academic dignitary, of whom it has been somewhat irreverently said that, while science is his forte, omniscience is his foible. It seems to us that Dr. Hartwig's talents entitle him to a remark exactly the converse. Notwithstanding the expectation held out to us by his title-page, we have been entirely at a loss to discover the "scientific" element in his work. It is completely swamped by the "popular" treatment. Moreover we do not see the advantage of culling, from authors who have, in the best sense of the word, achieved "popularity," passages which are as generally known to Englishmen as the way from Hyde-Park Corner to the Mansion House. Nor, in stringing together these extracts, does the compiler anywhere exhibit the skill or art of the magician who, with one wave of his wand, reanimates dry bones and calls up ideas that might otherwise remain dormant even in the minds of the imaginative. Sir Emerson Tennant has had his thousands of readers, and Dr. Livingstone his tens of thousands. What, then, but the very demon of book-making has prompted the Heidelberg doctor to publish this exceedingly useless work? We indeed admire his knowledge of our difficult idiom, which he writes with scarcely a mistake, and generally with a purity to which many of our countrymen are strangers; but (and we say it advisedly) his language never rises with his theme above the very commonest of common-place expression. One chapter of the descriptive portion of 'Tom Cringle's Log' will give a person who has never left the temperate zone a better notion of many physical aspects of the tropical world than a perusal of the whole of this big octavo.

Thus we fully endorse the strictures that were passed upon Dr. Hartwig's former volume in these pages*. The two books are, *mutatis mutandis*, as like one another as two peas. We have the same abundant poverty of illustrations—woodcuts not better than those which deface many a penny broad sheet, and, worse than these, the marvellous tricoloured engravings dignified by the euphonious designation of "chromoxylographic plates." It is well, however, to be thankful for small mercies: 'The Sea and its Living Wonders' was embellished by a dozen of these monstrous productions; in the 'Tropical World' the number is diminished by one-third. We have been puzzling ourselves to no purpose by trying to account for the insertion, among so much rubbish, of the figure of the Mongoose

* Ann. & Mag. Nat. Hist., January 1861, pp. 63–67.

(p. 323), the very curve of whose tail enabled us to detect the true value of the design, before we recognized in the corner the "hall-mark" of Mr. Wolf's initials.

Nothing disgusts a mechanic so much as to witness a loss of power in an engine of any sort—a pulley unskilfully applied, a lever acting at a manifest disadvantage, a pinion obviously misfitted. This, then, is our feeling when we regard Dr. Hartwig's works. Here is a German gentleman with an amount of application uncommon among any but those of his own nation, having the advantages of a very accurate acquaintance with English and of scientific tastes, who yet will insist upon fitting out our countrymen with a knowledge of what they either know already or may easily know of themselves. On the other hand is a vast mass of scientific literature in a language which comparatively few Englishmen comprehend, and which it would be of the greatest use for them to understand. Why should not Dr. Hartwig employ his powers in aiding them in this respect? Why should he not publish, in London, translations of some of those valuable treatises which are still sealed books to English naturalists? We are not defending our ordinary educational course, we are but simply giving utterance to a fact, when we say that a large majority of our fellow-labourers in this country are unable to become acquainted, except at a great sacrifice of time, with much that has been already worked out, and oftentimes admirably worked out, by the industrious brains of our Teutonic neighbours.

Phosphorescence, or the Emission of Light by Minerals, Plants, and Animals. By T. L. Phipson, Ph.D., F.C.S. London: Reeve & Co., 1862. 12mo.

The phenomena referred to by Dr. Phipson, in the little work before us, under the general term "phosphorescence," are of a very varied nature, and can scarcely be regarded as all falling under one category. They include all emissions of light which cannot be accounted for directly as phenomena of electricity or combustion; nay, some even of the latter, such as the luminosity of phosphorus, are considered as examples of phosphorescence by our author. Certain cosmical and meteorological phenomena, such as the zodiacal light, the apparent train of light left in the track of many aërolites, luminous fogs, &c., are also mentioned as examples of phosphorescence; indeed the author seems to have been anxious to omit noticing no luminous phenomenon the cause of which cannot readily be explained. Apart from all these doubtful instances, we have, however, a large number of phenomena to which no other term than that of phosphorescence can be applied: there are numerous mineral, vegetable, and animal substances to which the name of "light-bearers" may with justice be applied, and the emission of light from which is still entirely unexplained. We have minerals which give out light after exposure to the sun, and others which present similar phenomena when heated to a temperature far below that of incandescence. From others light is given off when they are rubbed or violently fractured: the same thing is observed in other mineral substances while undergoing particular chemical or molecular changes.

Of the phenomena described by the author as examples of phosphorescence in flowering plants, most, if not all, must be regarded as originating in electrical action; but the luminosity of certain Fungi rests upon a good foundation. The catalogue of luminous animals is a long one, and the chief points connected with them are well discussed by Dr. Phipson, in whose pages the reader will find an interesting account of a great number of curious phenomena.

In his theoretical view of the nature of phosphorescence, the author endeavours to bring all these multifarious phenomena under the same category; and here, we think, he is scarcely successful. At the base of his theory lies the correlation of the physical forces and their mutual convertibility; such a conversion of forces into light he assumes to take place in phosphorescent bodies, and thus thinks he has accounted for their phosphorescence. Thus the insolation of Bologna phosphorus, according to him, sets up certain vibrations (electric, chemical, or magnetic) in that body, which cease on its being removed into the dark, and, in ceasing, cause the emission of a proportionate amount of light. In like manner, on the application of heat to a body which emits light at a comparatively low temperature, we should have a certain amount of heat converted into light when a given point is reached. In these cases, such an hypothesis may certainly be the true one, but it is still far from explaining the phenomena; for a theory of phosphorescence ought at least to show some plausible reason why light is emitted under certain conditions by one body and not by others.

The luminosity of the Fungi is regarded by Dr. Phipson as due to chemical action; but, curiously enough, that of animals is ascribed to the conversion of nerve-force into light, although the luminous matter even of the higher forms of phosphoric animals (insects and Myriapods) will continue shining when smeared over other objects. Under these circumstances, and considering that decayed wood and putrescent animal matter are often luminous in the dark, we should prefer regarding the phosphorescence both of animals and plants as due to a chemical action, the subjection of which to the will in the former does not seem to present any special difficulty.

MISCELLANEOUS.

Notice of three Wombats in the Zoological Gardens. By Dr. J. E. Gray, F.R.S. &c.

There are at present in the Zoological Gardens in the Regent's Park three kinds of Wombats from Australia: two were sent from the Acclimatization Society of South Australia, at Victoria; but nothing is known of their peculiar habitat. They are evidently distinct from the common silver-grey Wombat, which we have long had alive.

Two of them are true *Phascolomys*, and have a blunt nose, with a distinct, bald, rugose, callous muzzle; and they have moderate-sized ears, which are usually bent back on the sides of the head.

They differ considerably in colour and in the form of the muzzle.

1. *Phascolomys ursinus.*

Dark silver-grey; middle of back, nose, and outside of limbs blacker; fur very dense, rather curled and crisp, consisting of abundance of under-fur and close-set, slender, very dark brown hair with slender silver-white tips, and a few interspersed white and fewer black, tapering, slender bristles; it has a subtrigonal muffle, pointed behind, and almost as long as broad. The ears are rounded at the tip.

This is the animal which is best known and usual in collections.

Hab. Van Diemen's Land.

2. *Phascolomys Angasii.*

The fur is blackish brown, nearly uniform; the muffle is oblong, transverse, rounded behind, and broader than long. The ears are rather pointed at the tip.

Hab. South Australia.

I have named this species after Mr. G. French Angas, who has paid so much attention to Australian and African zoology.

The third specimen is certainly a distinct genus, as distinct from *Phascolomys* as *Halmaturus* from *Macropus*, or *Ovibos* from *Bos*. It may be called

Lasiorhinus.

The nose is truncate and hairy, with large open nostrils on the sides, and without any naked muffle between them. The ears are large, produced, erect, acute, covered externally with short fur.

Lasiorhinus M'Coyi.

The fur is pale silver-grey, the hairs being black with silver-grey tips; the whiskers are long, strong, rigid, in a line on each side of the nose; the ears elongate, acute.

This animal seems to be the Broad-nosed Wombat (*P. latifrons*) of South Australia, described by Mr. G. F. Angas, in the 'Proceedings of the Zoological Society,' June 25, 1861, p. 268, from a specimen then living in the Botanic Garden in Adelaide, caught near the Sawler River, about thirty miles north of Adelaide.

It has just been figured as *Phascolomys lasiorhinus* by Mr. Gould in his 'Australian Mammals;' but this name is applicable to the genus.

I have named this species after Prof. M'Coy, the Director of the Melbourne Museum, who is forming a museum that is equalling, and, I may say, rivalling the museums of several European or American capitals.

Mr. Angas may possibly be correct in applying the specific name of *latifrons* to this species; and the characters that Professor Owen pointed out may prove to be generic: but this can only be determined when the skulls of these species can be compared with the typical skull described in the Proc. Zool. Soc. 1845, p. 82.

In the British Museum there is a very large specimen of a true *Phascolomys*, which, from the colour and rigidity of the fur, appears to be a third species. Unfortunately the skin is without any skull, and has no reliable habitat attributed to it, as it was purchased of Mr. Jamrach, in 1859, who received it from "Australia." It is very probably the "big yellow fellow," or Wombat, that the natives say is found on the banks of the Murray. (See Proc. Zool. Soc. 1861, p. 271.)

Phascolomys setosus.

Nearly uniform pale brown; the fur rigid, with a small quantity of under-fur on the shoulders and limbs, consisting almost entirely of dark brown bristles with pale tips, and rather more rigid black-brown longer bristles; the muffle subtrigonal, as long as broad.

Hab. Australia.

This is the specimen figured by Mr. Gould, in Part xi. of his 'Mammalia of Australia,' under the name of *Phascolomys latifrons*; but how he determined that it was the *P. latifrons* of Owen I do not know, as the only skin we have has no skull, and *P. latifrons* is only described from a skull. The different character of the fur is the best distinction. The young Tasmanian Wombat (*P. ursinus*) is dark, like the adult.

On the Occurrence of living Water-Beetles in the Intestines of th Common Trout.

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

Preston Rectory, Wellington, Salop,
May 21, 1863.

Gentlemen,—While examining the intestines of the common Trout (*Salmo fario*, Linn.) for *Echinorhynchi*, I was surprised to find, at the space of about half an inch from the anal orifice, two specimens of a small brown water-beetle, *alive and active*, amongst the contents of the intestine. I have not yet determined the species of beetle, nor do I at all know whether the discovery of a living non-parasitic animal in such a locality is a matter of ordinary occurrence. But in this case there is, it would seem, undoubted evidence of the power of an insect to survive unharmed the digestive process of a fish. The beetles had been swallowed by the trout with other food, and here they were quite lively and ready to be evacuated in a very short time.

That I have made no mistake in the matter is evident from the fact, that attached to the underside of one of the beetles was a quantity of mucus from the fish's intestine, in which were imbedded the proboscides of two or three specimens of *Echinorhynchus Proteus*. I have examined the stomach and intestines of various freshwater fish, but never before witnessed the occurrence of living forms of non-parasitic animals in the locality indicated. Is there anything remarkable in this, or is it an event of ordinary occurrence?

There is only one other way of accounting for the insect's admission—by supposing that it had entered the intestine through the anal orifice (?). "*Sub judice lis est.*"

I am, Gentlemen,
Yours very truly,
W. HOUGHTON.

Pretended "Parthenogenesis" of the Bernhard Crab.

"Cornwall, Sept. 5, 1770.

"SIR,—I pass a great deal of my time in walking on the cliffs and by the sea-side in this county. As I was one day going over the rocks at low water, I saw an infinite number of Periwinkles, out of which projected two claws resembling those of a Lobster. Curiosity induced me to break the shells of several, to discover, if I could, how the little creature could introduce itself, as the body of the Periwinkle generally filled its shell.

"I was soon satisfied in my searches, but, to my astonishment, found that it was the body of the Periwinkle that was undergoing this metamorphosis. This occasioned my breaking several shells more, in all of which I found the same appearances, and had the satisfaction of demonstrating to several gentlemen of undoubted veracity that the body of the Periwinkle actually underwent this change till it became a perfect Lobster. In some you might discern the most minute change, others were half-formed, and some were completely formed. I spread a dozen at least on a table at one time, which they traversed many times, to the satisfaction of several gentlemen present.

"It is a received opinion that the infant Lobster takes refuge in the empty shell of a Periwinkle. I was one of those who imbibed that opinion before I made this discovery.

"As I am little versed in studies of this nature, I request the thoughts of your ingenious correspondents on the subject. It seems probable that the Periwinkles may be produced from the berries of the Lobster, as it seems impossible that the Lobster can be produced in the first state from the Periwinkle.

"I am, Sir, yours, &c.,
"CORNUBIENSIS." *

New American Otter.

In the 'Canadian Naturalist' for June 1863, Mr. George Barnston describes and figures the skull of a new North-American Otter, which he calls *Lutra destructor*. He observes, "I propose to show that there exists throughout a great portion of the British territory of North America, if not further south, a smaller species of Otter, well known to the aboriginal Ojibways and the Crees as the *Pinaikewawkeek*, the breaker of beaver-houses and the dams. He closely re-

* Extracted from a newspaper of the above date.

sembles the larger Otter in dentition, colour, and shape, but is of more slender structure, and possesses marked differences in the proportion of the coronoid bone. He has, besides, distinct habits and modes of life, especially in his search for sustenance, which, I think, altogether entitles us to consider him as specifically distinct from the *Lutra canadensis.*"

On two Forms of Anthriscus sylvestris. By Dr. J. E. Gray, F.R.S.

On the banks of the Thames, between Kew and Richmond, there are now to be seen growing in abundance, side by side, so close together that their leaves are often to be seen intermixed, two very distinct forms of *Anthriscus sylvestris*: at least, I consider they are both that plant, as I cannot find any character in the flower, the fruit, or the leaves by which I can separate them.

One is a large succulent plant, of a bright, rather palish green colour, much branched, and with large broad leaves; the stem is thick, and has a few large ridges, and the flowers are rather large. The other is a slender rigid-stemmed plant, with comparatively few and distant branches, and comparatively few and smaller leaves. The stem has many small, subequal ridges. The stem and foliage are always dark, and generally of a more or less purple shade; but I have seen a few plants in which the stem and leaves were dark green.

These differences cannot arise from soil or any difference of external circumstances, such as situation, exposure, &c., as they grow side by side, and come into flower at the same time.

I have observed a similar fact, but one not so strongly marked, of two forms growing side by side and flowering at the same period, in the Wood-Anemone (*Anemone nemorosa*), which I described a short time ago.

Now, I wish some of your readers would explain to me, by any of the modern or ancient theories of the origin of species, what we are to learn from the existence of two forms of the same species in the same locality, under the same circumstances, and occurring at the same time. They cannot be regarded as varieties produced by soil or external circumstances, or any of the other conditions that are supposed to cause variation in species; and yet they are not species as we commonly regard species, though, if such specimens were collected in a foreign country, and only examined from the specimen in an herbarium, one might be inclined to regard them as allied species or very distinct varieties.

I do not find the two forms of this plant noticed in any of the English works on botany, nor in any of the floras of France or Germany that occur to me.

Indeed, what a wonderful thing it is to consider how plants of the same kind flower at the same period! how one week the banks of the railways are covered with one, and then with another kind, all the plants of each in bloom at once, and that the different species follow one after the other in the same succession year after year—varying, it is true, as the season is late or early, but yet each retaining its general place in the succession, and each appearing at the same time.

The banks of the railway-cuttings, which some condemn as being ugly, are the flower-gardens that gladden the eyes, especially in early spring, of thousands who have been pent up in the smoke of London for months. When first the golden coltsfoot spangles the banks, I can scarcely resist the desire to be moving along the lines. These flowers come and go in a day, almost as if by magic. They are followed, at least near London, by the lilac lady-smock; then come the cowslips, and in the copses which are often to be seen at the bottom of the banks, and in the hedges by the field-sides, the primrose and the wood-anemone, and, more obscure, but easily seen by sharp eyes, the wood-sorrel; and the hyacinth forms a blue carpet in the distance, and the beautiful golden broom and furze on the bank itself. Then come the large white beds of the wild chervil (*Anthriscus sylvestris*); and these are followed by the ox-eye daisy, all nearly of the same height, and each turning its little star-flower towards the great luminary as the world moves. The plants of the same kind being all nearly of the same height add much to the beauty of their appearance. This is especially seen in the fields of clover, which form a purple carpet; but I was especially struck with it in an alpine meadow that was just about to be cut down near the hospital on the Via Mala: there the flowers showed four beautifully even carpets, each to be seen through the other. Just above the pale green herbage, chiefly composed of the alpine dandelion, came the purple gentian, then the blue *Phyteuma*, and above all was the beautiful golden *Trollius*, or globe-flower. It was a sight never to be forgotten.

Planorbis crista.

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

Gentlemen,—Will you permit me to withdraw that portion of my letter in your last Number which states that I followed M. Moquin-Tandon in adopting the Linnean name *Planorbis crista*? Having adopted it, as any reader of my book may see, in opposition to the views of that author, it only remains for me to apologize to you for my carelessness in making the statement.

I am, Gentlemen,
Your obedient Servant,
May 1, 1863. Lovell Reeve.

On the Occurrence of Lymnæa stagnalis *in Scotland.* By Robert O. Cunningham, Esq., Prestonpans.

Mr. Lovell Reeve, in his recently published valuable work on the Land and Freshwater Mollusks of Great Britain, says, with respect to *Lymnæa stagnalis*, "This fine species stands alone among the Lymnæacea of the Eastern hemisphere for the conspicuous prominence of its size. In the Western hemisphere it is represented in a remarkable degree of parallelism by the *Lymnæa jugularis* of

Lake Superior, distinguished by the same prominent assemblage of characters. It ranges, in this country, with *L. auricularia*, not being found in Scotland, and appearing extremely rare and local in England, north of the midland counties."

In the summer of 1857, while engaged in looking over the collection of Mollusca of the late Prof. Fleming, of Edinburgh, he mentioned in the course of conversation that the *Lymnæa stagnalis* was reported to have been obtained by the late David Don, the botanist, in Gulane Loch, between seventeen and eighteen miles to the east of Edinburgh; but that, so far as he was aware, its occurrence in the aforesaid locality had not been confirmed by any subsequent observer. At the same time, he strongly recommended me to attempt, if possible, to ascertain the truth of the report. Accordingly, since that time I kept a sharp look-out for this interesting species in the habitat specified. It was not, however, until the 30th of April of the present year that my efforts were crowned with success, when I succeeded in procuring abundance of excellent specimens.

Gulane Loch is a sheet of water of inconsiderable depth, but of some extent, in the sandy common of the same name, which slopes gently downwards to the seashore in the neighbourhood of the small village of Aberlady. Owing to the extent and variety of its surface, this common has for a long time been known to the botanist as a locality for rare plants, several of which occur in the loch itself,—e. g. *Utricularia vulgaris, Menyanthes trifoliata, Sium repens*, and other plants which are not commonly met with in the adjoining district. Owing to the water being very much choked up with aquatic plants, it becomes a matter of very considerable difficulty to drag it with a net, more especially in the middle of summer, when the plants have grown up; and to this I attribute my want of success hitherto; for, on visiting the locality last month, which was much earlier than my wont, and when most of the plants were yet beneath the surface of the water, I easily procured the specimens already mentioned. The animals were generally clinging to plants of the genus *Chara*, near the surface of the water, and were associated with individuals of *Lymnæa peregra, L. palustris, Physa fontinalis, Cyclas cornea*, and various small species of *Planorbis*. I brought home about two dozen specimens, the greater number of which are at present in a state of captivity, and appear to be, on the whole, very active. I think it of some importance to record this fact, because of its interesting relation to the geographical distribution of this so much the finest species of our British Lymnææ. Should Mr. Reeve desire to possess Scotch specimens of it, I shall be only too happy to furnish him with them.

Descriptions of two new Species of Pycnogonoidea. By George Hodge.

Pallene attenuata, n. sp., Hodge.

Rostrum thick, constricted at the base, swelled near the middle, and rounded at the apex. Legs long, sparingly hispid; first, second, and third joints short, the second the longest; fourth rather stout, and as long as second and third united; fifth and sixth slender, and about the length of fourth; seventh very short; eighth convex on outer margin, straight on inner, with a few short hairs scattered along both margins. A *single* claw at the extremity, which, when pressed against the limb, reaches to junction of seventh joint. Foot-jaws long and slender, projecting considerably beyond end of rostrum. Anterior portion of thorax attenuated, and advanced to nearly on a line with the tip of rostrum, where it slightly bulges, and gives origin to foot-jaws; immediately behind which is seated the oculiferous tubercle, which is long and narrow. Abdomen long, rounded at apex, slightly tapering to base. At the origin of each leg on the dorsal aspect is a large wart-like protuberance.

One female of this species was taken near the Dogger Bank, in 25–30 fathoms, on an oozy bottom.

Nymphon brevirostre, n. sp., Hodge.

Rostrum short and stout; foot-jaws thick, divergent; second joint or hand nearly as long as first; palpi five-jointed, brush-like; first and second joints long and nearly of the same length, each of which is equal to the three terminal, the last being the shortest. Thorax robust. Abdomen stout and conical. Oculiferous tubercle midway between first pair of legs. Legs stout, sparingly furnished with stout spine-like hairs; first and third joints short; second slender at origin, but swelling upwards; fourth and fifth each as long as the three first; sixth much longer, slender; seventh short; eighth long, slightly bent, and furnished along its inner margin with a few short spines, and terminating in one moderately large claw and two small ones.

One female of this species was taken near the Dogger Bank, under the same circumstances as the foregoing.—*Trans. Tynes. Nat. Field Club*, 1863, p. 281.

On the Change in Form of the Teeth of the Susu (Platanista). By Dr. J. E. Gray, F.R.S. &c.

The front of the beak, in the younger specimens, is dilated and oblong, but it gradually becomes as compressed as the rest of the beak; and in the older specimens the end of the beak is turned up.

The teeth in the front half of the younger specimens are very long, slender, subcylindrical, slightly arched, and more or less flattened on the front and hinder side by the friction of the teeth of the other jaw, which alternate and fit between them when the jaws are closed. The hinder teeth of the animal at this age are short and cylindrical, with a conical end; the hindermost ones are very short, scarcely raised above the gums.

As the animal increases in age, the bases of the teeth increase in longitudinal diameter, and the apices become worn off, until they become the short, compressed, conical teeth figured by Sir Everard Home in the 'Philosophical Transactions' for 1818–1820, where they have a compressed, more or less hollow base; but in the more aged animal the bases of the teeth are solid, squarish, very rugose, or divided into short tubercles or broader lobes.

In the Museum of the College of Surgeons there is the skull of a young specimen, and another of an animal rather older than the one above described; and in the British Museum there is one rather older, showing the gradual change in the form of the teeth, and intermediate between the younger state and the jaws figured by Sir E. Home, which are also to be seen in the College of Surgeons' Museum. In the British Museum there is the skull of an aged individual, in which the teeth have solid rugose and lobed bases, as above described.

The change in form is so great that I was inclined at one time to consider the skull of the young animal as forming a genus distinct from *Platanista*, which is always characterized as having compressed teeth; and any one comparing the teeth of the old and young animals, without the intermediate gradations, might, at first sight, easily come to the conclusion that they could scarcely pass from one form to the other, as the long cylindrical front teeth of the young animal are converted, in the older one, into short, conical, compressed ones, by the wearing away of the tops and the alteration of the form of the base.

The sutures of the skull of this animal seem to be soon knit, for they are well closed in the skulls of the young animals.

Aquatic Hymenoptera.

At a recent meeting of the Linnæan Society, Mr. J. Lubbock read a paper on two aquatic Hymenoptera, one of which uses its wings in swimming. Till now, the author stated, no aquatic Hymenoptera or Orthoptera had been discovered, though the former group alone has been estimated as comprising some 50,000 species, 3500 of which live in Great Britain. In a basin of pond-water, on an early day in August last, he had been astonished to see one of these Hymenoptera (*Polynema natans*) quite at ease in the watery element, and actually swimming by means of its wings. At first he could hardly believe his eyes; but having found several specimens, and shown them to some friends, the fact was undoubted. The same phenomenon, moreover, was again observed, within a week, by Mr. Duchess, of Stepney. Another of the aquatic Hymenoptera, now first described under the name of *Walkeria aquatica*, was found in the same pond; but this, unlike the former, which swam by means of its wings, held its wings motionless when under water, and used its legs only; and though these were neither flattened nor provided with any well-developed fringe of setæ, they seemed very well to serve this purpose; indeed the motion of this species was more rapid than that of the former. Both species are fond of creeping along the sides of the vessel in which they are kept, or on the leaves and stems of aquatic plants; but they frequently quit their support, and swim boldly out into the open water. In these insects respiration appears to take place in the usual way, through spiracles. A common house-fly, placed under water, ceased to move in half an hour, while the specimens now referred to lived under water for several hours without suffering any apparent inconvenience, and one was observed to be quite lively after having been so placed at least twelve hours, which, it was stated from further observation, is probably about the limit of their endurance. Drawings of the two insects accompanied the paper, which also contained an account of their organization.

On the Appearances of Cotton-fibre during Solution and Disintegration. By Charles O'Neill, F.C.S.

These experiments referred to the application of Schweizer's solvent. Two strengths were used: the weaker contained oxide of copper equal to 4·3 grains metal per 1000, and 47 grs. dry ammonia; the stronger contained 15·4 grs. metal and 77 grs. dry ammonia per 1000. The latter is about the most concentrated solution which can be made. Referring to the researches of Payen, Frêmy, Peligot, Schlossberger, and others who have employed this solvent, the author said the only experimenter who seemed to have worked in the same direction with himself, and that apparently only to a small extent, was Dr. Cramer, whose paper he had only been able to see in a translation appended as a note to a memoir of M. Payen in 'Comptes Rendus,' vol. xlviii. p. 319.

Mr. O'Neill considers that cotton exhibits, under the action of this solvent (1) an external membrane distinct from the true cell-wall or cellulose matter; (2) spiral vessels situated either in or outside the external membrane; (3) the true cell-wall or cellulose; and (4) an inner medullary matter. The external membrane is insoluble in the solvent, and may be obtained in short hollow cylinders by first acting upon the cotton with the dilute solvent so as to gradually remove the cellulose, and then dissolving all soluble matters by the strong solvent. If the strong solution is first applied, the extraordinary dilatation of the cellulose bursts the external membrane, and reduces it to such a state of tenuity that it is invisible. This membrane is very elastic, appears to be quite impermeable to the solvent, and, when free from fissures, protects the enclosed matter from its action. It is not seen in cotton which has been submitted to the action of bleaching agents, being either chemically altered or, what is most probable, entirely removed.

The spiral vessels are unmistakeably apparent, running round the fibre in more or less close spirals, sometimes single, sometimes double and parallel, and at other times double and in opposite directions, or again seemingly wound close and tight round the cylinder. They are well seen in the spherical swellings or beads, but are prominent at the points of strangulation of long ovals formed when the ends of the fibres are held tightly. They collect in a close mass, forming a ligature, and are frequently ruptured, the ends projecting from the side of the fibre.

The cellulose is enormously dilated by the weaker solvent, and expands the external membrane into beautiful beads, which are doubtless the result of the spiral vessels acting as ligatures at the points of strangulation; at the open end of a fibre it can be seen oozing out as a mucilaginous substance. The stronger solution bursts the beads, or dissolves all the cellulose into a homogeneous mass, amidst which the empty cuticular membrane and the spiral vessels remain nearly unacted upon.

The substance called medullary matter is seen occupying the axes of the fibres; it is nearly insoluble in the solvents. It may be well seen projecting from the open end of a fibre where the cellulose is exuding, and often remains *in situ* when the fibre has quite disappeared. It has many appearances of being a distinct body, but the author in some cases thought it might be only the thickened or modified inner cell-wall; in others it looked like a shrunk membrane, probably the dried-up primordial utricle. It is generally absent or indistinct in old cotton, or cotton which has been submitted to bleaching agents.—*Proceedings of the Literary and Philosophical Society of Manchester*, April 1863.

On a singular Malformation of the Beak and Foot in the Young of the Domestic Fowl.

"Dear Sir,—With this I send you the body of the chicken I spoke to you about, the beak and feet of which bear a close resemblance to those of a Parrot, and I beg your acceptance of it.

"It may perhaps be as well if I state the circumstances which, it has occurred to me, may account for this freak of nature. I had one of the Parrot tribe, which, on account of the noise it made, was frequently placed in the yard where I kept a breed of white bantam fowls. If any of these came near the Parrot's cage to pick up the food it scattered, it became much enraged and screamed violently. Soon after this I set two hens on eggs, and in each brood I had one chicken of this strange form. My impression at the time was, and now is, that one of the hens had been frightened by the Parrot, and an effect thereby produced on some of her eggs.

"When I first mentioned it to you, I thought it had but three toes; on closer inspection I perceive there is a fourth toe; but the form of the foot still very closely resembles that of a Parrot.

"Yours very truly,
"Wm. Horn."

"P.S. The Parrot was never let out of the cage, and was, I believe, a female."

"J. E. Gray, Esq., British Museum."

—*Proc. Zool. Soc.* Feb. 24, 1863.

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END OF THE ELEVENTH VOLUME.

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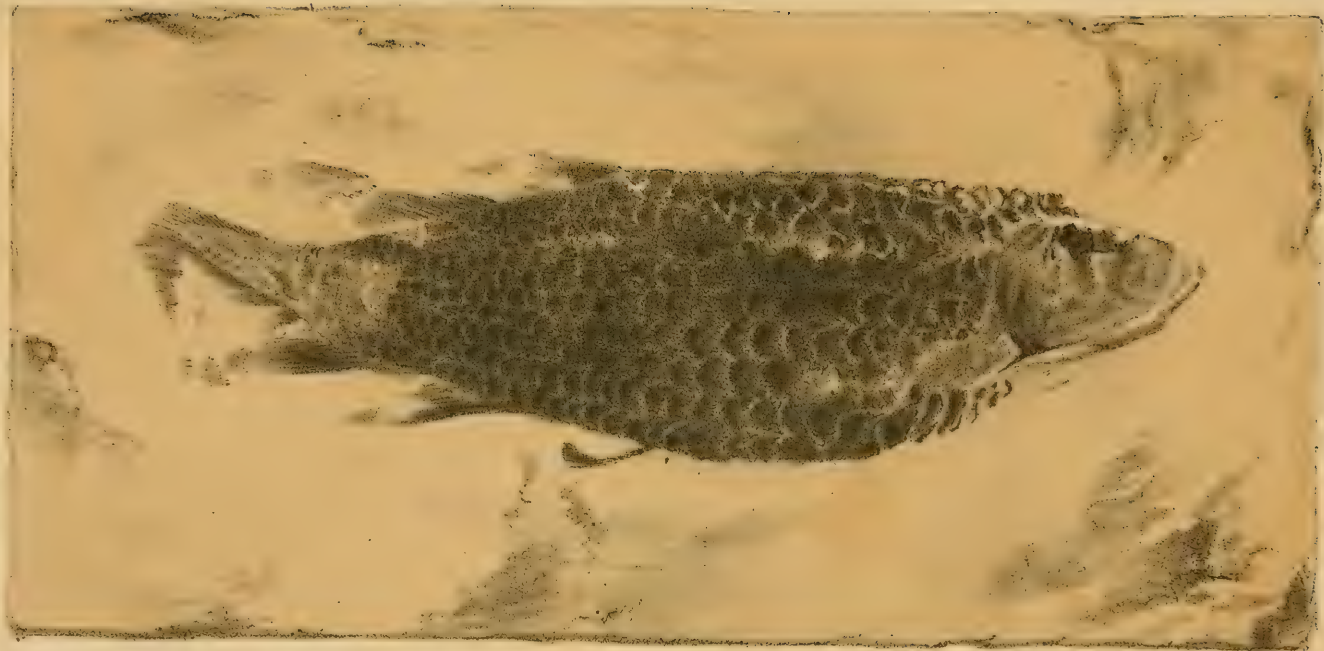
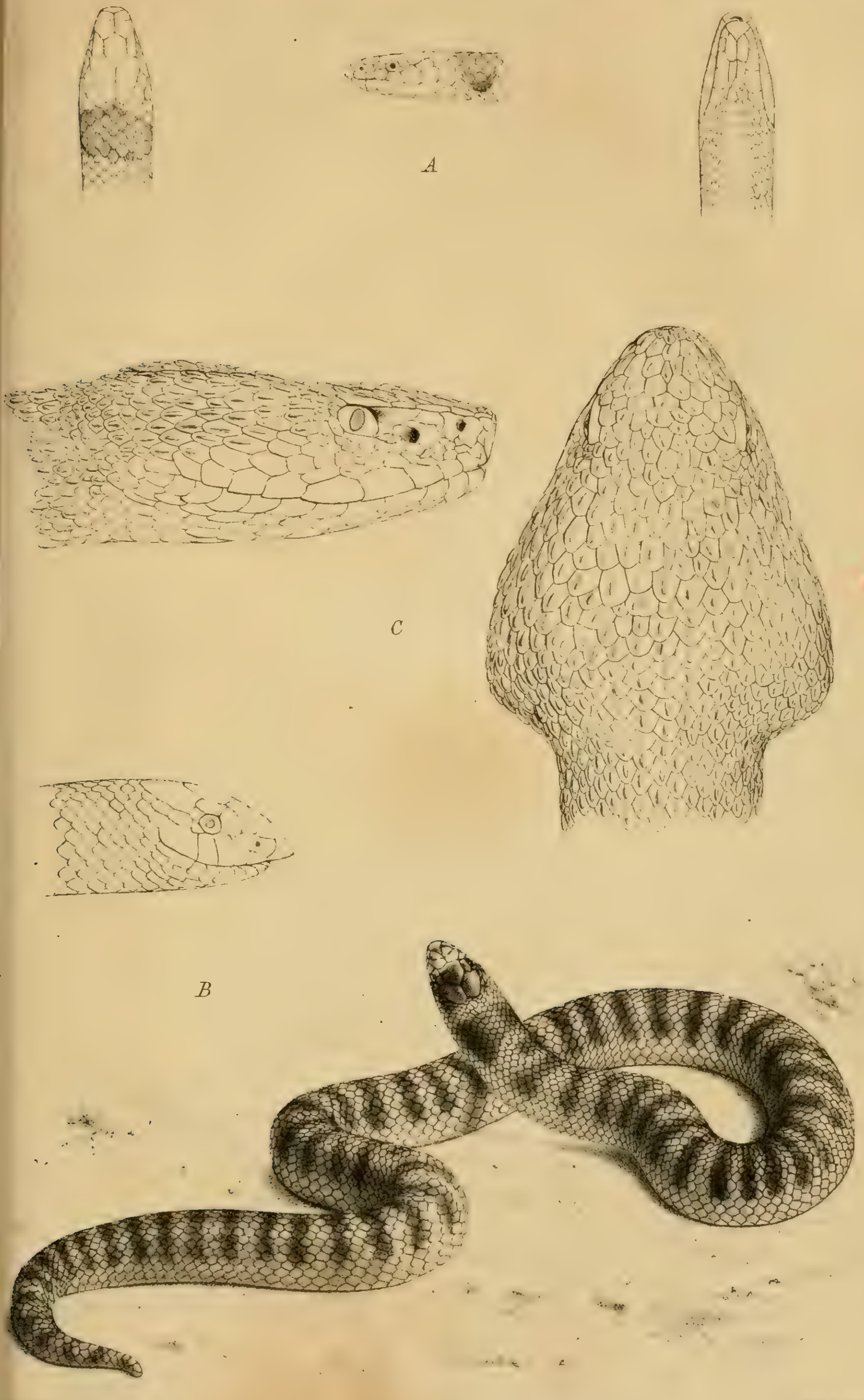
J. Basire sc.



Glyptolepis of Dura Den.

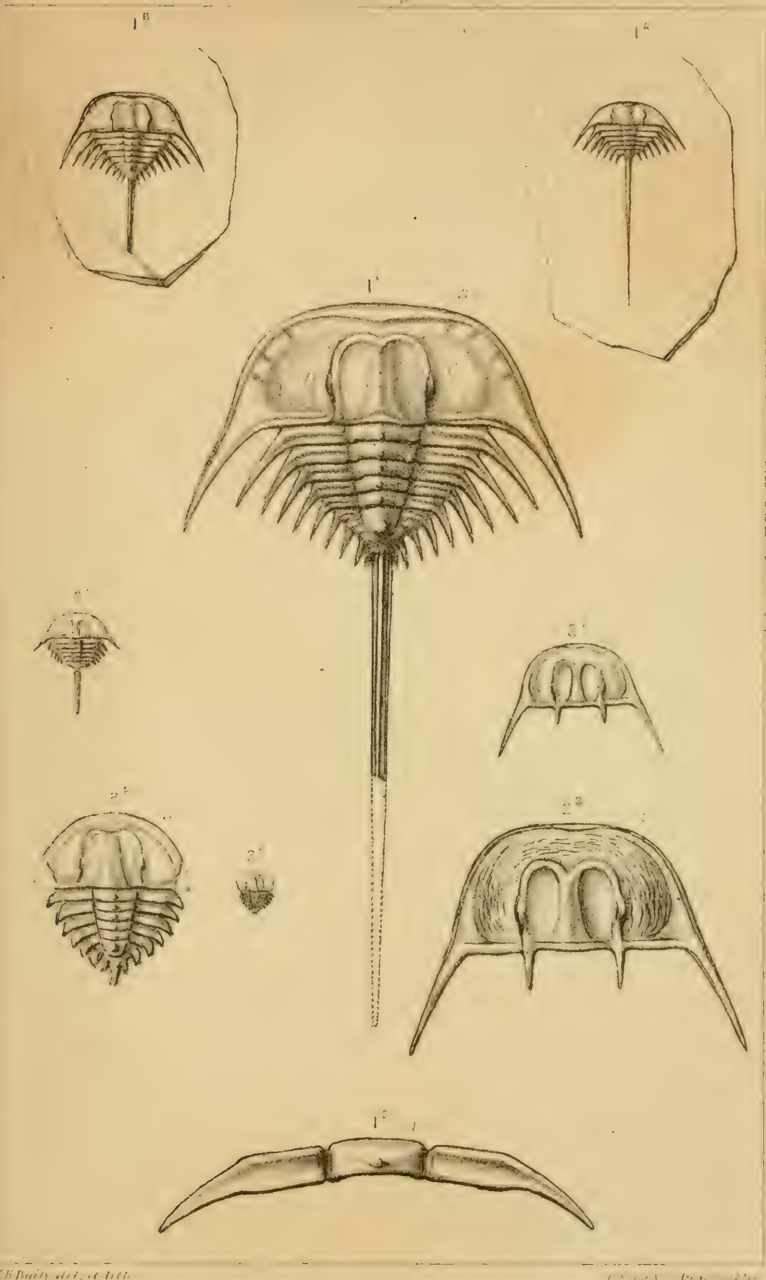


G. H. Ford.   W. West imp.

A. *Cercocalamus collaris.* B. *Brachyurophis semifasciata*
C. *Teleuraspis nummifera.*

H. Ford. W. West imp.

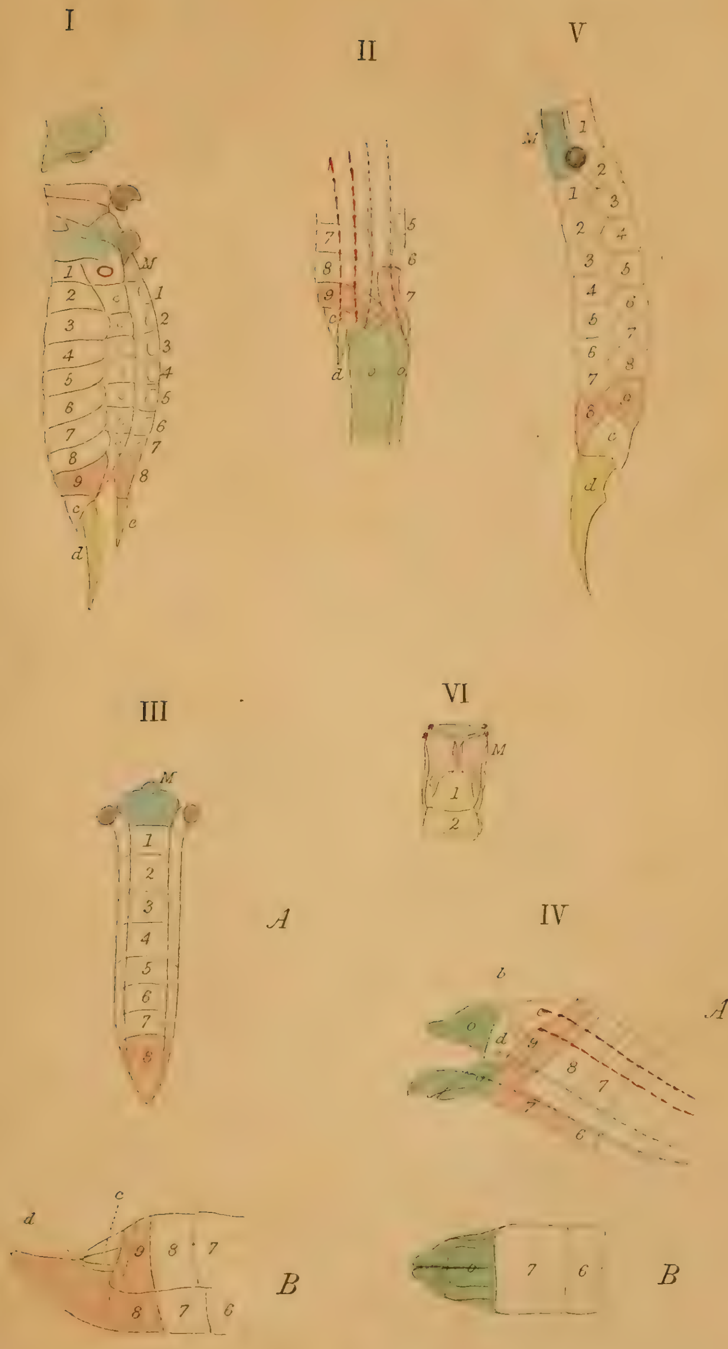
A. Platyplectrum marmoratum. B. Cryptotis brevis.
C. Hyla Krefftii.



W. H. Baily del. et lith.

Coal Measure Crustacea

1. a – d. Belinurus Reginæ. Baily.
2. a – c. „ arcuatus „
3. a – b. rotundus? Prestwich.



J. Basire Sc.

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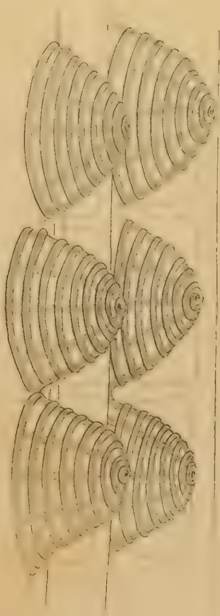


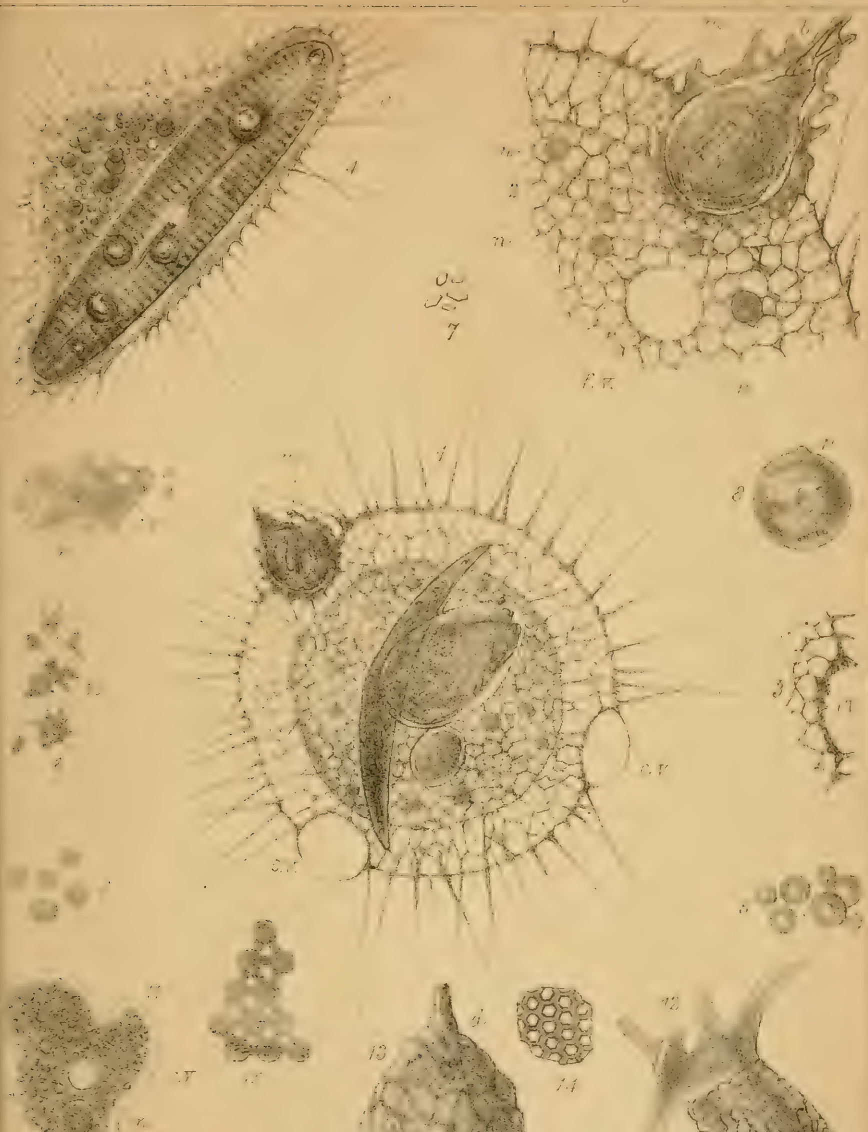
3

J. Alder del.

J. Basire. sc.

Wallach del et lith.

..., del. et lith.



G. C. Wallich del. et lith.

J. Basire sc.